THEORY OF KNOWLEDGE

The Essentials

For the TOK Course first assessed in 2022

2021 Edition

Michael Woolman, et al.

2021 Edition

Preface to the Original Edition

Since I wrote the first TOK textbook, Ways of Knowing, more than ten years ago, I have visited many IB Diploma schools and worked with TOK teachers and their students and marked several thousand TOK prescribed essays. Over these years it has become clear to me that teachers and students need a TOK text book that explains, in a straightforward manner, the concepts and issues at the heart of the subject and how these concepts and issues interact. So here it is.

The book is divided into three parts.

The first part, What TOK is About, briefly describes the origins and purpose of TOK. If you understand the origins and purpose of TOK you will understand the relevance of it to the Diploma as a whole and how it enables you to examine critically the knowledge you are expected to master in your six chosen hexagon subjects. Because the TOK diagram is at the core of the programme the implications and connections within it are explored, and the connections between the diagram and prescribed titles established.

Part Two, TOK Content, examines the major concepts in the TOK diagram and the Curriculum Guide. Ways of Knowing and Areas of Knowledge are explained, as are the linking question concepts. Knowledge Issues, an understanding of which is essential for assessment success, are explained and identified.

Part Three looks at Assessment. The importance of identifying knowledge issues in both the Essay and the Presentation is emphasised and the significance of the examiners' annual subject report is stressed.

Throughout the book I have capitalised both Ways of Knowing and Areas of Knowledge to emphasise these are specific TOK concepts used in a TOK context.

This book is a no-nonsense guide to TOK. It provides information about the concepts embedded in the TOK diagram and about the Curriculum Guides linking question concepts and how they both relate to create an awareness of the nature of knowledge that is the IB Diploma's Theory Of Knowledge. It is not, as one colleague called it TOK for Dummies. It is TOK for thinking intelligent students and teachers who have limited time at their disposal.

Michael Woolman, Coudrée, France, 2011

This edition has been prepared with the help of a range of contributors to address the Course for First Assessment in 2022.

Contents

Part One: What TOK is about?

Chapter 1 The origins and purpose of TOK - some background

Theory of Knowledge (TOK) is unique to the IB Diploma. No other secondary or high school curriculum has anything like it. It was a key claim in the Theory of Knowledge Curriculum Guide that TOK is 'a flagship element' of the Diploma Programme

An early Icelandic Manuscript. Theory of Knowledge asks you to think about your sources of knowledge. This is certainly History, but is it also Knowledge?

The first thing you as a student, obliged to 'do' TOK, should ask yourself is, 'What is this flagship I have to spend 100 hours of classroom and study time on? At the end of that time I have to write an essay and make an exhibition. And, if I don't complete those two assignments I will be denied my diploma even if I have completed all the other requirements. What's so special about TOK? No other secondary or high school programmes include it so why should this one?'

Let's go back a bit. To the swinging 60s when the creative Beatles sung and plucked their way to fame and fortune, and Elvis rocked his hips at the establishment. The creative founding fathers and mothers of the IB Diploma wanted to create a senior school programme providing a sound, liberal education which would guarantee their sons and daughters entry into the world's leading universities. To begin to be educated, these founding parents claimed, our children should be exposed to the two great traditions of learning, the humanities and the sciences. In order for the Diploma to guarantee this, they further argued, it must have certain compulsory elements.

To guarantee you an introduction to understanding the humanities they decided on four compulsory subjects

- knowledge of your own language and the ability to communicate with it and share its literature,
- a working knowledge of at least one language other than your own ,

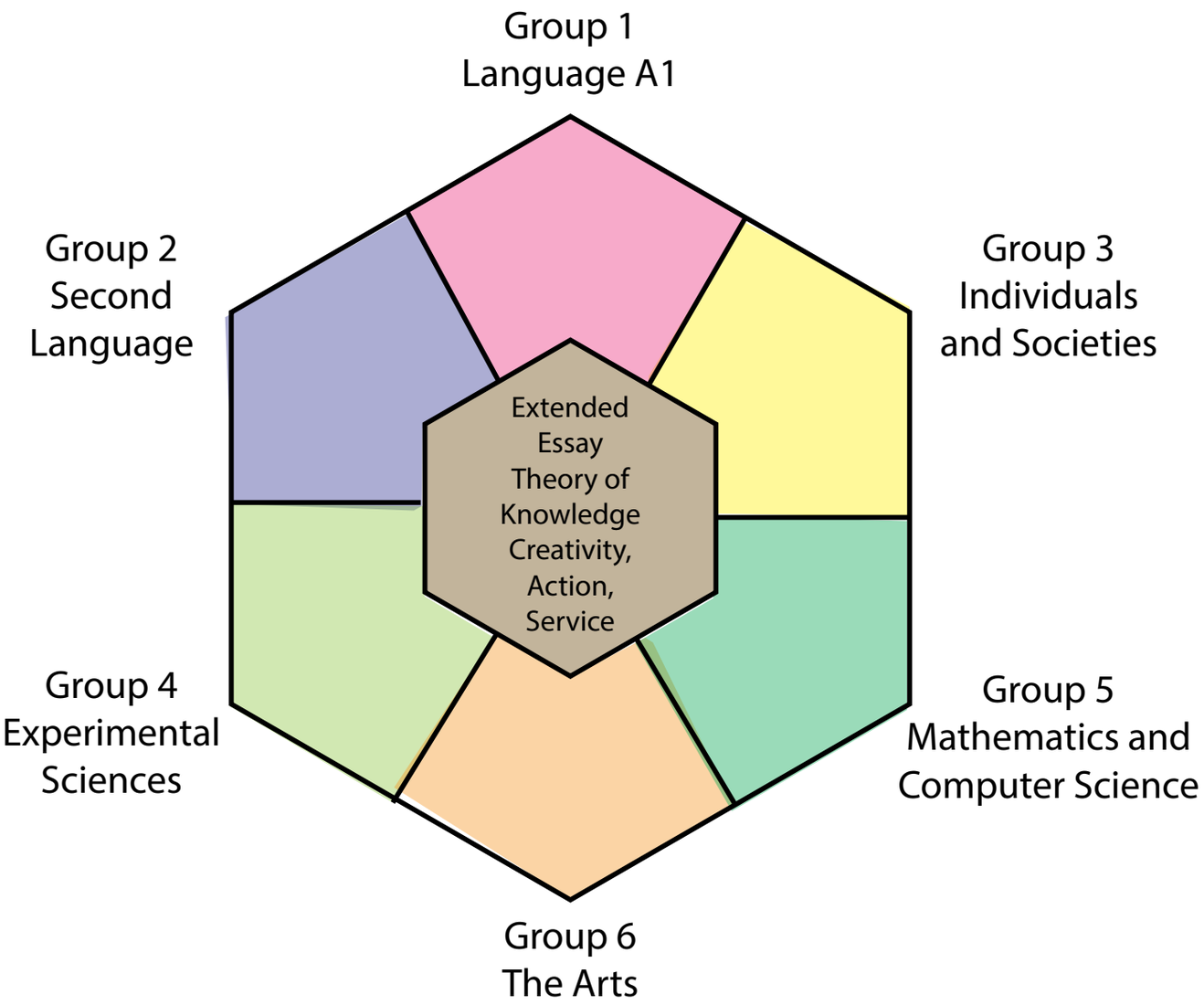
- awareness of the nature of humans as both individuals and as part of the societies they create,
- an understanding of the arts.

For the sciences they decided two compulsory subjects were needed:

- you should be aware of the nature of the physical sciences and how these sciences explore the non-human aspects of the phenomena of the natural world,
- you should be numerate and aware of mathematical processes .

To begin to be an educated person, they argued, you have to have been introduced to all these six subjects. Even if you found one or more of them challenging that was not a reason why you should give it up. Indeed, some argued, that was a reason for continuing to study it. So they invented the Diploma hexagon.

But it was not enough, these founding mothers and fathers argued, that you be exposed to aspects of the two great traditions of learning, the humanities and the sciences, embedded in the hexagon.



The Original DP Hexagon

.

You should also know why you are being exposed to them. They wanted you to be aware of the differences in the knowledge you were exposed to and why it was important to be grounded in both the humanities and the sciences. They wanted you to understand that the knowledge you use when learning and applying Pythagoras' theorem (Group 5 knowledge) is different from the knowledge you use when learning and responding to a poem by Rabindranath Tagore (Group 6 knowledge). They wanted you to understand knowledge created by a historian (Group 3 knowledge) is different from knowledge created by a scientist (Group 4 knowledge). By becoming aware of the different ways in which knowledge is created, they reasoned, you can begin to think critically about the validity of the types of knowledge you are being exposed to and to understand that the nature of knowledge varies from subject to subject.

Those founding parents wanted to be sure not only that you had a sound liberal education but also that you understood the variety and nature of the different kinds of knowledge to which you were being introduced. Above all they wanted you to examine critically the truth and validity of that knowledge. As you know already they were a creative lot, those founding mothers and fathers, living in a creative time. So they invented TOK.

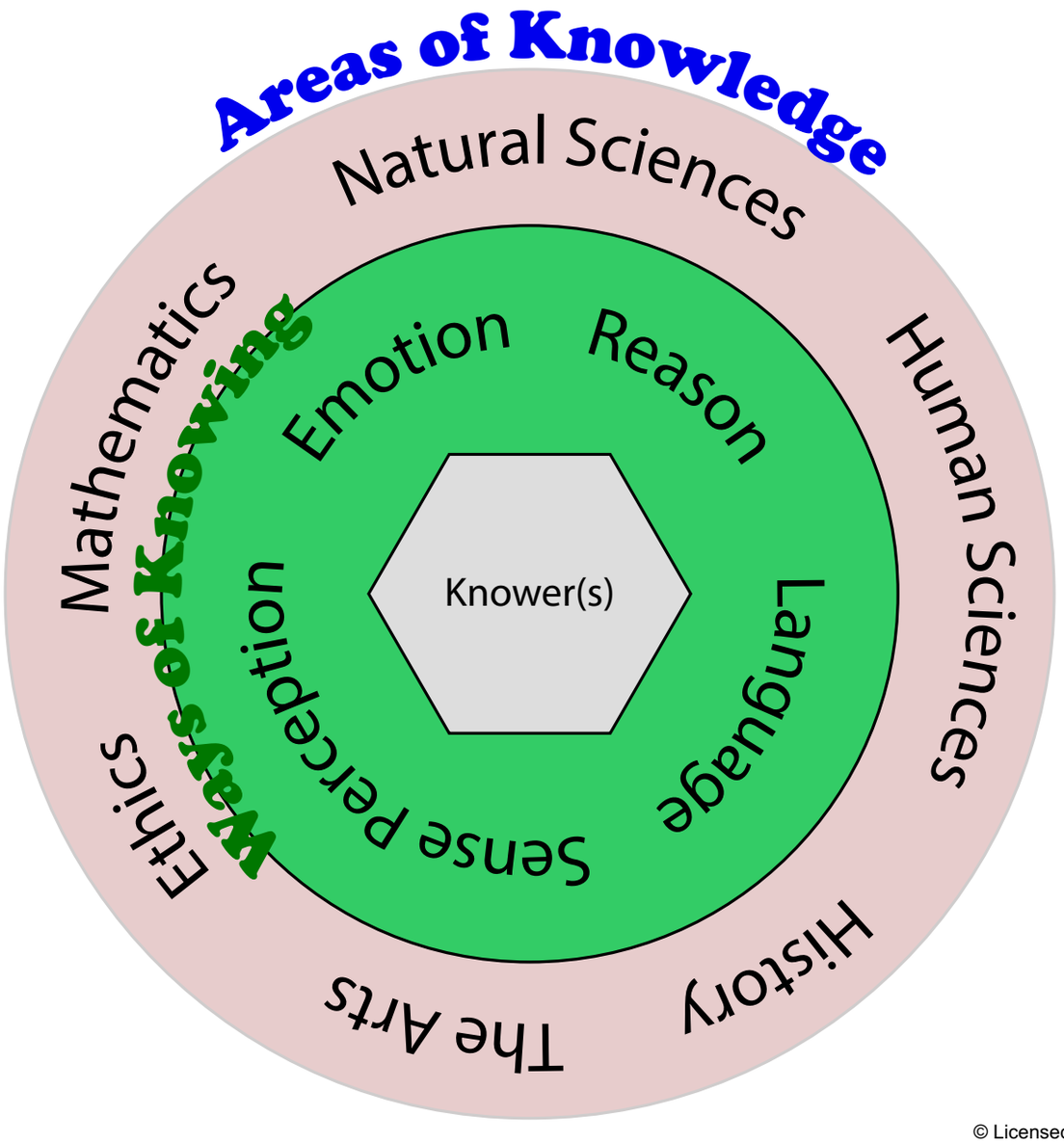
And that's why you have to spend 100 hours studying TOK and you have to prove, through an essay and an exhibition, that you are critically aware of the truth and validity of the knowledge you are acquiring when you study for the IB Diploma.

Radio Telescopes such as this at Parkes, Australia are vital to our knowledge of the Universe.

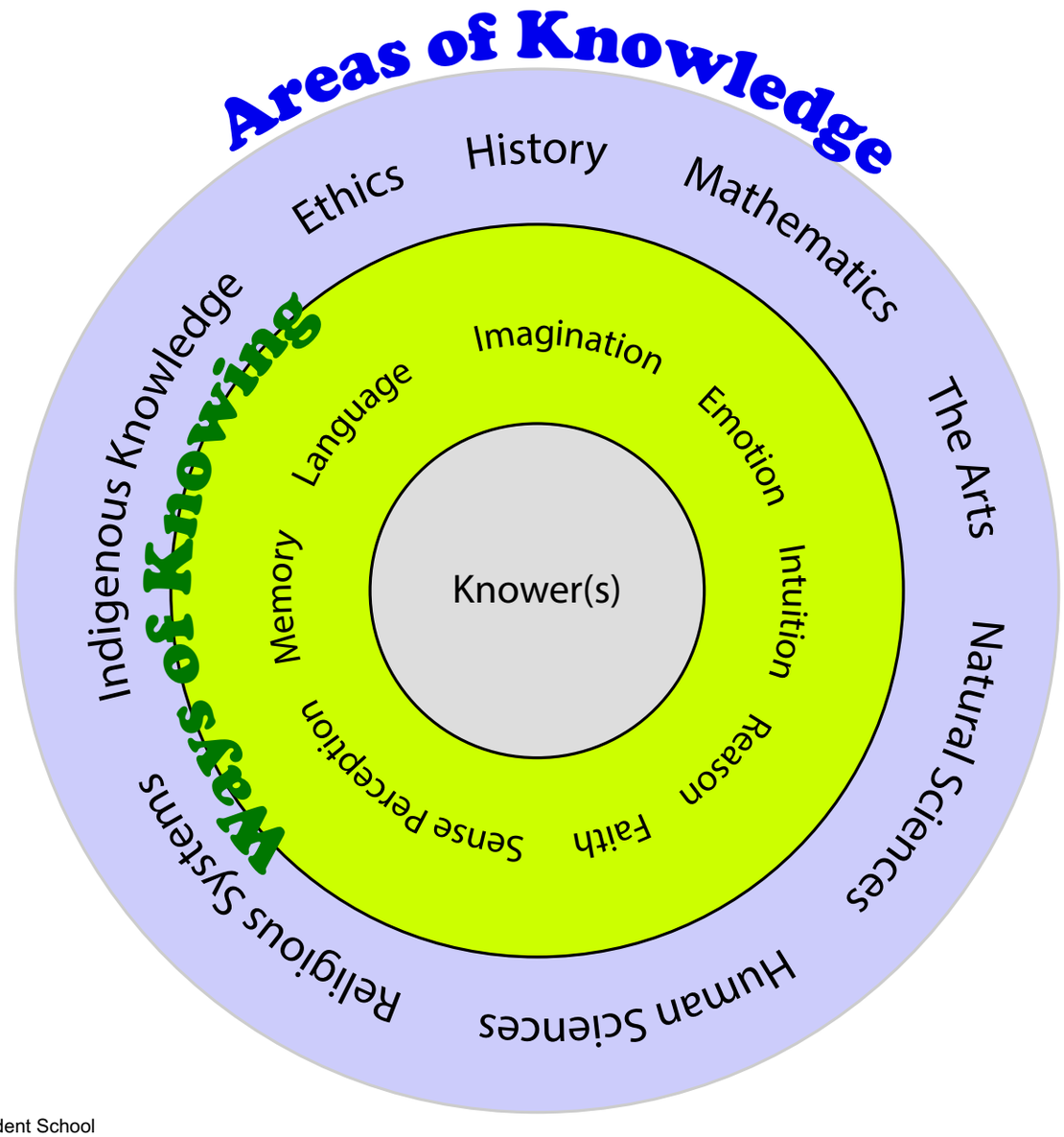
Chapter 2 The Evolution of the TOK Diagram

The TOK diagrams from previous Course Guides introduce the main TOK concepts and their relationships. It is suggested in the Guide that teachers and students may find it useful as a pictorial representation of the course. Like much connected with TOK, it has 'evolved' and this evolution presents an interesting question in its own right.

TOK Diagram (2008)



TOK Diagram (2015)



If you look at the Areas of Knowledge in the 2008 diagram, in the outer circle you can see their relationship to the hexagon.

At the top are Natural Sciences which correspond to the 'experimental sciences' of the hexagon and just to the left is Mathematics, Group 5. On the right we have Human Sciences and History which are components of what the hexagon calls 'individuals and societies'. Below them there is The Arts. So in that outer circle of the TOK diagram four of the hexagon groups are represented. Language, (Groups 1 and 2,) is in the inner circle. That leaves Ethics, which really is part of the 'individuals and societies', Group 3 of the hexagon. (No doubt you will have noticed that Ethics is the only area of knowledge in the outer circle, which is not usually taught as a subject in its own right in schools).

The TOK Diagram and the construction of knowledge

A major aim of the TOK course is to develop an awareness of how knowledge is constructed , critically examined and renewed by communities and individuals. The diagram indicates how this aim may be achieved.

Knower(s)

At the centre of the diagram are 'Knower(s)'.

'Knower(s)' can be interpreted in two ways but for the purpose of the aim quoted in the previous paragraph think of 'Knower(s)' as those members of society who actually create new knowledge: those people in universities and research institutes who spend their lives discovering what was not previously known and those creative writers and thinkers who lead us into new ways of understanding through their art and writing and music. So in the centre of the diagram, as the Knower(s) there will be physicists, chemists, biologists (natural sciences), mathematicians (mathematics), economists, sociologists, and anthropologists (human sciences); there will be historians (history) and moral philosophers (ethics) and there will be artists (the arts).

According to the TOK diagram these 'Knower(s)' will use the Ways of Knowing of the middle circle to create new knowledge in their disciplines (the outer circle). So, it is implied, an astrophysicist will use a combination of these Ways of Knowing—reason, sense perception, language and emotion—to find out more about say, a newly

Rodin's Thinker.

A cast from the original mould, Kyoto, Japan.

observed galaxy. A historian writing a history of the Pinochet years in Chile will also use these Ways of Knowing to describe and analyse these Pinochet years, and a mathematician will use these Ways of Knowing to investigate number theory. They will not, of course, use the Ways of Knowing in the same combinations. To what extent does a physicist, for instance, use sense perception in creating new knowledge? To what extent does a historian use emotion? Does a mathematician use anything other than reason?

The are many stories of mathematicians/scientists and 'eureka moments'. This is Isaac Newton's home, Woolsthorpe Manor, Lincolnshire, UK. The famous apple tree is at right. Newton insisted that the falling apple story was true. However, it did not give him the answer to the problem of gravity. It merely suggested that this was a good problem for him to pass the time with while avoiding an outbreak of plague at this isolated spot.

P.S. The apples taste like normal apples and confer no special powers.

Knower(s)—Ways of Knowing and Areas of Knowledge

The TOK diagrams allow you to plot the construction of knowledge. There are the knowledge makers in the middle, using the Ways of Knowing of the centre circle to create new knowledge in their particular disciplines in the outer circle. And that is what is at the heart of TOK. TOK is designed to encourage you to understand how knowledge is constructed, where it comes from, so you can look at it critically. 'Critically' is one of those words (and we will meet more of them when we look at language as a Way of Knowing) that can be misleading. In everyday usage if your teacher is 'critical' of your work it implies something negative, perhaps your work is badly planned or misses important ideas. Here 'critically' means something else, it means seeing things clearly, as they really are, in their context. So your critical thinking about, for instance a new sculpture, will be influenced by the ideas you are introduced to in TOK about the nature of artistic knowledge.

To what extent is artistic knowledge to be judged by reason or sense perception or emotion or language? Your critical thinking of the nature of calculus will be enhanced by your TOK awareness of how knowledge in mathematics is created by a combination of reason, sense perception, emotion and/or language.

As its name implies, TOK is about the nature of knowledge. The course encourages you to understand that schools and universities transmit and create a variety of Areas of Knowledge. Each of these areas has its own different truths and justifications. By the end of the course you should begin to understand these different truths and justifications and begin to evaluate these Areas of Knowledge by their own standards. The world of commerce is also a very important conduit for the creation and dissemination of knowledge. In the Middle Ages, if you wanted to become an apothecary (pharmacist), you became an apprentice to a Master of the Apothecaries Guild who gave you a basic training. You then became a Journeyman and travelled around improving your knowledge by working for other Masters. Finally, you became a Master and were allowed to display the symbol of the Guild (photograph),

So that's why those contemporaries of the Beatles, those IB founding fathers and mothers, invented TOK. Their invention is not perfect. Since the 1960s the 'great tradition' of sciences and humanities has been blurred by an ever-increasing attempt by social scientists to model their research on the methods of natural science. The six Areas of Knowledge of the outer ring of the TOK diagram are a selection. The four (/eight) Ways of Knowing are also a selection. With a little thought you can probably add to both the Areas of Knowledge and the Ways of Knowing. But TOK is a practical construct; a programme designed by concerned educators to help you understand the nature of the knowledge you are studying.

A Caution: The student, as 'Knower'

The original TOK diagram in the Curriculum Guide has Knower(s) at the centre. Immediately beneath the diagram are two statements:

> Teachers and students may find the TOK figure useful as a pictorial representation of the TOK course.
>
> Because the course is centred on student reflection and questioning the diagram places the knower(s) as individuals and groups, at the centre.

The suggestion here is the way that you as a student 'know' something, through reflection and questioning, is the same as the way academics and researchers and the creators of knowledge know something, through the Ways of Knowing and Areas of Knowledge. It might seem the diagram and the two statements together suggest your learning, your becoming a 'knower', is itself similar to the process with which academics, researchers and artists create new knowledge.

On the surface this idea may seem plausible. Of course you use sense perception, reason, language and emotion to learn. You use your eyes to read text books and literature, your ears to listen to your teachers and your other senses to become familiar with how things feel, taste and smell. You use reason to check out what you have read or heard. It is with language, through reading and listening that you acquire most of your learning, your knowing, at school. And you use your emotions to understand ideas and concepts, and respond to what you learn.

But the learned knowledge you acquire at school is not the same kind of knowledge as the knowledge constructed by the research Knower(s). You do not construct new knowledge. What you do is process existing knowledge, making it meaningful for yourself. When you are introduced to Pythagoras Theorem it might be that your teacher sets up a situation in which you 'discover' the sum of the areas of the squares on two sides of a right angle triangle are equal to the area of square on the hypotenuse. But although

that 'discovery' might help you to understand the theorem it is not knowledge you have created. You may, as the teachers might say, have 'constructed' that knowledge. You constructed it because it was put before you in such a way that the reconstruction of what other people have known for two thousand years was possible.

Most of what you learn at school is what is known as 'knowledge by authority'. To understand this it is worth looking briefly at two school subjects: natural science and history. In school science students undertake identical, or similar investigations, all of which have been undertaken before, under the direction of a teacher, with an outcome that is predictable and examinable for the purpose of proving you have understood it. In contrast 'real' science probes for new knowledge seeking understanding as yet unknown. This does not mean that school science has no value. It demands careful observation, rational interpretation, precise use of language and a search for truth. School history is similar: it demands careful analysis and a search for truth, but it is not real history. It is packaged. Students work with material given to them. Original sources are not available (although facsimiles might be) and because school history is assessed by examinations, students must predict what the examiner wants and deliver accordingly.

In normal classroom activities the student as 'knower' at the centre of the TOK diagram is quite a different 'Knower' from the researcher as a Knower. Your Extended Essay, however, with its demand for original research takes you, however briefly, into the world of the researcher as Knower. Here you are expected to produce a little original research, to creatively extend the boundaries of knowledge, be it however small an extension, to find out, to construct, something no-one has found out or constructed and to come to a conclusion nobody has ever reached before. At that point you, as a Knower, come to the centre of the diagram with the same status as the established researcher.

Assessment and TOK Diagram

'OK'. I can hear you saying. 'The idea that TOK was born out of educational idealism may be all well and fine but the real curriculum of any exam subject can be only really seen in the exam questions. When you prepare for an exam you look carefully at past papers. What do the TOK exam papers tell us?'

The Prescribed Essay

Well, there are no exam papers in the conventional sense. Each year the IB publishes a list of TOK essay titles and students must select one of these and, in their own time, write an essay exploring the TOK issues in their selected title. So, to know what TOK is really about look at these titles and see how they relate to the TOK diagram.

1. Using history and at least one other area of knowledge, examine the claim that it is possible to attain knowledge despite problems of bias and selection.

The relationship of this question to the TOK diagram is direct. What the student is expected to do is look critically at how Ways of Knowing - reason, perception, emotion and language - are used by historians and how these Ways of Knowing create problems of bias and selection, and then compare this with how the same Ways of Knowing with emphasis on bias and selection in another Area of Knowledge, the Arts perhaps or natural or human science.

2. Through different methods of justification, we can reach conclusions in ethics that are as well supported as those provided in mathematics. To what extent would you agree?

Once again the relationship of the question to the TOK diagram is clear. Ethics and Mathematics are Areas of Knowledge and students are expected to explore the ways in which justification is a key process ethicists and mathematicians use to create knowledge in their disciplines. Of course, being a TOK question students are expected to show how the Ways of Knowing—reason, sense perception, language and emotion—can be regarded as generating justification.

In both of these essay titles the initial focus is on the Areas of Knowledge. In some essay titles the initial focus is on the Ways of Knowing.

We can be certain that

$1.414 \neq \sqrt{2}$

because

$1.414^2 = 1.999396$

and this is not 2

3. Knowledge is generated through the interaction of critical and creative thinking. Evaluate this statement in two areas of knowledge.

Although the phrase 'Ways of Knowing' is not specifically stated, students are expected to relate 'critical and creative thinking' to Ways of Knowing, asking themselves in what ways reason, language, emotion and sense perception generate critical and creative thinking and to apply their ideas to two Areas of Knowledge.

Another example of focussing initially on Ways of Knowing is seen in this Question:

4. Compare and contrast knowledge, which can be expressed in words/symbols, with knowledge that cannot be expressed in this way. Consider Creativity, Action, Service (CAS) and one or more areas of knowledge.

Knowledge, which can be expressed (or not expressed) in words and symbols, is clearly an invitation to discuss the advantages and disadvantages of language as a way of knowing. Considering CAS as equivalent to an area of knowledge is an interesting development. Students who choose this title must begin by defining what knowledge had been created in them by their CAS experience. They then need to compare that new personal knowledge with at least one of the Areas of Knowledge in the TOK diagram(s). In this case the 'Knower(s)' in the middle of the diagram has clearly moved from the academics and researchers to the students undertaking their CAS and analysing what new knowledge their CAS experience has created within themselves.

Theory of Knowledge Exhibition.

This part is internally assessed and accounts for one third of the final assessment.

You are required to select three objects and provide a commentary on how they demonstrate TOK issues in their relationship to the real World.

As a start, you might like to look at the excellent series of podcasts from the BBC - A History of the World in 100 Objects.

This can be found by using a Podcasts App and searching on BBC or the title. At the time of writing, this link:

https://www.bbc.co.uk/programmes/b00nrtd2/episodes/downloads

will take you to the Home page, but not to the podcasts.

The series deals mostly with valuable objects from the British Museum. However, more mundane items also have interesting stories to tell. Each podcast tells the story of the object and its place in 'History' in its broadest sense.

We will consider several objects in the last section of this book and will make comments on how they relate to the TOK objectives.

Chapter 3 Knowledge Issues

Here are the stated objectives of the TOK course that will be first assessed in 2022:

Having completed the TOK course, students should be able to:

- demonstrate TOK thinking through the critical examination of knowledge questions
- identify and explore links between knowledge questions and the world around us
- identify and explore links between knowledge questions and areas of knowledge
- develop relevant, clear and coherent arguments
- use examples and evidence effectively to support a discussion
- demonstrate awareness and evaluation of different points of view
- consider the implications of arguments and conclusions.

We have already looked at some examples of what it means to be a 'Knower'. As you may have realised, Knowers are people who ask questions. Some of these may be profound:

- where did the matter in the Universe come from?
- do we continue to 'exist' after death?
- what is the best way of running a nation's economy?
- should we legalise human cloning - should it ever become possible?
- is the Universe curved in a fourth spatial dimension?

Other questions are narrower (but may still be hard to answer).

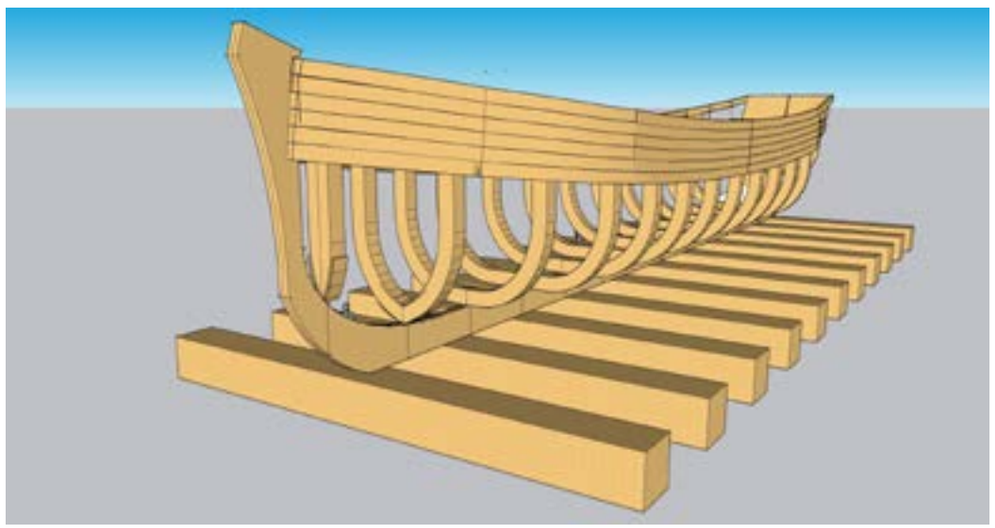
- how much paint will I need to paint my living room?
- do sunspots affect the Earth's climate?
- is that house a 'good buy'?
- does the Country have enough electricity generating capacity?

So some questions are deep and fundamental and we look to elite research groups for their solution. Other very important questions crop up in day to day life and we look to an army of comparatively ordinary people to solve them. We will look at a few and ask what processes are employed in arriving at useful solutions - Knowledge.

1. What is the best option for buying a new car?

This will depend on your circumstances. You may have a choice between paying cash, a Bank loan, Hire Purchase or Leasing. You will determine the cost of each option using **Mathematics** (Compound Interest etc.). You may not, of course, choose the cheapest option as tax and other factors may also be involved. You may also have **Emotional** considerations in coming to your decision. You might, for example, prefer leasing to a loan because it looks less like you cannot afford the car.

2. Will my ship float?



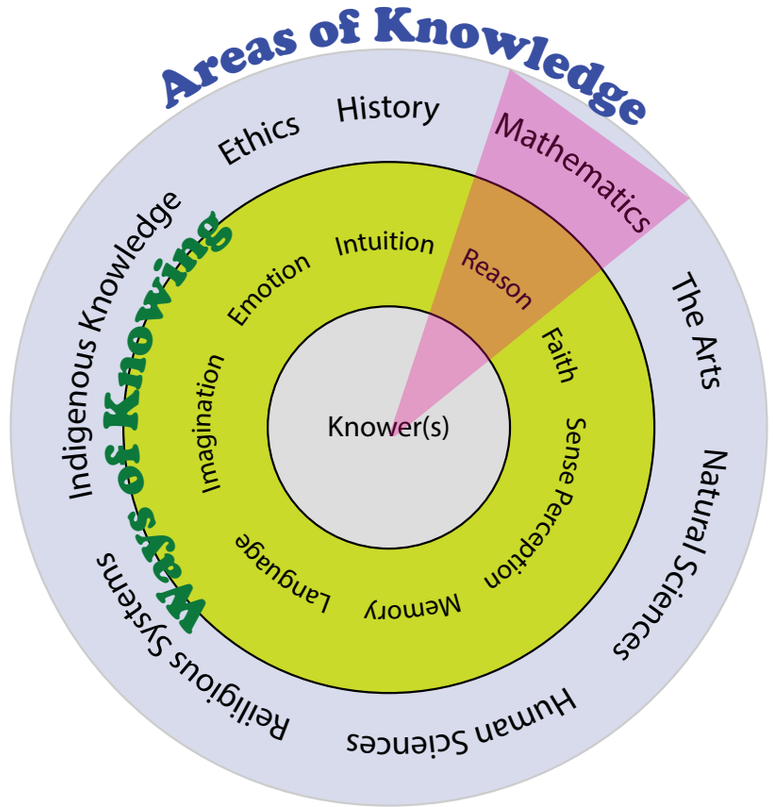
Ships used to be built on traditional lines. Builders used **Memory** and **Indigenous Knowledge**. Modern designers will want to improve on previous designs. But how will s/he know if the hull will float at the right depth? How low will the hull sink when the ship is fully loaded?

All these questions can be answered by calculating the weight of the materials used and the volume of the hull using **Mathematics**. The issues of the depth at which the hull will float in the water can be settled using the Principle of Archimedes (**Science** - Physics).

We have begun with two comparatively straightforward questions so that we can illustrate the processes involved in arriving at the solutions. In the first problem (car purchase) we have mainly used Reason (as a Way of Knowing) to arrive at a conclusion that is in the Area of Knowledge - Mathematics.

If it helps you see this, imagine that you can use the TOK diagram as if the discs can be rotated. In this case, the discs are rotated so as to align Reason with Mathematics.

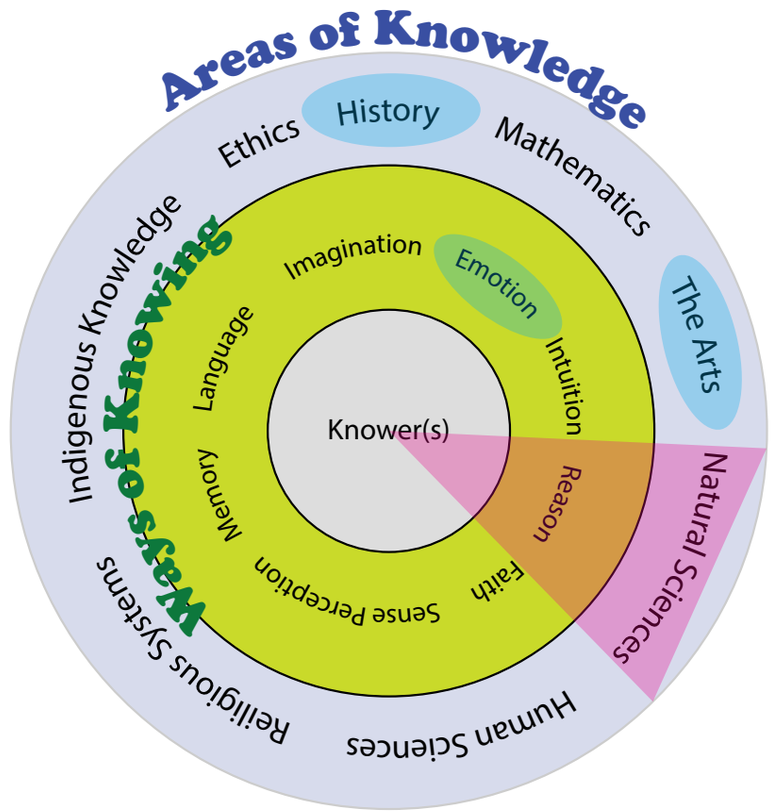
This alignment shows the main part of the process. As we remarked, there may be a sense in which Emotion as a Way of Knowing might contribute to the final decision.



The question of designing a ship begins (and very nearly, but not quite) ends with the issue of whether or not it will float properly. As we have said, processes of reason lead primarily to Knowledge that sits clearly in the realms of Natural Science and Technology.

However, the light blue ellipses indicate that the designers of ships almost always have aesthetic considerations in mind. Seafarers refer to their ships as 'she', probably in honour of their Mothers and that they depend on their ships as they once depended on their Mothers. The term 'beauty' is often used, even when describing warships.

The documentary (https://www.youtube.com/watch?v=-jCma_56PiU&t=649s) from about 32:30 to 35:30 contains eyewitness accounts of the sinking of the battleship *Bismarck*. Even though they are describing a terrible and violent event, they still use terms such as "a majestic scene" and "her beauty lost".



3. Will it rain tomorrow?

Everybody knows that all you need to do to secure an absolute 'yes' to this question is to organise a barbecue.

But this is, of course, not real Knowledge. This is not to say there are not items of **Indigenous Knowledge** that have more validity.

"Red sky at night, shepherds delight. Red sky in the morning , shepherds warning" is a familiar saying in England.

This means that a red sunset suggests that the next day will be fine but a red sunrise predicts bad weather.

Also in England, there is a very persistent legend based on St. Swithun who is buried in Winchester (England) and whose Feast Day is 15th July. The legend goes:

St Swithun's day if thou dost rain

For forty days it will remain

St Swithun's day if thou be fair

For forty days 'twill rain nae mare

(nae mare - no more). The shorter version is:

If on St Swithun's day it really pours

You're better off to stay indoors.

Both mean that rain on the 15th July presages a wet summer. A dry 15th predicts a dry summer. The *Guinness Book of Records* takes the legend seriously and publishes its worst results. These include 1913 when 15 hours of rain on St. Swithun's Day were followed by 30 of the next 40 days being dry. This is dry for England!

Does your culture have a similar legend?

Barometers - weather, **technology** and long term experience.

Mariners, even in these days of rapid communication, still pay attention to their barometers. These measure air pressure. The model shown is an aneroid barometer. The silver drum just visible behind the scale contains a vacuum. It is prevented from collapsing by a flexible spring. A rise in air pressure compresses the drum moving the silver arrow clockwise and vice versa. At the time the photograph was taken, it was actually raining. Dry, sunny weather is associated with high pressure and wet, stormy weather with low pressure.

The gold arrow is moved by turning the knob on the front. This is moved to the position of the silver arrow at each observation. The pressure has fallen since the last observation, predicting deteriorating weather - which happened. This is known as a 'falling glass'.

Modern weather forecasts still use barometric pressure as a major input. Pressure readings from multiple stations allow all sorts of predictions such as wind speed and direction. Air flows from places of high pressure to places of low pressure. However, because of the rotation of the Earth it does so in the spiralling patterns visible on weather maps and satellite photographs.

A modern weather forecast also uses measures of temperature, humidity, taken by weather balloons, satellites etc. The data is processed by very sophisticated computers. These now end up with the modern answer to our question:

Chance of rainfall 30%, possible rainfall: 3 to 5 mm.

Not so well known are the specialist forecasts provided for mariners, aviators, farmers etc. These focus on issues of particular interest to these groups. For example, mariners are interested in storms and violent seas. Aviators need to avoid thunderstorms and the extreme turbulence that is associated with them. Farmers are concerned with late frosts, how much rain they can expect during the growing season and other issues.

As a postscript, while working on an early computer model of the atmosphere, Edward Norton Lorenz (1917 – 2008) proved that detailed long term weather forecasts will never be possible and invented a new branch of **Mathematics** - Chaos Theory.

4. Is that a genuine Rembrandt?

It still occasionally happens that a painting is found in an attic that looks as if it might have been painted by a major artist such as Rembrandt. Dusty paintings in attics are usually worth about $20. Genuine Rembrandts fetch millions. So there is a lot of money riding on arriving at the truth. For example, the Ashmolean Museum in Oxford, UK was left (in 1951) a small wood panel portrait of a bearded man, probably by Rembrandt. For many years this was thought not to be genuine, however...

What does 'truth' mean here? It is not the same meaning as truth in Mathematics but, as so much money is involved, it needs to aspire to it.

So what Ways of Knowing are involved? A surprising number.

1. Does it look 'right' to an expert on the artist's work?

There are a small number of art experts who are said to be able to detect fakes, even if they have been expertly produced. They are not entirely using **Intuition.** A detailed Knowledge of **The Arts** and issues such as 'brushwork' are involved. For those of us who do not have this expertise, this can be a bit difficult to understand. It is reasonably obvious that Vincent van Gogh used bolder brush strokes than Rembrandt, but is it possible to detect a deliberate attempt to copy his technique? The brushwork of the Oxford portrait was deemed to be too 'free' for the painting to be a genuine Rembrandt. The panel was consigned to the basement. Other indicators are features such as 'is this a normal subject for this artist?'

2. Is there a chain of ownership that can be traced back to the artist - a **History**?

In some cases, the current owner is a direct descendant of the original purchaser. Perhaps they even have the original bill of sale. Or perhaps it was painted directly on their wall. Failing that, the next best thing is to look for a chain of ownership. This means that the current owner bought it from A through dealer X who bought it from B through dealer Y and so on back to the artist. This search for 'provenance' is somewhat like policework!

3. **Scientific** Evidence.

Mostly, this rests on looking at details such as the composition of the paint. This can now be established with microscopic samples that are non-destructive of the artwork. Acrylic paints are comparatively recent inventions. Artists used to mix their own paints and their actual recipes can be characteristic of the artist.

The canvas, frame etc. can also help establish authenticity. The Oxford Rembrandt was rescued from the basement partly because a dendrochronologist (tree-ring expert) established that the panel it had come from was from the same tree as an already authenticated Rembrandt.

X-Ray photography can reveal details of layers of paint below the surface that show the process by which the painting was developed. Sometimes there are entire paintings under the finished article that can be revealing.

We have managed to put highlighters on quite a number of the items on the TOK diagram with this one example.

5. What is Fear?

This is is a question that sits in the **Human Sciences** area of Knowledge. Why would we be interested in answers to this question?

We all experience fear at times in our lives. Sometimes fear is useful - it saves us from injury and is entirely rational. It really is not a good idea to stand on safety railings.

Other fears are less rational. Fear of failure can prevent us from trying things that we might end up enjoying. Teachers are trained to be aware that many students are reluctant to answer questions in class for fear of looking foolish. Others do not answer because they do not want to be seen as too clever. Helping students overcome this fear is one of the major challenges faced by teachers. There is no single 'best answer' to this question. This is often the case with the Human Sciences and finding answers can raise serious questions of **Ethics**. Is it ethical to conduct experiments in which people are deliberately made afraid?

Our question is very wide-ranging. We will stand a better chance of finding answers by refining the question. For example, do people assess risk accurately?

This is a fairly important question and it may be possible to justify an experiment to elicit rational answers ethically.

You might like to break off at this stage to spend some time thinking about this problem and how you might set up an experiment to get some useful answers.

You might begin with an investigation of whether people fear risks in relation to their actual threat level.

For example, you may find that fear of dying as a result of a shark attack is widespread. This is not related to actual risk as this risk can be reduced to zero by not swimming in the sea.

There is a theory that fear is related to a person's level of revulsion at the manner of their demise should the worst occur, not the actual risk.

This may explain why people do not fear road accidents as much as they should. Many more people are killed in road accidents than in shark attacks even taking into account that people spend more time on the roads than in the sea.

Risk Assessment has become increasingly important for many industries and a great deal of money is spent on its evaluations

Postscript

2020 saw a highly unusual Worldwide event related to COVID-19.

Many Governments responded with measures (lockdowns, curfews etc.) that exceeded those taken by their predecessors, even in wartime.

How did your Government react?

Was the response proportional to the risk or was it driven by irrational fear?

Did the long term economic and social damage exceed the risks of the disease?

Areas of Knowledge

Chapter 4 History

The Normans (Northmen who had settled in France) left their mark on British History by building castles such as the Tower of London

History is the study of the human past. The word 'history' comes from the Greek 'historia', which means 'inquiry, knowledge acquired by investigation'. In TOK we need to understand the nature of that 'investigation'. The TOK guide makes it quite clear that history is not a scientific investigation. Would be 'knowers' of history, historians, cannot directly observe the past and therefore cannot be classified as scientists. Knowledge in history is, at best, second hand. This makes historical investigation, the creation of new history, quite distinct from other Areas of Knowledge.

A nineteenth century German historian, Ranke, used the phrase '*wie es eigentlich gewesen*' ('how it really was') to describe how he believed historians should present their records of the past. Ranke and his fellow nineteenth century historians believed that not only was it possible to present the past 'how it really was' but also that they were doing exactly that when they wrote their history books. They regarded history as they regarded the natural sciences. There are, they claimed, 'historical' facts just as there are 'scientific' facts. In the same way that scientific facts were independent of the scientists, so historical facts were regarded as independent of historians. The historians' job was to collect together a proven body of facts and present them.

Modern historians regard this approach not only as impossibly idealistic but also as simply impossible. Why? Isn't that what history is about? What is history if it is not about the facts of the past? If it isn't the past '*wie es eigentlich gewesen*'?

We all know, or think we know, what a 'fact' is: a reliable piece of information, something we know to be, in the common sense meaning of the word 'true'. We also know, or think we know, what a historical fact is. We can produce, without too much trouble, at least half a dozen historical facts: the date of Nelson Mandela's release from prison, the year the French revolutionaries stormed the Bastille, the number of times Brazil has won the World (Soccer) Cup, the year of Tut Ankh Amon's death, the name of the Chinese communist ruler responsible for the purges in the 1960s, and so on. These are facts, definite pieces of historical knowledge.

These 'facts', these pieces of evidence about the human past, are important to historians. Historians collect their evidence from wherever they can and must be certain of its accuracy. Certain historical facts, often obtained from archives, may be collected directly. Historians can visit public record offices and examine historical documents personally. Historians sometimes interview people who were directly connected with the historical events they are researching and obtain 'oral' history. Other historical evidence is obtained from the academic disciplines, which underpin history, subjects like archaeology, palaeontology, numismatology, and so on.

Epigraphy is an interesting example of such a discipline. This is the study of ancient inscriptions: letters and words and symbols, chiselled, moulded or embossed on stones, metal, clay, even wood. These inscriptions and their interpretation by epigraphists provide some of the basic factual evidence for historians.

But factual evidence is only the start of history. History is the processing of this evidence into a coherent narrative with causes and effects. Historians write in the context of their own time and are inevitably influenced in their interpretations, their motivations, ideas and values as well as the ideas and values of those who will read their works. All history, it has been forcefully argued by an Italian historian Benedetto Croce, is contemporary history.

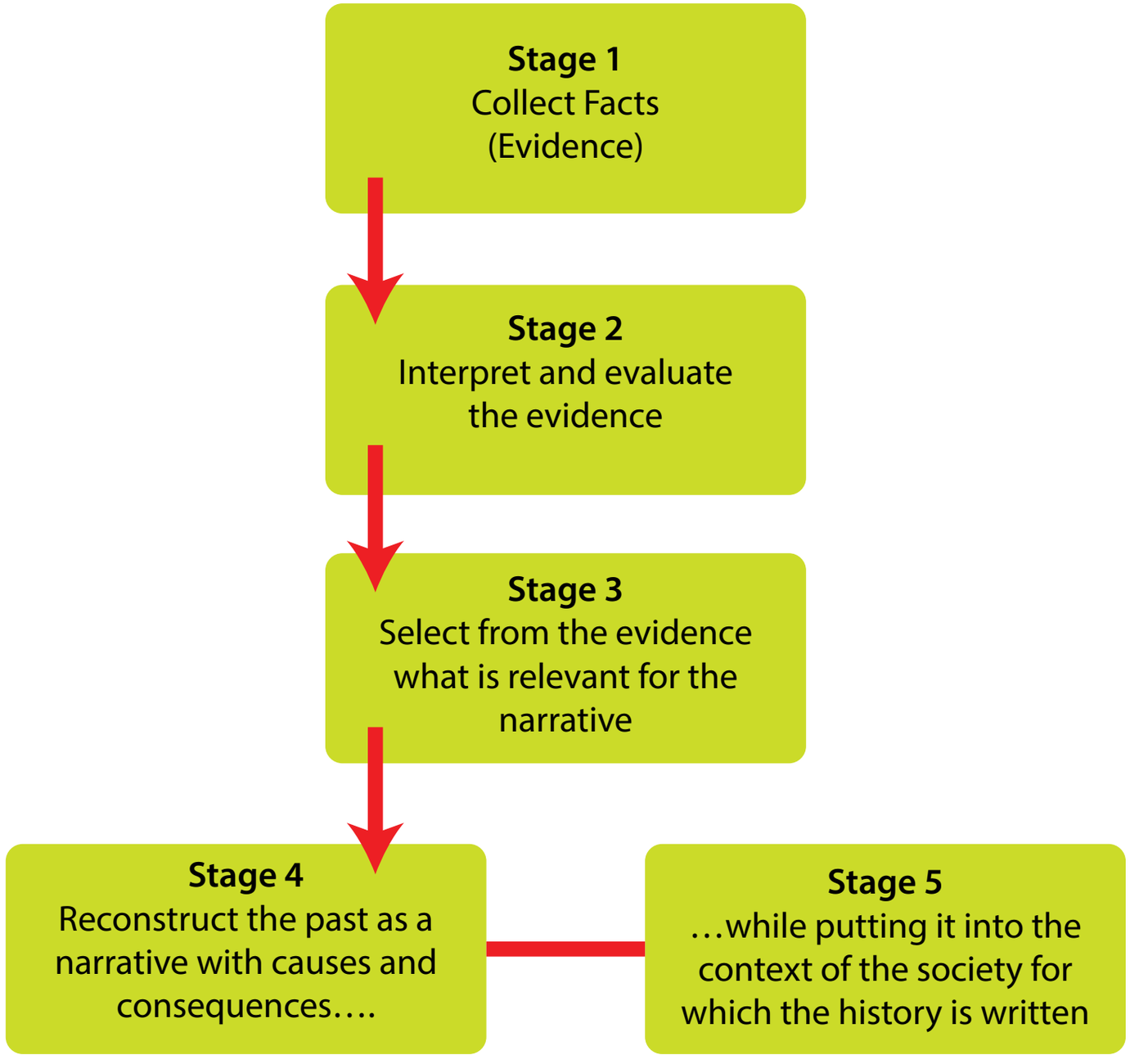
Stage 1. Collect Facts (Evidence)

Primary and Secondary Sources

The problem with the past is that it has passed. It has gone. It can't be observed and it can't be verified by further observation, We have to explore the past through what remains: through the multitude of surviving artefacts. Historians use what they term 'primary sources' as their main access to the past.

Primary sources are the foundations of history. They include every conceivable type of document: maps, treaties, church and temple records, imperial archive documents, letters, legal records, diaries, newspapers, catalogues and even bus tickets. They can be formal or informal, private or public, serious or frivolous. Primary sources also include artefacts. The underground bunkers in Whitehall, London from which Churchill ran his wartime government are a wonderful primary source, as are the pyramids in South America, the Great Wall of China, cave paintings in central France and stone sculptures on the Easter Islands.

The History Area of Knowledge is constructed something like this:



'Secondary sources' are also used: these are sources of information provided by other historians. Gibbon's *Decline and Fall of the Roman Empire*, written in the eighteenth century, is a secondary source. It is Gibbon's account of the end of the Roman Empire, written almost two thousand years after the event(s). It describes and analyses. In contrast, Julius Caesar's The *Gallic Wars* is a primary source: Caesar actually was there, fighting those wars. Other secondary sources might not be so obvious: the novel *Huckleberry Finn* is a secondary source much used by historians writing about slavery in the United States in the nineteenth century, even though it is a work of fiction.

Stage 2. Interpret and evaluate the evidence

Information from both primary and secondary sources needs to be treated with great caution.

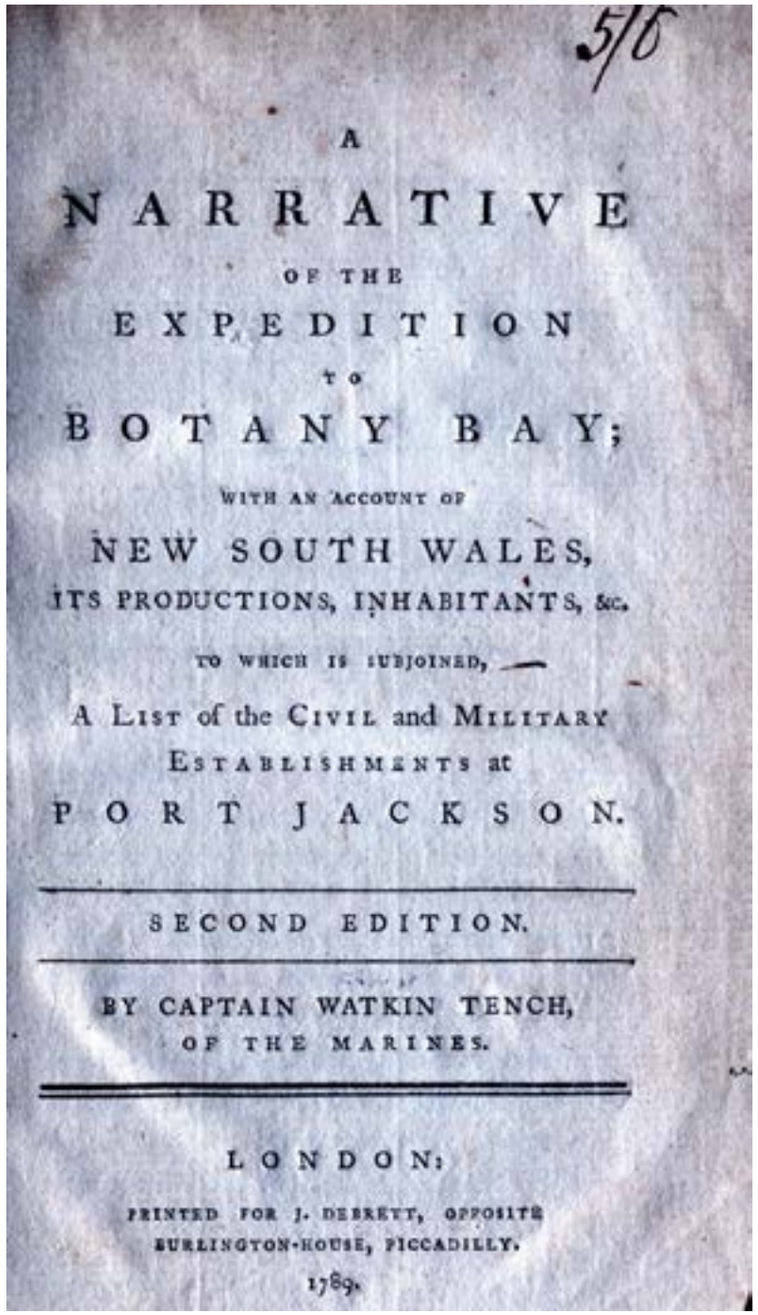
Can historians be sure they understand the meaning of any evidence as it was originally intended? If it is a document do the actual words mean what they seem to mean? An example here might be 'presently' which used to mean 'now'. If the language used has to be translated, has the bias of the translator, however subconscious, affected the interpretation? Historians attempt to overcome these problems by using as many varied primary sources as possible.

Historians are wary of all sources and here are some of the questions they ask when using primary (and secondary) sources:

- Who produced this source?
- When was it produced?
- Was the creator of the source an eyewitness?
- Why was the source produced?
- Where was the source produced?
- Is there consistency within the source?
- Is there consistency with other sources?

Example

This is the title page of an account by one of the military guards accompanying the first group of convicts transported from England to Australia on the 'First Fleet' in 1787. This voyage occurred 17 years after James Cook's First Voyage of Discovery, an event often confused with the First Fleet.


5/6

A

NARRATIVE

OF THE

EXPEDITION

TO

BOTANY BAY;

WITH AN ACCOUNT OF

NEW SOUTH WALES,

ITS PRODUCTIONS, INHABITANTS, &c.

TO WHICH IS SUBJOINED,

A List of the Civil and Military

Establishments at

PORT JACKSON.

SECOND EDITION.

BY CAPTAIN WATKIN TENCH,

OF THE MARINES.

LONDON:

PRINTED FOR J. DEBRETT, OPPOSITE

BURLINGTON-HOUSE, PICCADILLY.

1789.

How does this compare with our dot points?

- Who produced this source?

Author: Watkin Tench, Publisher J. Debrett of Picadilly, London.

- When was it produced?

1789 (2 years after the event).

- Was the creator of the source an eyewitness?

Yes.

- Why was the source produced?

Not clear.

- Where was the source produced?

London.

- Is there consistency within the source?

We would need to read the whole book...

- Is there consistency with other sources?

... and compare it with other accounts of the same events to establish this.

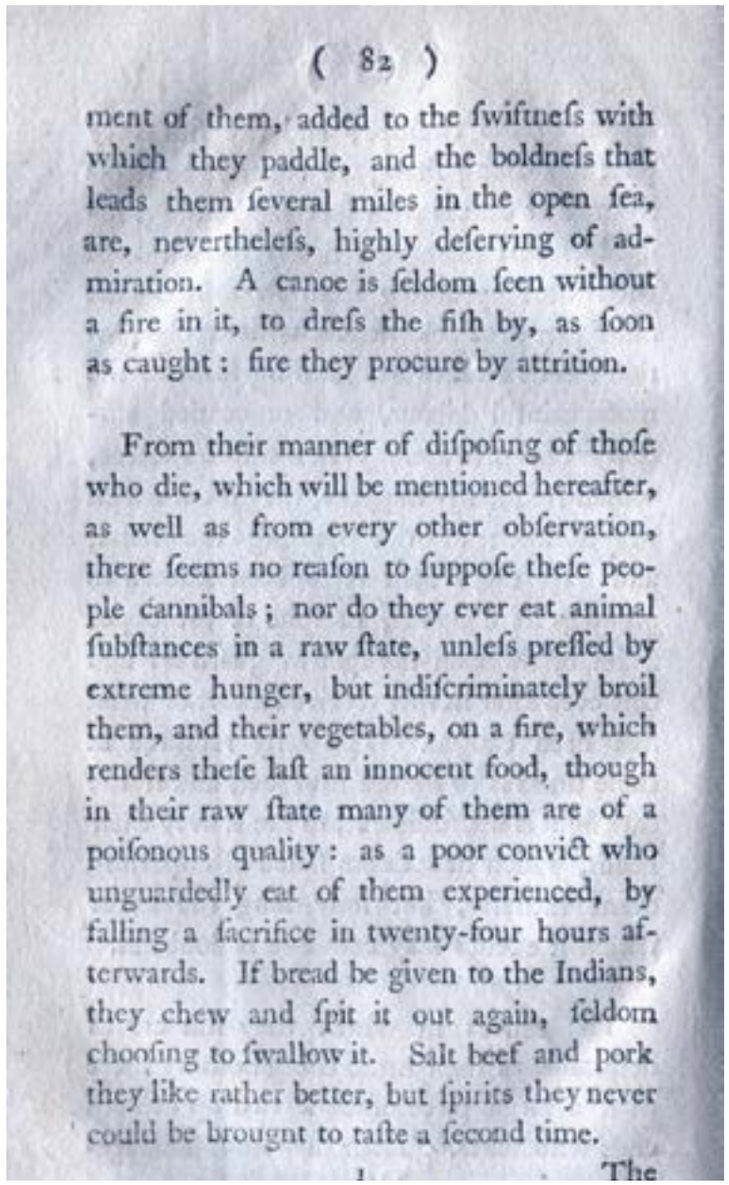
A question arises as to its authenticity. Is this a forgery? The hand written 5/6 on the Title Page suggests not. Why?

5/6 is the price paid by the parents of one of our contributors when they bought it from a second-hand bookshop in the 1950s. It is five shillings and sixpence or a bit over a quarter of a Pound Sterling. Even allowing for inflation, it is not that valuable and not worth the large amount of effort in making a forgery.

Even assuming we accept the authenticity of a document such as this, a historian's troubles are not yet over. This is in reasonably modern English. The problems in reading it are not much more than realising that: diſpoſing of thoſe is read as 'disposing of those'.

What do the observations in the second paragraph tell you about Tench himself and his observations about the diet of the Indigenous people he is describing? Remember that there was no common language between the two groups.

All these questions are aspects of one main question: how reliable is this source? Historians approach sources attempting to imaginatively understand—not necessarily to sympathise with—the minds of the creators of the documents (tablets, stela, etc.). Imaginative understanding is an important part of a historian's skill, but varies from historian to historian. Can modern historians, coming with their own prejudices and biases, reliably process information from the past? Can they process it being not only aware of the intentions of the creators, but also fully aware of the biases and prejudices of the generation to which they themselves belong? Is there any way in which modern historians can guarantee their freedom from bias or prejudice or expectation? Would Japanese historians be able to interpret European feudalism without being influenced by their understanding of the similar social systems in Japan?



(82)

ment of them, added to the ſwiftneſs with which they paddle, and the boldneſs that leads them ſeveral miles in the open ſea, are, nevertheleſs, highly deſerving of admiration. A canoe is ſeldom ſeen without a fire in it, to dreſs the fiſh by, as ſoon as caught: fire they procure by attrition.

From their manner of diſpoſing of thoſe who die, which will be mentioned hereafter, as well as from every other obſervation, there ſeems no reaſon to ſuppoſe theſe people cannibals; nor do they ever eat animal ſubſtances in a raw ſtate, unleſs preſſed by extreme hunger, but indiſcriminately broil them, and their vegetables, on a fire, which renders theſe laſt an innocent food, though in their raw ſtate many of them are of a poiſonous quality: as a poor convict who unguardedly eat of them experienced, by falling a ſacrifice in twenty-four hours afterwards. If bread be given to the Indians, they chew and ſpit it out again, ſeldom chooſing to ſwallow it. Salt beef and pork they like rather better, but ſpirits they never could be brought to taſte a ſecond time.

The

Historians need to put their primary sources into their context. Primary sources need careful evaluation. They might tell (a) what the writer(s) genuinely thought had happened or was happening, or (b) what the writer(s) wanted others to think they thought, or even what the writer(s) thought ought to have happened. A well-known example of this is the 'fact' that common people, the

'peasants' in Medieval Europe were devout Christians. What evidence we have for this comes, of course, from the people in the Middle Ages who wrote about their own lives and times. And the people who wrote about their own lives and times in the Middle Ages in Europe were monks and priests. Were these people capable of being objective about something so important to them as their religion?

Stage 3. Select from the evidence what is relevant for your narrative

Having interpreted and evaluated the evidence historians then have the task of selecting which 'facts' are to be used in their histories. Historians select, but what they select inevitably reflects the perspective of the audience for whom they write. When the histories of the 'Arab Spring' revolutions in north Africa in 2011 come to be written those historians seeking to explain to the Chinese will write a quite different story from those historians writing to influence American foreign policy. Historians who feel strongly about the spread of democracy will write a different narrative from those whose values are underpinned by religion. Other historians will write history to earn a living or increase their status in an academic community. The material they select for instance to explain the downfall of aging dictators may be 'true' but will be a selection of the truth appealing to a particular audience. Historians select, but what they select reflects the reason they are writing and the history and the audience for whom they are writing.

Stage 4. Reconstructing the past as a narrative with causes and consequences

History is not a portrait of the past, nor historians' thoughts about the past, but the bringing together of these two things. The task of the historian is to create a narrative, to write a 'story' from selected evidence, a story describing human activity in the past and analysing the cause and consequences of these human actions. Out of this will come the narrative, a tale of events and motivations, actions, successes, failures, aspirations and all the other human activities.

Stage 5. Put into context of the society for which the history is written

Historians also put their conclusions into some kind of context. They ask themselves questions about the relevance of their findings and conclusions to other contexts. What, if anything, can conclusions tell us about human communities in general? They might compare the artefacts from one culture with the artefacts found in another. Historians often compare and contrast human behaviour from the past with contemporary human behaviour. Historians continually reinterpret the events of the past and reappraise them for each new generation.

An example: the life of the 20th Century Ugandan President Idi Amin

If Historians were to write a history of the life of the Ugandan leader Idi Amin, who ruled Uganda from 1971 to 1979, their work might develop like this:

Stage One. Collect the facts (Evidence)

Obviously researchers would have to find out as much as possible about Amin. They would have to read all the published material about Amin, would have to visit the government archives in Uganda to see records of government proceedings and in other countries that had dealings with him, obtain facsimiles of newspaper and other contemporary accounts of events, speak to people who knew Amin and worked with him, and so on and so on , finding out as much about him and his actions and attitudes as possible.

Stage Two. Interpret and evaluate the evidence

Of course with a subject like Amin, researchers could never read everything and would at some time have to say, enough, now I have an immense amount of information, which of this information is really reliable? Which tells me something about Amin that is important? Is there information here that is plainly biased? Is there information here that is clearly a true and accurate account of the events described? The historian has to make judgements about these things.

Stage Three. Select from the evidence what is relevant.

At this point the motive and perspective of the historian is important. Researchers will have some idea of the emphasis and perspective of the history. What is the purpose of the research and who will be the intended audience? If it is intended for the general reader is it possible that material may be selected because it will improve sales of the book? Whatever the motive, selection is inevitable. Writers have to decide on their perspective: was, for instance Amin a victim of the times he lived in or was he responsible for his actions?

Stage Four. Reconstruct the past as a narrative with causes and effect.

Having decided on the material to be used historians then put together an account of Amin's life, possibly starting with his childhood and early military career and presumably trying to define certain strands and developments which enable the reader to get a clear picture of his way of life, his attitudes and motivations, his political and social values, what caused him to be the person he was. Certain key events, presumably his career in the colonial army, his coming to power, his tyrannical rule, his speech at the United Nations and final overthrow, will be described.

Stage Five. Put into context

This last step will attempt to put Amin in some sort of historical and geographical context. The political, social and economic state not only of Uganda, but of eastern and central Africa at the time will be considered. Another important consideration will be the effect of Amin's rule. What is the legacy of his years in power?

History and the TOK diagram

In TOK students are expected to come to some understanding of what Ways of Knowing, selected from sense perception, reason, language and emotion, historians use to create history.

In Stage 1: collecting evidence, there is obviously considerable use of sense perception. Historians use their senses to study artefacts and documents. The difference between them and natural and human scientists, as we have already seen, is the nature of the material they perceive.

In Stage 2: interpreting and evaluating the evidence. Reason and language become important but so also does imagination. Historians have to use their imagination to recreate the purpose of artefacts, the motivation of the people creating them, the reliability and built-in bias of primary sources. Is this imaginative projection reason or emotion?

In Stage 3: historians select evidence relevant to their narrative. Reasons must be significant in this process but again emotion must be involved. Selection can be motivated by values and attitudes that are embedded into a society often without the society being aware they are.

In Stage 4: reconstructing the past as a narrative. Language is important, as Language is the medium with which the past is presented and the choice of words and the way the past is presented can influence that reconstruction.

The final Stage 5: the assumptions Historians are making about the society for which the history is written are as emotional as they are reasoned. Generalising about the use of the TOK Ways of Knowing is always a little difficult. As a TOK student you should be prepared to look at each 'bit' of history you encounter and bring your awareness of the way history is created to critically examine it.

Historians themselves are keen to debate the nature of their discipline and have suggested many reasons for the study of history.

Here, selected from the comments of historians, are some of them. It will help your understanding of the nature of the subject if you put these in some order of importance for (a) yourself (b) your grandparents (c) your history teacher and (d) the chief political leader of your country.

History makes people patriotic.

History is an intellectual pursuit in itself, an activity of the reasoning mind.

Societies need to know and understand their past. History helps us to understand the present.

History explains why things happen.

History teaches us about human behaviour.

The history of other countries makes us more tolerant.

History provides a pleasurable leisure time activity.

Finally, history embodied in a place.

The shrine at the site if the assassination of Mahatma Gandhi.

Chapter 5 The Human Sciences

The human sciences are the Areas of Knowledge that study human behaviour, human society and human relationships. The best known of these are:

- **anthropology** (the study of human societies and customs),
- **economics** (the study of the production and distribution of wealth),
- **political science** (the study of the state and systems of government),
- **sociology** (the study of the structure and functioning of human society)
- **psychology** (the study of the human mind and its behaviour in specific contexts).

In recent years many colleges and universities have developed degree courses, which use knowledge from the human sciences for specific purposes. For instance, business studies borrow from economics and psychology, and Education courses are composed of, among other things, knowledge from psychology and sociology..

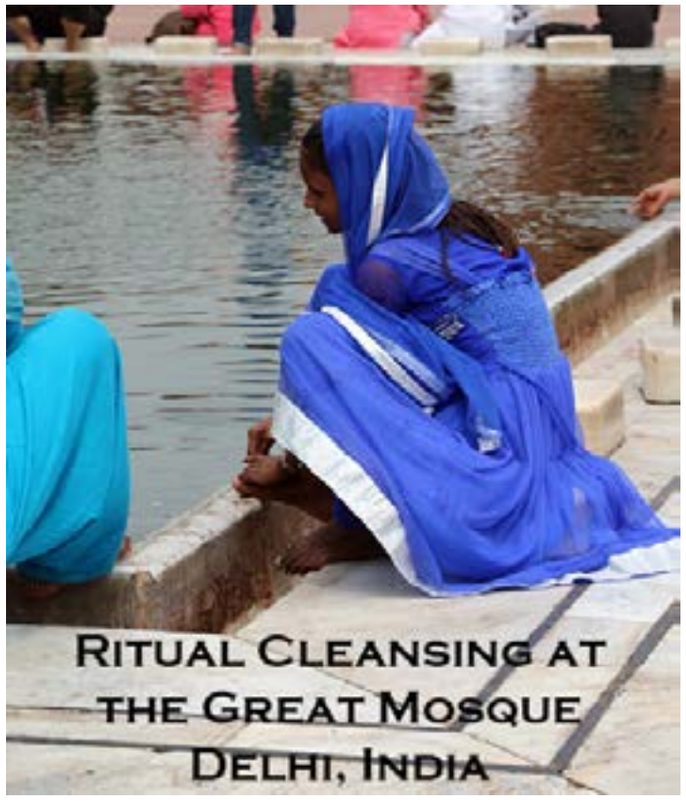
The human sciences are sometimes called the 'social sciences'.

The TOK curriculum planners use the word 'social' rather than 'human'.

Natural science, as you will see, is the study of the natural world or the 'phenomena of the physical universe' as philosophers call it. Human beings are certainly a 'phenomena of the physical universe' and human scientists, those scholars who work within the academic disciplines that study the behaviour of human beings, appear to use the same basic method of enquiry as the natural scientists. They observe a selection of 'the phenomena of the natural world'. They use inductive logic to generalise and they create theories that explain and predict. But, despite these apparent similarities of subject matter and method the knowledge generated by human scientists does not have quite the same status as knowledge generated by natural scientists. It is not that knowledge generated by human scientists is not valued, rather that it is valued in a different way. It is regarded rather more as a guideline to what is 'probably' the truth rather than the 'firm' truth of natural science.

Some human scientists resent this. They claim to apply the same standards of objectivity, precision, testability, and reliability as natural scientists; the knowledge they create deserves the same status as knowledge created in the natural sciences. They argue that life would be impossible if people didn't behave in a more or less predictable, measurable way. There are, for example, patterns of behaviour we all follow to obtain social and financial security. Studying human behaviour, they further claim, can help us understand these rules and enables us to generalise about human behaviour in the same way as natural scientists generalise from their observations about other features of the natural world. Of course, they agree, there are exceptions, but in general human behaviour is consistent enough to justify the human sciences as being as objective, precise and testable as any other scientific knowledge. Basically, their view is that human behaviour can be described by a set of rules or laws in much the same way as other aspects of the physical world are described by, for instance, the laws of physics. Human actions, they argue, are simply a division of the phenomena of the natural universe and the action of humans must be governed in the same way as other phenomena.

Despite these claims, human science is not quite as reliable, as precise, as objective, and as testable as natural science. Human beings are unique 'phenomena of the physical universe'. But human behaviour, for a whole variety of reasons, is inconsistent and difficult to measure accurately; it is imprecise and subjective. To further complicate matters human scientists are themselves humans; they are part of what they are observing. It is challenging for them to separate their own understanding and awareness of themselves as human beings from the subjects they study. Therefore the methods used to create knowledge in the human sciences are somewhat different from the methods used by natural scientists. To understand the human sciences as a TOK Area of Knowledge we should look at some of those methods.



Observing in the human sciences is not the same as observing in the natural sciences. Considering these problems of observation human scientists have to decide on the appropriate observation methods and data collection techniques using distinct ways of observing. Look at the diagram (page 36) showing what, for TOK purposes, I have called the 'Basic Human Science Method'.

As you can see Stages 1, 4, 5 and 6 are the same as the basic scientific method. Stages 2 and 3, focussing on observation, are different.

Five alternative observational techniques are defined: (i) surveys and questionnaires (ii) observations when subjects observed are unaware they are being observed (sometimes called 'in the wild') (iii) controlled experiments, (iv) face-to-face interviews and (v) analysis of existing data. These, of course, are not the only ways data is collected but give a sufficient variety to illustrate the observational problems of human scientists. Each technique has its own advantages and disadvantages.

Surveys and questionnaires

Well-designed surveys and questionnaires can, and do, produce accurate data. The two main problems seem to be reliability of the answer (do those completing the survey/questionnaire understand the questions?) and the selection and number of people who respond to the questionnaire.

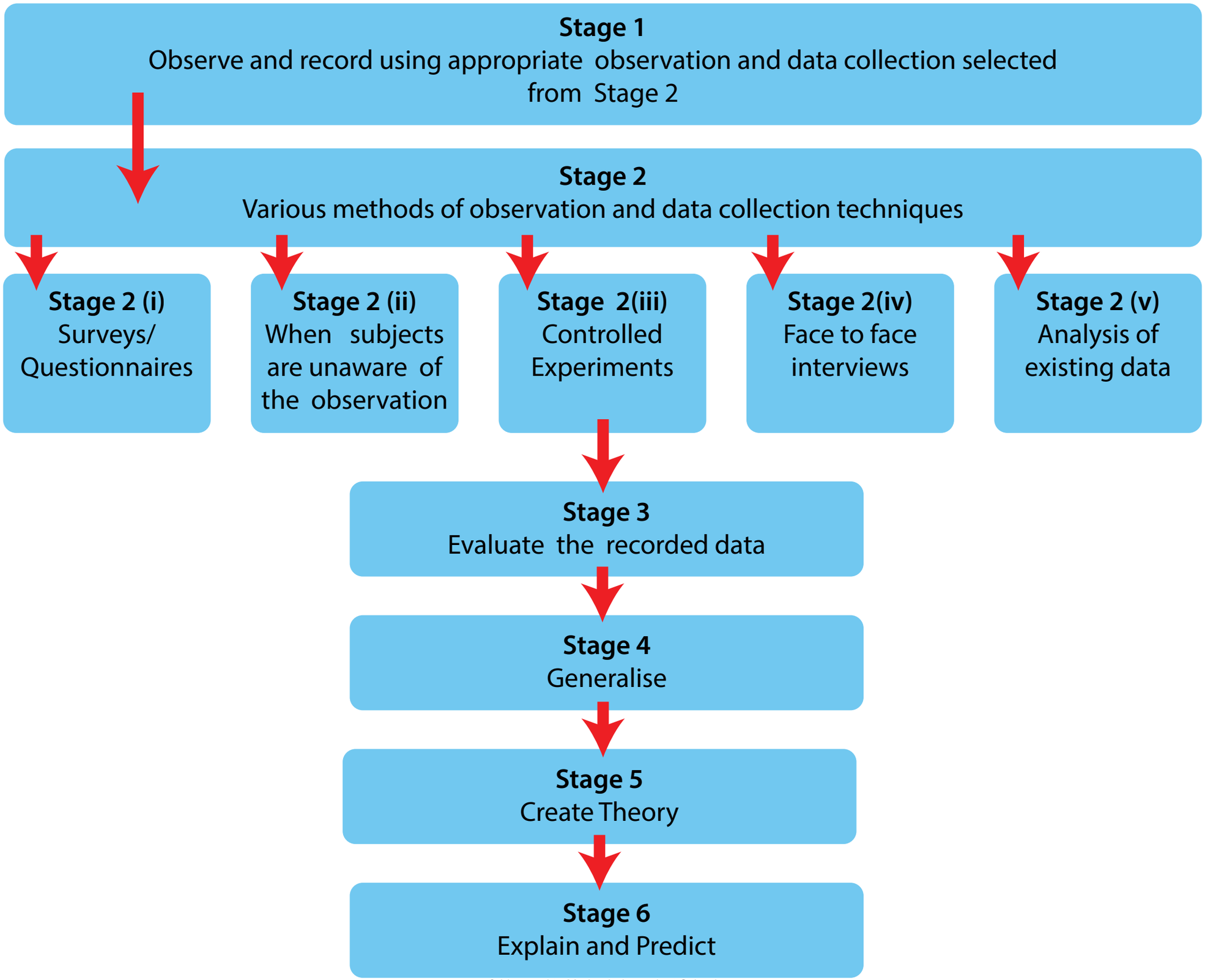
'Leading Questions' from the BBC Classic, Yes Minister: https://www.youtube.com/watch?v=G0ZZJXw4MTA

'In the wild' observation

This too can produce accurate data about people's physical behaviour. You can observe what people do but not why they do it. Economists observe (the patterns of the rise and fall of prices on the stock exchange). They theorise (when certain conditions are fulfilled prices will drop dramatically). They deduce (these certain conditions are likely to be fulfilled next May). They predict (next May there will be a stock exchange crash). The verification of their prediction (their repeat experiment) takes place in May, when the stock exchange crashes or doesn't crash.

Another set of -in the wild' observations might address the question: Why are some people attracted to dangerous jobs?

The 'Basic Human Science Method'



Controlled Experiments

Observation in the natural sciences often means experimenting. The replication of the experiment, confirming the knowledge generated by previous experiments, is the test that natural scientific knowledge has to pass. In the human sciences this kind of experiment is impossible. Controlled experiments with very small groups of people, experiments, which concentrate on all possible variables, are extremely difficult to run. Could research into attitudes to homework in any one class in your school or college be replicated? It might indicate attitudes for that particular group at that particular time, and these attitudes might reflect more general attitudes throughout the school or college or even schools and colleges generally. But replication in the rigorous sense of the natural science experiment is not possible. 'Laboratory experiments' in the human sciences are faced with too many uncontrollable variables. People change from day to day: they worry, their cars break down, their crops don't grow, they get excited, they get bored. People change over time: they get older, they get backaches, their children don't do their homework. And groups of people change and therefore cultures change. Compare your parents' and your grandparents' attitudes to sex, drugs and rock 'n' roll, and footwear. Human behaviour is too inconsistent to be part of controlled experiments.

Face-to-face interviews

Face-to-face interviews have obvious disadvantages. The researcher can adapt the questions to ensure they are understood. Non-verbal clues including body language can be observed and recorded.

Analysis of existing data.

Researchers examine data that has already been collected and is readily available: government or other surveys, censuses, tax returns, educational and health records, information in newspapers and journals. Human scientists can use these resources often obtaining data, which was not intended by the original research.

These five techniques present similar problems to the researcher.

Observing what can't be observed

Much of what human scientists concern themselves with cannot be 'seen', in the sense of being observable through the senses, with or without instruments to aid the seeing. You cannot see 'motivation' or 'leadership' or 'concentration'.

To understand these, and the many similar characteristics of human behaviour, human scientists have to rely on their own 'empathy and introspection', rather like the proverbial 'sixth sense'. Why didn't you attend class yesterday? Were you lazy? Ill? Bored? Otherwise engaged? Rebellious? Doing your own thing? Human scientists cannot be sure of your reason for being absent (they can ask you of course, but what would the answer be worth?) so they must consult their own repertoire of motives to understand your behaviour. But their 'repertoire of motives' may be misleading. They may pick the wrong one or not even have the correct one in their repertoire. Or the behaviour may be a blend of motives that are impossible to separate from each other. Human scientists can make some well informed attempts to define the reason you were not in class yesterday and their empathetic analysis will probably give them some accurate insights into your behaviour. But 'probably' is not 'definitely'. You can't see what can't be seen.

Being observed by the observed

If you knew human scientists researching into the effectiveness of homework were watching your behaviour, would you act entirely normally? You might sense what it is they hoped to know (even if you were wrong) and give them that information. Or, depending on a variety of factors, including possibly your character or mood, or how sympathetic you find the researchers, you might deliberately ensure they don't get the information you sense they are seeking. You might distort information to present yourself in a more flattering way. Or again, you may believe the researchers are going to provide the school administration with information which will lead to your homework load being increased, so you make sure your behaviour indicates that you already work six hours every evening and couldn't possible manage any more.

Observing what you want to observe

Both the natural sciences and the human sciences are human constructs. These humans who construct them have values, values that classify actions and achievements, goals and aspirations, as good or bad, just or unjust, worthy or worthless. Any personal values or biases that scientists, natural or human, bring to their research should be made explicit and compensated for. Physicists looking for an all-embracing Theory of Everything must be extremely careful that their desire to find such a theory doesn't interfere with their observations and deductions. Human scientists face the same kinds of problems as physicists. But, their researches are even more vulnerable to personal values because they, the human scientists, are themselves human and part of their own subject matter. Human scientists researching the effectiveness of homework have themselves experienced homework. Their own experience may lead them to believe that homework is fundamental to success later in life or that it is simply a device used to keep young people busy and to control them or train them to work hard or one of a thousand other things. They may make their values explicit and compensate for them, may even overcompensate, but it is impossible for them to ignore them completely.

Total, value-free objectivity is not possible in either natural or human science. But, in human science it is more difficult to achieve than in natural science. Seeing what you want to see distorts.

The Hawthorne Effect

Aware as they are of the possible problems, human scientists do, nevertheless, attempt laboratory type tests. A well-known example of such a test took place at the Western Electrical Company's factory in Hawthorne in California. The managers were concerned about efficiency, so they hired a team of human scientists to investigate the effects of changing working conditions on productivity and morale. A group of workers was installed in an assembly line in a room separated from the main assembly line. In this separate room variations in working conditions could be altered and carefully monitored. The researchers changed certain working conditions, for instance the level of lighting and the frequency of breaks, but changed only one variable at a time, in the best experimental tradition. The results at first seem self-evident: the better the lighting or the more breaks, the 'better' the working environment, the higher the morale and productivity. But then the researchers 'dis-improved' the environment: lower levels of lighting and fewer breaks, and still the productivity improved. Morale and productivity, it was concluded, increased because the workers were singled out for attention: a consequence now known generally as the Hawthorne Effect. The Hawthorne Experiment indicates a major difficulty with 'laboratory' experimenting in the human sciences: the problem of the observers being observed by the observed.

TOK Ways of Knowing

TOK's Ways of Knowing, sense perception, reason, emotion and language are all involved in the creation of knowledge in the human sciences. The complication for the Human Sciences is that the emotions of the researchers inevitably affect their reason when interpreting sense perception data. To what extent their reason is affected will depend on many factors. Language is used to both create and communicate findings. An obvious TOK knowledge issue, for instance, is: To what extent does the language of questionnaires and surveys and interviews affect the data produced by them?

The search for perfection

Human scientists are aware of the imperfections of human science as an Area of Knowledge. For this reason they constantly appraise the methods they use. They are particularly interested in distinguishing the human sciences from what is known as 'human lore', the kind of traditional common sense beliefs about a society and how it works, which members of a particular society hold. Human science, they claim, is different from human lore for three main reasons:

Human science is an 'explanatory enterprise of culturally universal validity'. The important word here is 'universal'. If the human sciences do give 'universal' explanations of human behaviour then it would be significantly different from human lore.

Human science is an 'explanatory enterprise that is interpretively neutral'. Human science is not subjective and human scientists are neutral when they report and interpret human behaviour.

Human science is an 'explanatory enterprise which is evaluatively independent.' Human science looks at human behaviour and explains it without judging.

TOK aims to get you thinking critically about such statements. The difference between human science and natural science is a basic TOK knowledge issue.

Example

There are some occupations that are particularly unforgiving of human error. Surgeons, Police, Pilots and many other workers can kill people if they make mistakes. Their training regimes obviously focus on technical competence.

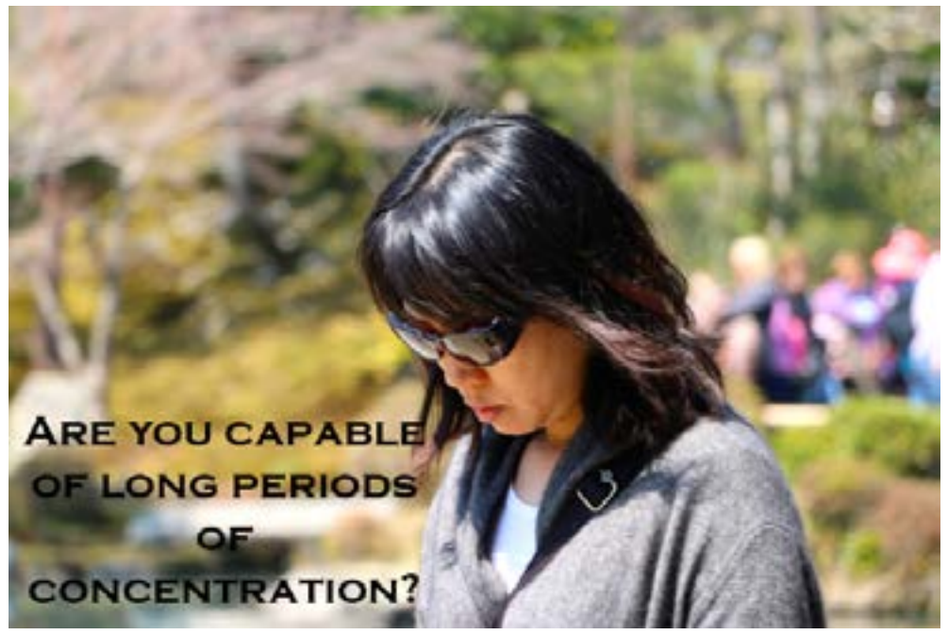
Surgeons must have a clear understanding of Anatomy and must be dextrous etc.

Pilots must be able to control an aeroplane and police must be fit and have a clear understanding of their powers.

However, 'Human Factors' play a major part in the training of such people. This acknowledges that everyone is subject to human failings such as fatigue, over-confidence, forgetfulness etc.

Weaknesses. Accepting that one has weaknesses can be a painful process. What are your weaknesses?

Fatigue. This is mainly managed by limiting the working hours of such people. Research into how much sleep people need after they have worked a long shift has improved safety in a number of areas. Have you ever experienced 'jet-lag'? Did you have any strategies for overcoming it?



Errors. When you make a mistake, what do you do?

A Try to hide your part in it and then attempt to blame somebody else.

B Admit the mistake, try to put it right and finally do your best not to repeat it.

Unless you answered B, you should not train to be a surgeon etc. Most people have to learn this!

The magazine *Flight Safety* offers a monthly prize for the best 'I made a mistake and am lucky to be alive' story contributed by a working pilot.

Status Gradients. Every human grouping has a tendency to develop 'seniority structures'. This applies to companies, sports clubs, schools etc. These arise because some people have more experience and skill at a job than others. The Head of Mathematics at your school has the job for a reason.

However, too much adherence to seniority can be a danger. If a nurse spots a mistake during an operation, s/he is encouraged to 'speak up' and the surgeon has to listen even though it is the surgeon that has the greater expertise.

Forgetfulness. Aviation has pioneered the use of printed lists to ensure that pre-flight and other procedures are fully completed. This ritual is followed even though the pilots concerned may have followed the procedure thousands of times. The practice has now been adopted in other areas such as hospitals with consequent reductions in error rates.

Chapter 6 Natural Sciences.

Natural Science as an area of knowledge became an obsession in the 20th century. Natural science, we have come to believe, is reliable, precise, objective, testable and self-correcting. It has, at its core, the unremitting vigilance of scientists examining evidence they collect about the nature of the natural world and ruthlessly applying logic to any analysis of that evidence. We assume the facts science gives us are true and justified. Science uses '**the scientific method**'. Other disciplines model their claims to know on 'the scientific method'.

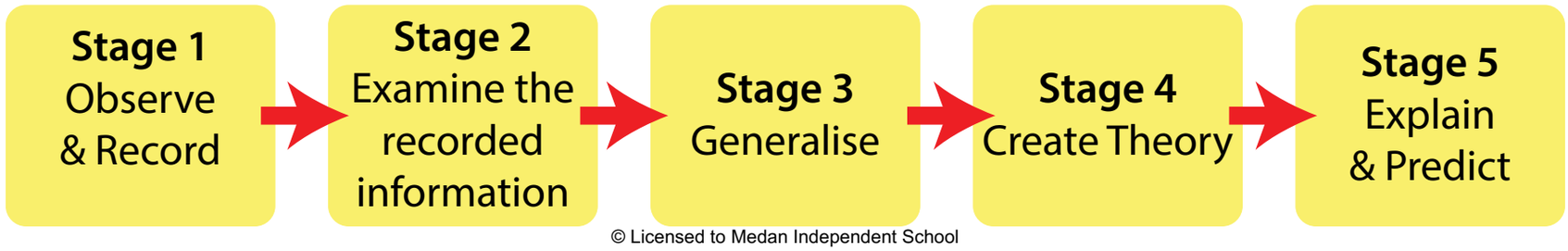
Much has been written by scientists, historians of science and philosophers about the nature of scientific knowledge. The 'scientific method', the process by which scientific knowledge is acquired, has been scrutinised so intensively that every attempt to define it has led to definitions, counterdefinitions, redefinitions and reservations.

There is, however, a generally accepted popular understanding of the scientific method. For convenience let us call this the Basic Scientific Method, although the formal name is **naive inductivism**.

Scientists tell us where the energy of the Sun comes from and why Sunsets are red. Poets and artists tell us about their beauty.

The Basic Scientific Method

Scientists observe the world through their senses and record the information their senses provide. They collect as much of this sensory information as they can, from as many observations as possible. Using this information they make generalisations about the things they have observed. These generalisations form the basis of a theory that explains why the information they have collected is as it is. The theory will also predict what is likely to happen in similar circumstances in the future.



Stage 1: Observe and Record

Using their sense perception, and instruments which heighten their sense perception, natural scientists observe the phenomena of the natural world (carefully avoiding unpredictable human behaviour) keeping careful records of their observations. These observations may be direct observations of natural events, or observations of planned experiments.

The Royal Observatory, Greenwich was one of the first buildings dedicated to scientific investigation. It marks the zero line of Longitude.

Stage 2: Examine the recorded information

They then critically examine the information they have received, checking for any contradictions or inconsistencies and making further observations if needed.

Stage 3: Generalise

When they are as certain as they can be that the information they have is accurate, they examine it looking for patterns, forms and consistencies that can lead to generalisations about the phenomena they are observing.

Stage 4: Create Theory

From these generalisations they create new scientific theories about the nature of the phenomena they have been observing. These theories are always provisional, only valid until they are proved invalid.

Stage 5: Explain and Predict

The final stage of the basic scientific method is using the new theory to predict what will happen in the future. Provided further observations of natural phenomena are compatible with the theory then the theory and predictions based on it continue to be accepted. When future observations are incompatible with the theory, it is rejected.

Here are two illustrations of the Basic Scientific Method in practice.

Example 1: Marine Tides

Stage 1: Observe and Record.

Marine scientists observed the rise and fall of marine tides around the world, recording the information. To make accurate measurements tide gauges at precise, fixed locations measured the water level over time. Records of both water level and time were (and are) kept.

Stage 2: Examine the information.

They examined and collated the information from the gauges checking the data was correct and looking for patterns and relationships within the data. They noticed that the times and sizes of the tides were connected in some way with the alignment of the sun and the moon and by the pattern of ocean currents and the shapes of the coastlines.

Stage 3: Generalise

Using the information they made generalisations about tides throughout the world.

Stage 4: Create Theory

Using these generalisations they created a theory that the gravitational effect of the sun and the moon control the tides. At its simplest the theory is that the moon orbits the earth in the same direction as the earth rotates on its axis, so it takes slightly more than a day, about fifty minutes more, for the moon to return to the same place in the sky and therefore the tides rise and fall in a pattern slightly more than twelve hours. The sun also exerts a gravitational pull, which affects the tides. When the earth, the moon and the sun are aligned or almost aligned the gravitational pull of the sun and the moon reinforce each other resulting in higher and lower than normal tides.

Stage 5: Explain and Predict

Look at the tide tables for any coastal town or harbour and you will see that the marine scientists can predict the time of high and low tides to the minute. As long as their predictions continue to be true, the theory that the gravitational pull of the sun and the moon controls the tides will be accepted.

Postscript.

Galileo Galilei (1564-1642) was right about a lot of things, but not about what causes the tides. He hypothesised that the tides were caused by the movement of seawater in the seas as the Earth's surface sped up and slowed down because of its rotation on its axis and its revolution around the Sun. There is no disgrace in Science in being wrong. The only crime is fabricating evidence to support a theory (even if that theory is right).

Example 2: The structure of DNA

Stage 1: Observe and Record

Before Watson and Crick made public their theory of the molecular structure of DNA, many other scientists searched for understanding of the molecule that carries genetic information from one generation to another in every species on Earth. In the middle of the 19th century, The Czech monk Mendel had experimented with peas and he was able to show that certain physical characteristics in the peas, for instance, shape and colour were inherited in what we now call genes. A few year later a Swiss doctor, Friedrich Miescher, isolated a compound from the nuclei of cells. He called this compound nucleic acid, what we now know as the NA in DNA. It wasn't until 1944 that an American scientist, Oswald Avery, proved genes were constructed with nucleic acid. Avery's work was well publicised among the scientific community and it became widely accepted that nucleic acid held the secret that controlled the hereditary material in humans and all other living organisms. Scientists also knew, through the work of Erwin Chargoff, that the nucleic acid molecule contains equal amounts of adenine and thymine (30%) and guanine and cytosine.(20%). In short, much observing and recording had been taking place over a long period of time.

Stage 2: Examine the information

So by 1951 there was a lot of information available about the possible structure of the 'life' molecule. Rosalind Franklin, a scientist at King's College in London was attempting to determine the shape of this nucleic acid molecule using an experimental approach with x-ray images. In Cambridge Watson and Crick tried to make sense of the information by making physical models.

Stage 3: Generalise

It was one of Franklyn's x-ray images that finally revealed the structure of the molecule to Watson and Crick. Studying it they noticed a fuzzy X at its centre, using both deductive and inductive reasoning they came to the conclusion the molecule must be in the shape of a double helix.

Stage 4: Create Theory

With this x-ray image and the information about adenine-guanine and cytosine thymine bonds, Crick and Watson constructed a model of the molecule as a double helix with the bonds of equal length making the rungs in a double helix. Once the model was constructed it became clear DNA could be the carrier of the genetic code. Because of the structure of the molecule, it is able to split into two pieces. A new molecule is formed from each piece and due to the specific adenine-guanine and cytosine-thymine pairings identical molecules are produced. They constructed their theory as compatible with the information available to them.

Stage 5: Explain and Predict

Although the scientists of the 1950s were not aware of it when they made their dramatic discoveries about the structure of DNA, it has powerful predictive qualities. The knowledge of how genetic material is stored and copied has given a new way to looking at biological processes. Amongst other things diseases that are caused by a lack of a particular protein can be treated by gene therapy.

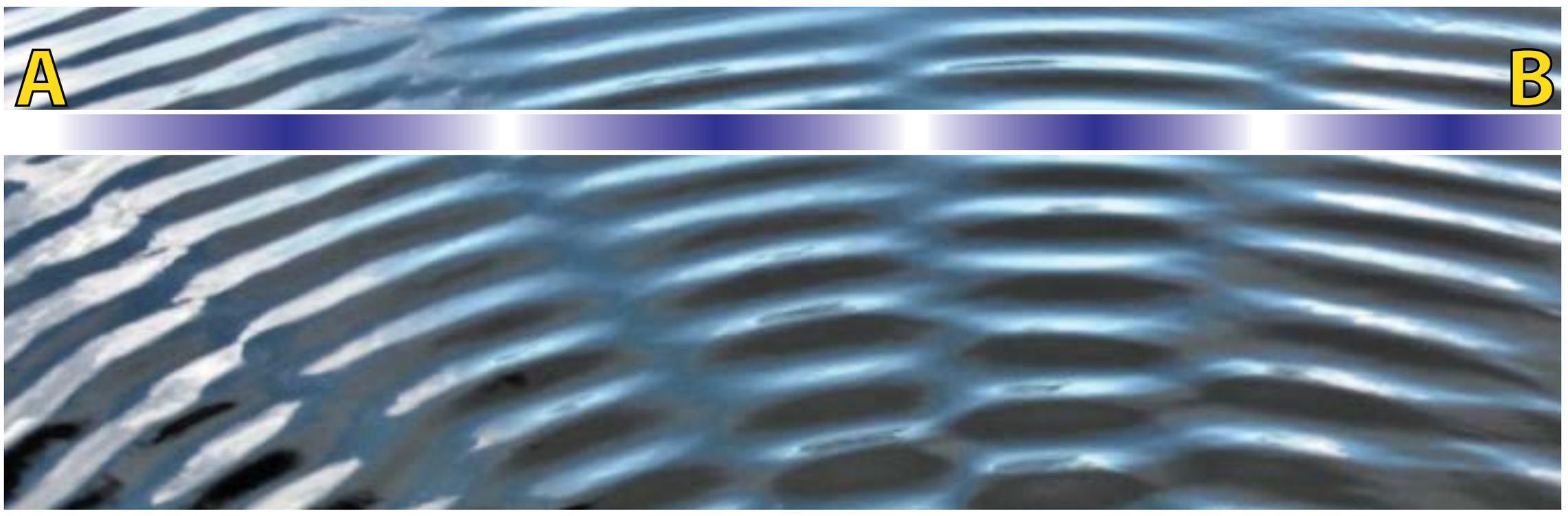
Before proceeding, it is worth taking a quick look at the evidence that was assembled before any structure for DNA could be postulated. Atoms are too small to be seen using visible light whose wavelength is too big. Instead, scientists have to use x-rays that have a wavelength comparable with the gaps between atoms in solid matter. Even then, we cannot 'see' the atoms. Instead we depend on a phenomenon known as interference.

The details are complex so we will use a simplified example.

When water waves pass through the gaps in a traditional multi-arch bridge, they are blocked by the pillars. However, the waves that pass through the gaps tend to spread out in semi-circular fronts. As there are several arches, there are several of these fronts. These run into each other and 'interfere' with one another.

In some places, the peaks coincided and the waves are big. In other places, the peaks coincide with the troughs and the water is calm. Under ideal conditions, even though the waves are in motion the pattern is static.

Our example is a laboratory set up, but it illustrates the point.



If we were able to photograph the heights of the waves along a line AB we would get a pattern of 'fuzzy dots' as shown.

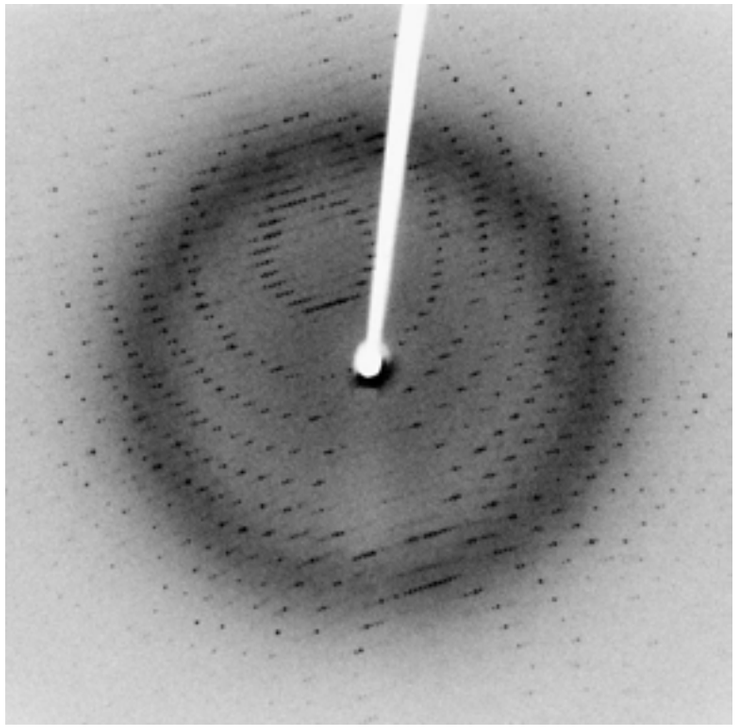
With some quit complex mathematics, it would be possible to infer the placing of the pillars and the gaps between them.

When shining x-rays through a complex molecule, the pattern is a two dimensional array of dots.

An example (By Jeff Dahl Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=3020011) is shown.

From this, it is possible to infer the structure of the molecule.

This was done in the days before computers - a remarkable achievement.



Ways of Knowing in the Natural Sciences.

The TOK diagram gives us a restricted choice.

As TOK students we must ask ourselves how scientists use the four Ways of Knowing, reason, language, sense perception and emotion when they create new knowledge and, of course, we must then question the reliability of these Ways of Knowing within the context of natural science.

Stage 1: Observe and Record

The first stage is observation, beginning with sense perception. Stage one begins with sense perception. The first stage is observation. Scientists begin to construct new knowledge using their senses, by observations of the physical phenomena of the world. To be valid, scientific observations must be accurate and unbiased. We know already how easy it is for our senses to be deceived, making our observations inaccurate and misleading. Our senses cannot be trusted. Of course scientists are aware of this problem and take great care with their observations.

Stage one also involves language as a way of knowing Observations have to be described in language. There has to be what is called an 'observation statement'. This statement will be scrutinised and used by other scientists. But even the simplest observation statement, because it uses language, can be subject to a variety of interpretations. For instance, here is an observational statement

about tides, in simple everyday language: The highest tide was recorded at 14.42. Much is assumed in this statement. It is assumed there is such a thing as a tide, an immense concept in itself. It is also assumed it is possible to have a highest tide, which implies a lowest and a mean and the concept of height. Is the concept of height really appropriate in describing the movement of water? Isn't there an implication that the sea level is constantly changing? The precision of the observational statement is as precise as the language used and the ideas that are embedded in that language. However neutral the initial observation is, the language of the observation statement inevitably influences that neutrality.

Stage 2: Examine the recorded information

The Way of Knowing at stage two changes to reason. Scientists look at the information they have and search for patterns and explanations of the phenomena. They use their reasoning power to look for logical explanations of the patterns they observe. But to do this they need to use imagination and sometimes intuition, both of which could be regarded as using emotion as a Way of Knowing. They almost certainly use language to organise their thinking and their findings and to discuss them with their colleagues.

Stage 3: Generalise

Generalising uses reason in the form of inductive logic. You already know the problem with inductive logic, the unreliability of generalisations. Science is looking for certainty. Inductive logic does not give certainty. It can give good reasons for supporting a conclusion but it can never guarantee it. Deductively one might argue:

- The scientific method demands certainty
- Inductive logic can never be certain
- Therefore the scientific method cannot use inductive logic.
- This creates what is known, rather grandly, as the Problem of Induction.

We earlier attempted to use inductive logic to test the generalisation using three tests, the Sufficient Number Test, the Varying Circumstances Test and the Exceptions Test. If the generalisation passes these three tests we can suggest probability rather than certainty.

Generalising of course involves language with, inevitably, the possibility of bewitchment.

Stages 4: Creating a Theory.

The creation of a theory should be pure deductive reason. Deductive logic, you will recall, guarantees that if the premises of an argument are sound then the argument must be valid. The problem of course is that the 'facts', the premises, have been created by inductive reason. Theories and the thought processes that create them are of course using language.

Stage 5: Explaining and Predicting

Again the Ways of Knowing here are deductive reason and language. Reason is used to claim that if the theory is valid now it should be valid in the future. Language is used to explain the claim and to communicate it.

So, from a TOK diagram perspective, the natural sciences start with a firm sense perception foundation and are carried along with inductive and deductive reason, with language used to create ideas and explain them. Where does this leave emotion?

Scientists are human. They don't just observe whatever is there to be observed they choose what they observe. They 'choose' for as many reasons as there are scientists. They choose for financial reasons (what industry will pay for); for social reasons, (what societies see as important); for political reasons, (what governments want) for practical reasons (what equipment is available); for personal reasons (to advance their career) and so on. Science is also influenced by trends: at the moment it is fashionable to concern oneself with the problems of 'global warming'. The observations scientists make are inevitably influenced by the reason they are observing. Emotion is used here to motivate the scientists, not to create new knowledge.

Despite the problems with sense perception, inductive logic and language, natural science works. It delivers. Predictions about the tides have been proved to be right so far. Laws of nature may not be certain but they probably are. The more observations we make, the more information we have confirming what we know, then the more likely it is to be true. So, the tide may not rise and fall tomorrow but it probably, very probably, will.

Alternatives to the Basic Scientific

Method: Falsification and Scientific Revolution.

Some scientists and philosophers argue strongly The Basic Scientific Method is not really the basis of scientific knowledge. Two well known alternatives you may have heard of are Karl Popper's **Principle of Falsification** and Thomas Kuhn's **Theory of Scientific Revolution**.

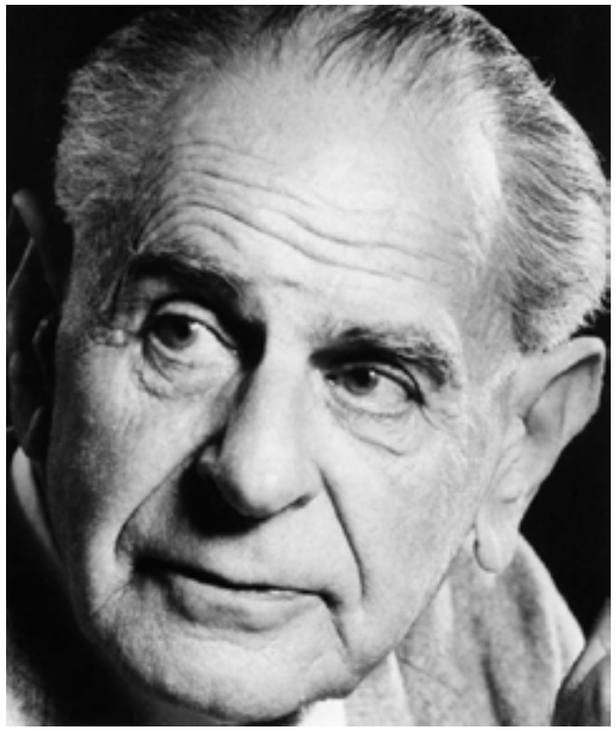
Principle of Falsification

From the diagram on page 53 you can see that the Principle of Falsification depends as much on observation as the Basic Scientific Method. The difference, amongst other things, is that this method does not begin with observation. The observation, the empirical experiment, is undertaken after the theory has been stated and with the sole view of falsifying. Popper's method is as dependent on observation, and therefore, as subject to the problems of sense perception, as the Basic Scientific Method. What it is not subject to is the Problem of Induction. No generalisations, and therefore no inductive logic, are used. Popper's Theory has three obvious advantages over the Basic Scientific Method: certainty, scientific relevance and growth.

KARL POPPER'S PRINCIPLE OF FALSIFICATION

1. Certainty

Falsification has one clear advantage over the Basic Scientific Method. If one single false example shows the hypothesis to be unacceptable, it is unsatisfactory, it cannot be 'scientific'. Therefore a certainty is achieved: the certainty is that there is no certainty. With the Basic Scientific Method no matter how many observations are made which support a hypothesis, there can never be certainty. The next, as yet unmade observation, may disprove the theory.



Sir Karl Raimund Popper (1902 – 1994)

2. Scientific Relevance

Falsification has another advantage. It can be used to distinguish scientific valid hypotheses from non-scientific hypotheses. A hypothesis that cannot be falsified cannot be scientific.

Earthquakes under the Pacific Ocean always occur in June is an easy hypothesis to test by empirical experimentation, by observation, and to falsify or not, so it has scientific potential. That there will, or will not, be earthquakes under the Pacific Ocean in June is not a scientific hypothesis because it cannot be falsified. You cannot test the theory that there will, or will not be, an earthquake under the Pacific in June. The statement is true by definition.

3. Scientific Growth

Falsification encourages the growth of scientific knowledge. Science progresses when hypotheses are falsified and new, and better, theories replace them. Science progresses in this trial and error way. If you cannot, theoretically, falsify a hypothesis then it will not lead to new knowledge.

Does Popper's Principle of Falsification reflect accurately how science has progressed in the last two thousand years? Two major developments in the history of science would suggest the answer to this question might be 'No'.

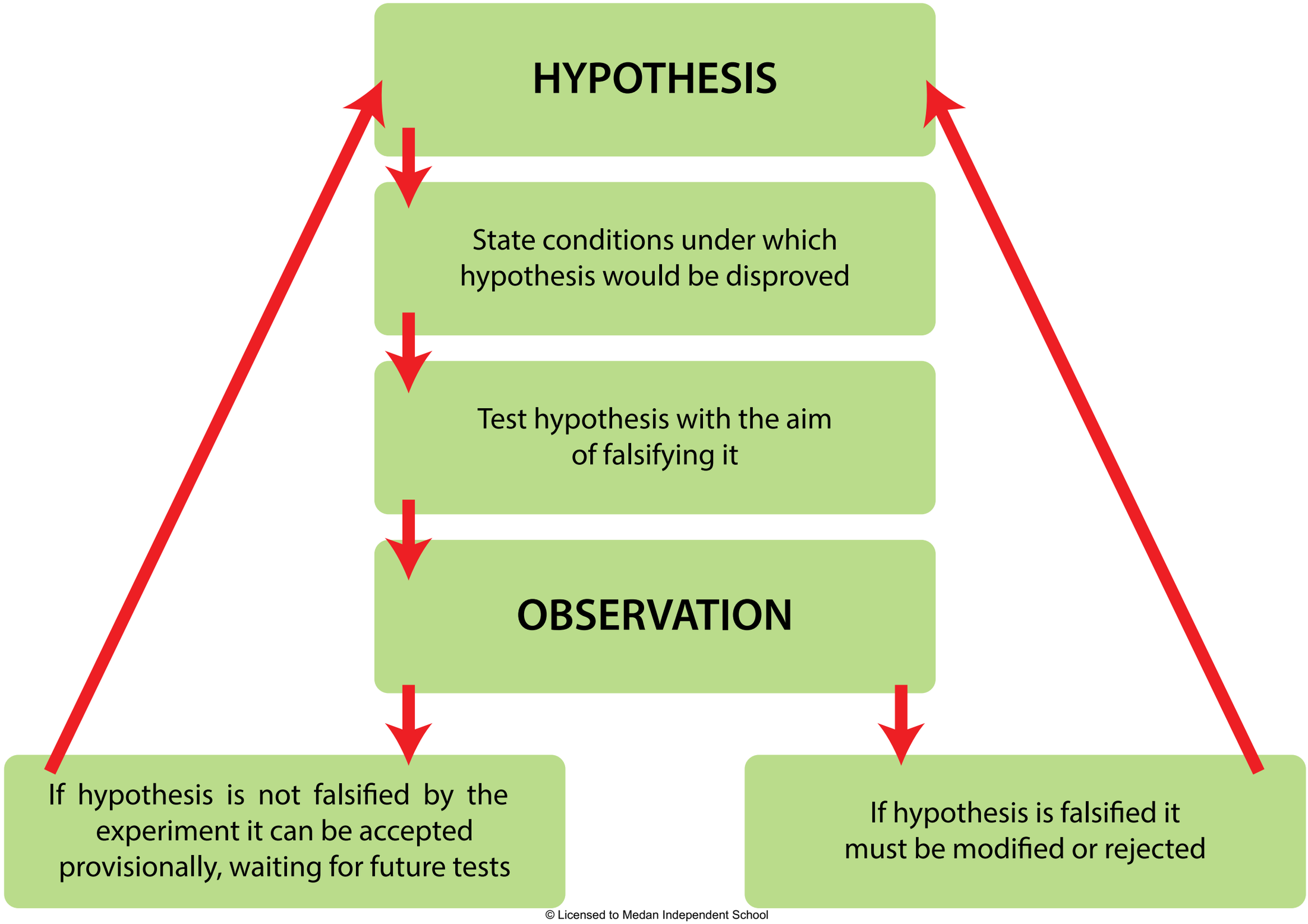
For about 1500 years the Ptolemaic view of the universe put the earth at its centre. In the late 15th century Copernicus after observing the sun and the planets conceived the idea that the earth and the other planets in our solar system, moved round the sun. Despite the considerable evidence he presented to his fellow scientists falsifying the Ptolemaic view, it was several centuries before his ideas were accepted. Sir Isaac Newton's laws of gravity and motion were accepted and applied for over two centuries.

They had, in part, been falsified soon after they were published, by observations of the moon's orbit. Only in the 20th century did Albert Einstein, through falsification of parts of them, show they had to be revised or modified.

Many cultures have been fascinated by the heavens.

The principle point of the great observatory at Jaipur, India was, however, astrology.

Karl Popper's Principle of Falsification



> The empirical basis of objective science has thus nothing 'absolute' about it. Science does not rest upon rock bottom. The bold structure of its theories rises, as it were, above a swamp. It is like a building erected on piles...driven down from far above into the swamp, but not to any natural or given base; and when we cease our attempt to drive our piles into a deeper layer, it is not because we have reached firm ground. We simply stop when we are satisfied that they are firm enough to carry the structure, or at least for the time being.
>
> Karl Popper

Scientific Revolution

A physicist turned scientific historian, Thomas Kuhn, argues that neither the Basic Scientific Method nor Falsification reflects what happens in reality. Kuhn argues that science progresses through 'revolutions'. A scientific revolution, like any other revolution, is a movement in which one system is replaced, dramatically, by another system. Reduced to its simplest level Kuhn's argument is this:

Within a restricted scientific community, say taxonomy within biology, the acceptance of what Kuhn calls a paradigm emerges. All the scientists working within this taxonomic community work within a collection of assumptions, laws and theories which they accept as rigorous and normal. Taxonomists agree on certain principles for the classification of, say, insects. As they go about their work, classifying insects, they relate their observations of insects to the paradigm that is the normal science of their particular scientific community. They adjust and modify their paradigm if falsifications become apparent but consistently stay within it. Eventually there comes a point when new observations are no longer compatible with the existing paradigm. It may be that progress in another branch of biology, say knowledge of the DNA of genes, gives them information about insects that is incompatible with the existing paradigm. Revolution. The old paradigm goes and is replaced by a new one. This new paradigm, which is based on the new assumptions, laws and theories arising from knowledge of DNA, attracts more and more taxonomists and becomes the paradigm, their new normal science. This paradigm becomes accepted until it too is overthrown.

Chapter 7 The Arts

The arts comprise a huge range of human creative activity. They include painting, sculpture, ceramics, architecture, music, dance, film, and all the many genres of literature. For TOK purposes it is helpful to restrict our discussion to the conventional school subjects of literature, art and music. In your A1 language literature classes you read novels and discuss the ideas embedded in them. In your art classes you create your own art and look at paintings and sculptures by famous artists, and discuss their intent and impact. In music you make music and listen to music from all parts of the world .

Both science and art organise reality. The 'reality' of science is the natural world organised rationally through our sense perception. The 'reality' of art is the reality of our experience as emotional humans organised in such a way that we can communicate it to others. The knowledge of art is knowledge acquired by our ability to understand our fellow humans' emotions, our ability to empathise. Empathy is to the artist what sense perception is to the scientist.

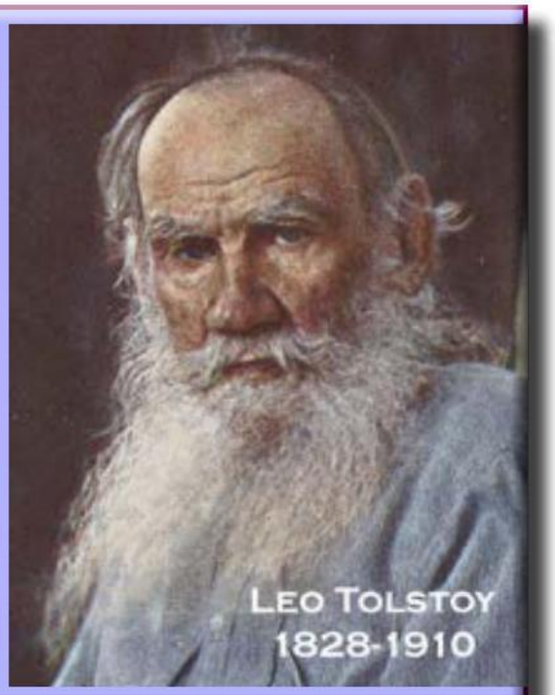
The 19th century Russian Writer Leo Tolstoy, a serious artist himself, defined art's way of knowing in a way appropriate for TOK:

> To evoke in oneself a feeling one has experienced, and having evoked it in oneself, then, by means of movements, lines, colours, sound or forms, expressed in words, so to transmit that feeling that others may experience the same feeling—that is the activity of art. Art is a human activity, consisting in this, that one man consciously, by means of certain external signs, hands on to others feelings he has lived through, and that other people are infected by these feelings, and also experience them.

Tolstoy has not focussed on how the artist obtains the experience that has created the feeling he evokes. In TOK diagram terms that experience begins with sense perception, the same sense perception that creates knowledge in the natural and human sciences. Artists observe the world about them; they see, hear, touch, taste and smell the world they live in. They observe the way people behave and they respond to that behaviour sometimes with emotion, sometimes with reason, often with a mixture of both and they create Tolstoy's 'feeling that one has experienced'. The thing that artists do (that scientists do not do) is to bring

their own response, their own emotional instincts and values, to the creation of that 'feeling'. The knowledge issue is to determine the origin and value, the 'truth', of those emotional instincts and values.

Count Leo Tolstoy 1828-1910: Russian landowner and writer whose works include *War and Peace* (considered by many to be the greatest novel ever written), *Anna Karenina* and *Death of Ivan Ulich*. He spent the last years of his life in voluntary poverty, living as a peasant, having given his estate to his family and disposed of all his possessions. In 1901 the Russian Orthodox Church excommunicated him because of his hostility to their practices. His description of art, just quoted, is taken from his work *What is Art?* - published in 1898.



To reduce art as a way-of-knowing to a diagram is inviting scorn from philosophers, but for those of you who are uncertain what Tolstoy is saying, here it is:

Stage 1
Observe the world and the human behaviour in and on it

→

Stage 2
Respond to and interpret that world, create a 'feeling' about it

→

Stage 3
Evoke a feeling one has experienced

→

Stage 4
Recreate that feeling (using external signs)

→

Stage 5
Transmit that feeling so others are able to share that experience

Stage 1 Observe the world and human behaviour in and on it.

Artists are free to observe anything. They can look at the sea, at tsunamis, at mountains, at desserts, at animals, birds and their fellow humans. They can even leave their physical world and observe the universe

Stage 2 Respond to and interpret that world, create a feeling about it.

The artists' personal responses and interpretations can be totally unrestricted. They can use their emotions and their reason and their self awareness to explain their responses to the detail of an insect's wing case, the need a child has for parental love, the obsessive greed of some members of society, the problems that lead people to war or murder, the pains and pleasure of love, of frustration, of ambition and of corruption. This feeling can arise from artists' exceptional imagination and intellect, their ability to understand and interpret the world and the people who live in it in a personal and often profound way.

Stage 3 Evoke a feeling one has experienced

'Evoke' here means to recall and to bring it to the centre of your thoughts, your consciousness, to make it the focal point of your interest and to feel it with clarity and intensity.

Stage 4 Recreate that feeling

What distinguishes great artists is not only the quality, the 'truth' of their feelings, but also their ability to manipulate what Tolstoy calls 'external signs' to transmit that truth. Great artists are great because their ability to recreate understanding with their chosen signs, be these signs in paint, marble, words, music or movement, is outstanding.

Stage 5 Transmit that feeling so others are able to share that experience

The experience of the artist becomes an experience for the artist's audience, reader, viewer and listener when the audience share the feeling created. The artist has evoked something to share. For this reason one can argue that art is not a matter of personal response. If your response

to a work of art is not the feeling that the artist evoked (Stage 3) then the artist has failed. You may not like the feeling evoked that the artist has recreated in you, a feeling readers, viewers or listeners may respond to in different ways.

What the artist knows…

From *The Meaning of Art* Herbert Read 1972

The artist pours his knowledge into works of art. He knows—he does not merely feel—but he knows by sympathetic identification and imaginative insight. He knows as the perspicacious lover knows about the nature of love, by 'proving it upon his pulses' He knows by feeling at one with the object, as Keats felt at one with the sparrow. He knows the reality that he suffers when the outer object is drawn into his own being, into the mysterious depths of subjectivity. He knows not bare facts or abstract laws but vivid values —he knows things appreciatively, in their immediacy and concreteness. He knows with the totality of his body: with sense, mood, instinct, and intelligence, both conscious and subconscious. He knows by descending to the roots of being, which no idea can encompass—to the obscure spring of man's creative intuition—the source of dreams and of art alike. There, in the deep recesses of his mind, he is in touch with the instinctively common part of man's nature—with the values that are not peculiar to him as an artist, not to one man or a few, but are basic in the emotional experiences and secret longings of most human beings. If it were not so, art could not serve as the language of all humanity—a way of communicating across all the barriers of place and time. The cave paintings by men of the reindeer age — the paintings at Lascaux and Altamira — would not speak so eloquently to us today; nor would the art of the whole world be a 'museum without walls' where any man can find incomparable treasures. The work of all ages and countries — Gothic counterpoint, Egyptian sculpture, Chinese landscape, Mayan temple, Russian ballet, English drama, and American novel — bear alike the spiritual imprint of humanity. In the realm of art, far more than in morals, politics, or religion, the whole world is kin.

Area of Knowledge or area of experience?

Because the arts, as an Area of Knowledge, depend on creativity and individual insights, it has been suggested that it is an area of experience rather than an area of knowledge. Within Tolstoy's definition a case can be made that knowledge — his 'feeling' — is generated and transmitted. Whether you call the arts an Area of Knowledge or an Area of Experience depends on your understanding of what you mean by 'knowledge' and what it is 'to know'.

The knowledge within the arts, based on the evocation of feelings, is not the justified true belief of Plato. Plato was hostile to art. For him it was a rival to the pursuit of truth and had the potential to corrupt. It is not difficult to have sympathy for the pragmatic Plato. The 'truth' of the arts cannot be put into words. It is difficult to explain adequately the 'feelings' people experience when reading a novel, listening to music or looking at art

Art as an area of knowledge: Literature

'Literature' is one of those bewitching words that can mean many things. In the context of the arts as an area of knowledge it means poetry, drama, novels and short stories, works of art created with language by individual poets, playwrights and novelists. The kind of material you study in Language A1. Here is an example of literature, a short poem by a distinguished Nigerian writer.

Refugee Mother and Child

No Madonna and Child could touch
that picture of a mother's tenderness
for a son she soon would have to forget.

The air was heavy with odours
of diarrhoea of unwashed children
with washed out ribs and dried-up
bottoms struggling in laboured
steps behind blown empty bellies.
Most mothers there had long ceased
to care but not this one; she held
a ghost smile between her teeth
and in her eyes the ghost of a mother's

pride as she combed the rust-coloured
hair left on his skull and then
singing in her began carefully
to part it…In another life this
would have been a little daily
act of no consequence before his
breakfast and school; now she
did it like putting flowers
on a tiny grave.

Chinua Achebe

Achebe has done exactly what Tolstoy claims artists do. He has observed an incident in a refugee camp (Stage 1) and the feeling he experienced there (Stage 2), evoked the incident he saw directly and his compassionate response indirectly (Stage 3), has re-created that incident and his feeling with external signs (Stage 4) in this case words, transmitted that feeling to others and recreated it so that others share the experience (Stage 5).

Perhaps you are thinking, that's fine for this short emotional poem but how can a novel, *Huckleberry Finn* for example, possibly recall a 'feeling' that Mark Twain had experienced? The answer to that question is simple. Huckleberry Finn recalls not one feeling but a multitude of feelings that Mark Twain had about, amongst other things, the pains and pleasures of childhood, hypocrisy and pretence, and the values of the people who lived on and along the Mississippi River in the mid nineteenth century. His 'external symbols'— the extended prose narrative, the choice of Huck, a 14 year old, as narrator, the selection of events—determine the effectiveness of the recreation and transmission of Mark Twain's feelings. That *Huckleberry Finn* has been read and enjoyed for over a century, and continues to be widely read in the 21st century is proof of the quality of the 'medium' of the novel as well as its 'message.'

A problem some people find in reading literature is the problem of accepting the message that is transmitted. If you are not able to accept the 'truth' of literature then it has failed as literature. Mark Twain doesn't openly list the pains and pleasures of childhood, his feeling, his truth, comes from the convincing way in which he presents Huck and his values, displaying the truth rather than explaining it. If Huck is not convincing then the reader will not accept the truth on which his portrayal is based.

This 'convincingness' leads to another problem some people have with literature: how can you be convinced by something you know doesn't exist? Huck is a character in a book. He is an imaginary person, a product of Mark Twain's imagination, they argue. You can only be convinced by him if you are prepared to be imaginative too. Literature demands the reader uses imagination. Imaginative involvement in literature can take us into a whole range of awareness that is not otherwise easily accessible or might even be dangerous. We can suffer with Huck in his relationship with his father. We can savour the grandeur and power of the river. We can comprehend the bitterness and the folly of family feuds. Our imaginative involvement is caused by the skill of the writer in creating, through external signs, the situation in which we willingly suspend our disbelief.

HUCKLEBERRY FINN.

Imagination is the power of the mind to create images of things, which are not present, and to relate to images of things that are not real. Imagination could be described as creative thought. When we are creatively thinking — imagining — when we are drifting down the Mississippi with Huck, we are not deluding ourselves. We know our imaginary experience is not real. When we read literature our imagination is brought into action by the feelings and external symbols of the writer creating images in our minds. We 'see' the waves ripple on the surface of the water and we 'see' the paddle boat, belching smoke, steaming up the centre of the river. When writers present us with events or people that we cannot accept, that our imaginations can't process, either our imagination, or the writer, has failed.

Art as an area of knowledge : The Visual Arts

The great palaces of the world—The Imperial Palaces of the Forbidden City in Beijing, the Topkapi Palace in Istanbul, the Palace of Versailles in France, are famous examples of the visual arts; clearly illustrating Tolstoy's definition of art as a Way of Knowing. All three create a definite feeling about the power and status of the dynastic families that commissioned and owned them, and the feelings the architects had when they designed them. By the use of external symbols — stone, glass, wood, space, trees — the architects of these palaces transmit the 'truth' of the wealth and opulence and power of the great ruling families. In the same way 'the glory of God' is transmitted through the architecture of the great mosques, temples and cathedrals throughout the world.

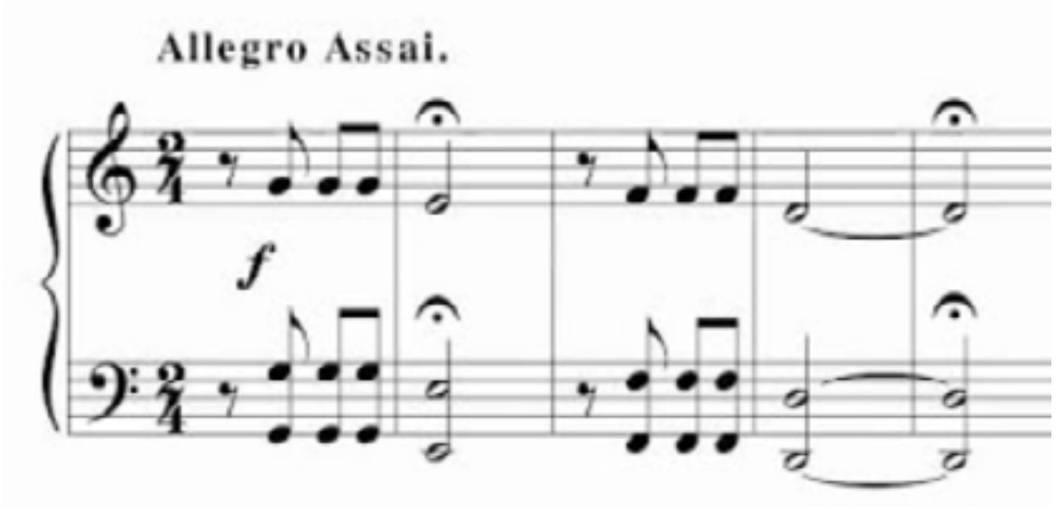
The architects of the palaces have created, through their art, their feeling of power and glory. If their art is successful they have communicated that feeling. We do not have to agree with their feeling to appreciate the 'truth' of their art. We can admire the 'external symbols' easily, the design and shape of the buildings, the craftsmanship by which art is constructed. But we also visit the Imperial Palace to sense the glory and power of the Chinese Emperors, however much we may regard them as despotic tyrants.

This ability to communicate feeling applies to the other visual arts, even though these may lack the grandeur of great architecture. A Persian miniature can convey the excitement of a hunt, and a French impressionist the delight of a garden, as a cathedral displays the glory of God. Abstract art, which developed in the 1940s and 1950s, is as much art in Tolstoy's definition as the more conventional art of the cathedral architects and the French impressionists. By eliminating recognisable figures and objects, artists are free to express their feelings with abstract lines, colours and shapes.

Wasily Kandinsky (1866-1944), a pioneer abstract painter produced in his paintings 'the choir of colours which nature has so painfully thrust into my soul'. Painting was for him 'an exact replica of an inner emotion'.

Art as an area of knowledge : Music

Music is the simplest of the arts to relate to our interpretation of Tolstoy's construction of an Area of Knowledge. Anyone who has attended an American major league baseball game knows what knowledge is transmitted through music. Just before the game begins, the guest singer walks to the diamond, the spectators rise and with hands on their hearts join together to sing *The Star Spangled Banner*. Everyone in the stadium is, for that moment, part of a confident, united nation: 'the land of the free and the home of the brave'. Patriotism, pride in one's country, fills the ballpark. You can feel the stars and stripes rising above the stadium, spreading the message of freedom and confidence.



A famous opening.

Do you recognise it?

The Star Spangled Banner makes its statement with clarity: its external symbols, the musical sounds, evoke the composer's feeling of patriotism and recreate that feeling within those baseball fans. The musical message in this case is far from subtle but it is certainly powerful in a style that no language can be.

Beethoven was convinced of the power of music as an area of knowledge. 'Music', he said, 'is a higher revelation than all wisdom and philosophy.' He claimed it was 'an entrance into the higher world of knowledge which comprehends mankind but which mankind cannot comprehend.' He stated also it was 'the mediator between the intellectual and the sensuous life'.

Music expresses mood and atmosphere— serenity, exuberance, anticipation, triumph, sadness, fury and much else—in a way language cannot. Movie makers claim that music is responsible for 80% of the emotional impact of their work. More important than these definable moods and atmospheres is the power of music to express feelings which can only be expressed, and transmitted, through music itself.

Feelings for which there are no words. Great music is alive: it creates indefinable feelings that change as you become increasingly familiar with it and feelings of which you never tire.

Not all music, not all art, is great and timeless. Popular music, as it is called, the music of the charts, is hypnotic, entertaining and temporary. Alan Bloom, a distinguished American political philosopher has this to say about rock music in particular:

...(there) are the three great lyrical themes (of rock music): sex, hate and a smarmy, hypocritical version of brotherly love... A glance at the videos that project images on the wall of Plato's cave since MTV took it over suffices to prove this. Nothing noble, sublime, profound, delicate, tasteful or even decent can find a place in such a tableaux. There is room only for the intense, changing, crude and immediate...

If it does nothing else this tirade confirms the power of music.

The Arts and the TOK diagram

In TOK diagram terms Achebe's knowledge starts with his sense perception, what he observed in the refugee camp. His sense perception is filtered through emotion, his compassion for the mother and child and to some extent reason, his comparison with alternatives, and is dependent on language both to construct and transmit the 'knowledge'.

The visual arts have one advantage over literature, an advantage they share with music: they are free from the bewitchment of language. The knowledge generated by the visual arts is wordless. The medieval architects' feeling for the glory of God expressed and transmitted through great cathedrals transcends any attempt to put this feeling into words. Words, as symbols, we already know, create a barrier to our knowing. Visual art, in a metaphorical sense, creates its own language. The external symbols used by artists, the paint, the canvas, the marble, the bricks and mortar, become the language, and on the skill of the artist in manipulating this language depends, partially, the success of the art. 'Partially' is important here. If the knowledge is not worth transmitting no amount of artistic skill in the manipulation of the external symbols will make it so.

Opera combines poetry, music, drama and design (sets, clothes and lighting).

Dr. Samuel Johnson described it as "an exotic and irrational entertainment".

It is usually staged in buildings dedicated to the Art such as the Sydney Opera House (right), one of the most recognisable buildings in the World.

Chapter 8 Mathematics

The Greek mathematician Euclid is famous for his great work, *Elements of Geometry*, which he wrote about 300BC. Elements of Geometry begins with a systematic explanation of the plane (two dimensional) geometry still taught in schools today. Euclid's method of creating this mathematical knowledge is a clear example of how mathematical knowledge is created and formalised.

He started his explanations by assuming a small set of concepts, called axioms. These axioms are at the heart of mathematics and so it is important to understand where they come from. Euclid assumed them. That is he accepted them as being true, without proof, for the purpose of argument.

At the start of his section on plane geometry he listed the five assumed axioms on which his geometry was based.

Here they are:

Euclid's Axioms (Sometimes called Euclid's Postulates)

- Two points determine a line segment.
- A line segment can be extended indefinitely along a line.
- A circle can be drawn with a centre and a radius.
- All right angles are congruent.
- If two lines are cut by another line (called a transversal) and the interior angles on the same side of the transversal have a total measure of less than 180° then the lines will intersect on that side of the transversal.

These assumed axioms underpin all his plane geometry. Euclid assumed these axioms with his intellectual insight, sometimes called 'intuitive knowledge'. It is knowledge, which is accepted, assumed as obvious, self-evident. What mathematicians have been doing ever since is use reason, reason completely independent of sense perception, to create sets of rules defined with

language. Once these rules are defined and accepted all further mathematical ideas and theorems, are constructed from them using deductive reasoning.

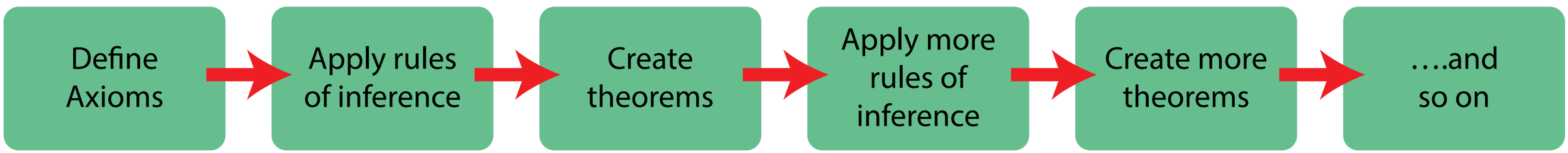
Most mathematicians are not directly concerned with axioms. They know axioms are the rock bottom foundations of mathematics but find it difficult to define them. They assume them as 'given' and work with theorems developed from them. They would probably claim that, if necessary or desirable, they could define the particular axioms on which their work is based, but they seldom have reason to do this.

There are, of course, different sets of axioms for different parts of mathematics. In 1908 Ernst Zermelo and Abraham Fraenkel defined a set of axioms known as are the Seven Axioms of Set Theory . The truth of these Zermelo-Fraenkel axioms, it has been argued, 'is established by intuitions, which lie too deep for proof since all proof depends on them'.

A well publicised set of axioms is known as the *Peano Postulates*, named after the 19th century Italian Giuseppe Peano (1858-1932). These axioms define the 'fundamental laws' from which the number system is developed. Peano assumes there are such things as 'numbers' and then defines them in a set of five axioms.

Axioms are the foundations of mathematics. Using what they call 'rules of inferences', mathematicians apply deductive reason to these axioms and create more mathematical knowledge, called theorems. That is the 'mathematical method'. There are no alternative 'mathematical methods'.

Here is a diagrammatic representation of this 'mathematical method':



Bewitched by Words and Axioms.

The discovery that all mathematics follows inevitably from a small collection of fundamental laws is one which immeasurably enhanced the intellectual beauty of the whole; to those who have been oppressed by the fragmentary and incomplete nature of most chains of deduction this discovery comes with all the overwhelming force of revelation; like a palace emerging from the autumn mist as the traveller ascends an Italian hillside, the stately storeys of the mathematical edifice appear in due order and proportion, with a new perfection in every part.

Bertrand Russell (1872-1970), philosopher and mathematician

Axioms, rules of inference and theorems Axioms

Axiomatic knowledge is what philosophers call *a priori* knowledge. *A priori* knowledge is constructed by reasons rather than observation. Most mathematicians claim their axioms are 'self-evident', but this seems simply to be their way of claiming them to be *a priori*. If they are self-evident the very evidence for this must be *a priori* rationalism. Plato was one of the first philosophers to suggest mathematical axioms, and the numbers they use, were *a priori*, although he did not use that term. He saw numbers as belonging to a 'separate and eternal realm' to which humans had a privileged access because of their ability to rationalise.

Rules of Inference

Inference is the forming of conclusions from the information available. Rules of inference therefore, are those rules which mathematicians apply deductively to the mathematical information available to them: axioms. The rules of inference themselves, like axioms, are *a priori*. Rules of inference generate theorems from axioms, and to these new theorems the rules of inference can also be applied.

If ... then

A well known rule of inference, one we are all familiar with in some form or other, is the if ... then rule. Here is a simple example of the if ... then rule in action.

Arithmetically, if $1+6=7$ and $5+4=9$

then $(1+6)+(5+4)=7+9$

or

Algebraically, (algebra is simply arithmetic with variables instead of numbers)

if $x = y$ and $p = q$

then $x + p = y + q$

In bewitching language: equals added to equals are equals. To continue in language rather than numbers or variables, what rules of inference do is **imply**. That $x = y$ and $p = q$ implies that $x + p = y + q$.

Applying rules of inference deductively to axioms creates new mathematical statements. Each new statement must be consistent with the original axioms, and, use only the original axioms and the new statements generated by the application of the rules of inference. The rules of inference control the process of creating mathematical knowledge in the form of theorems.

Theorems

A theorem is a statement created by deductively applying the rules of inference to axioms. The theorem is presented at the end of the deduction, following the representation of the application of the laws of inference. A theorem is a statement of mathematical knowledge. The process of arriving at it, which has just been described, is the mathematical Way of Knowing.

We all know Pythagoras' Theorem:

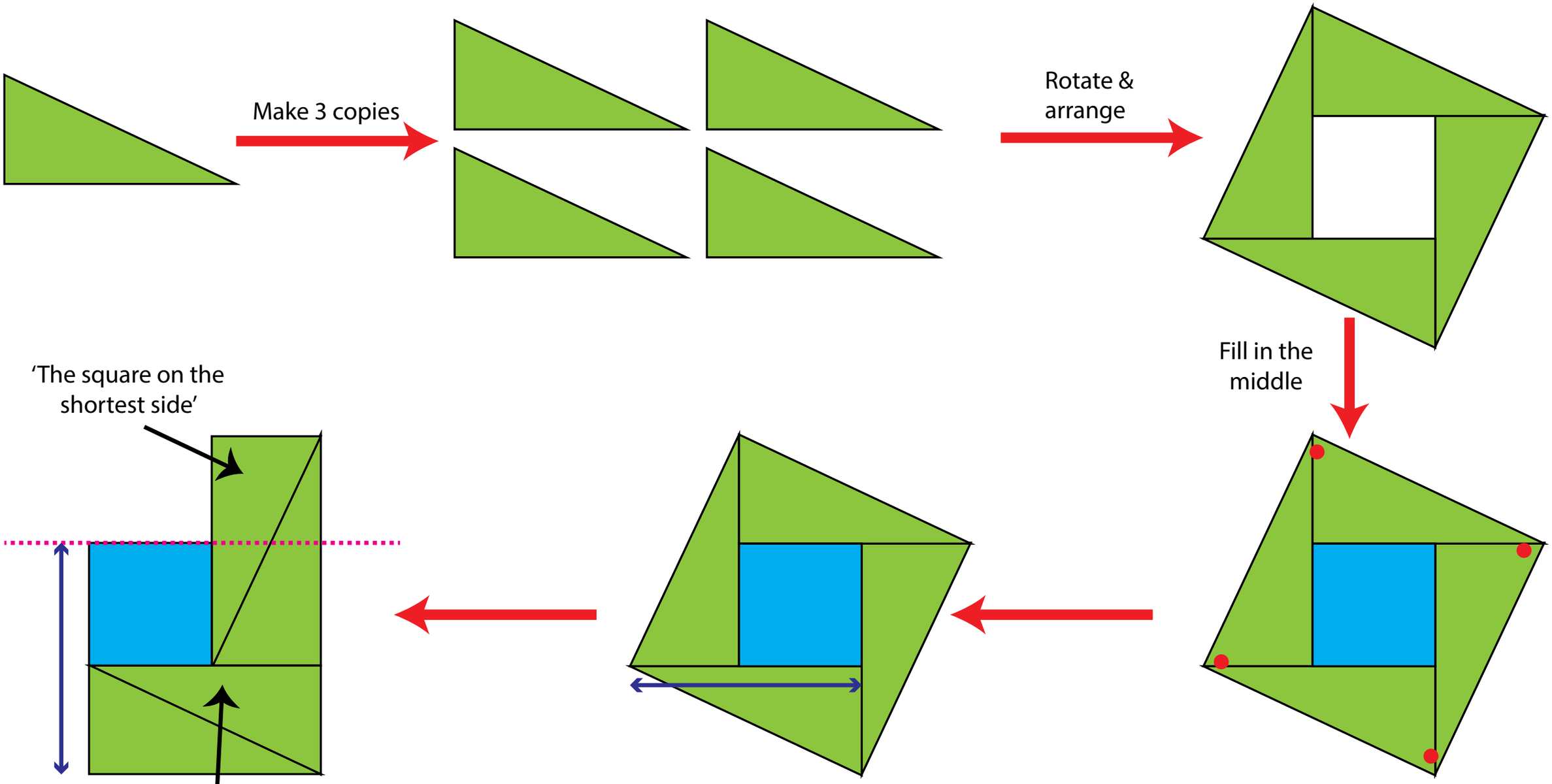
'The sum of the squares on the arms of a right triangle equals the square on the hypotenuse.'

This theorem is derived from the 5 Axioms defined in Euclid's Elements. But mathematicians, and budding mathematicians in schools, do not think of Euclid's axioms every time, or even anytime they use it.

They take the deductive logic, the application of the rules of inference that arrived at the theorem, as a given. They know they could justify their use of the theorem, but it is not necessary for them to do so.

One of the key features of Mathematics is the concept of **proof**.

The Pythagorean School of Mathematics almost certainly proved the Theorem using tiles that they rearranged. The outline follows. There are a few details for you to fill in.



TOK Ways of Knowing and mathematics

One of the reasons why mathematics is so highly esteemed as an Area of Knowledge is because it is objective. Science, we have seen, is a human construct which strives to be objective, but scientists are aware of the problems of objectivity created by observation and experience-based induction. Mathematics, as an area of knowledge, is free from both observation and induction. The only subjective influence in mathematics would seem to be the mathematician's personal choice of the process of applying the rules of inference: which rules are to be applied, in what order and for what end. As an area of knowledge it demands precise and rigorous reasoned intellectual understanding. Despite the fact that most adults do not need more than elementary arithmetical skills in their daily lives, a considerable part of our education is devoted to mathematical knowledge.

It should be clear to you now that mathematics depends on deductive reasoning. Rules of inference are deductive reason. Applying these rules is free from emotion and when language could become a problem mathematicians use their own precise symbols. The big knowledge problems with mathematics are the nature of axioms and where these axioms originate. If, as it has been claimed, axioms are 'established by intuitions which lie too deep for proof ' should we just accept them? Is that *a priori* intuitive knowledge really created by reason?

Mathematics and Sense perception

The mathematical Way of Knowing explored in this chapter is the Way of Knowing of pure mathematics. No reference has been made to the natural world and it might seem that mathematics has no connection whatsoever with anything other than itself. Applied mathematics, as distinct from pure mathematics, is the use of mathematics in the natural world. Applied mathematics enables humans to construct models of the universe or the trajectory of satellites or the nature of radio waves. This is not mathematics as an area of knowledge as it has been described in this book, rather the use of an area of knowledge to further knowledge in other areas, whether it be physics, economics or even stage design. Perhaps the value of mathematics lies in its ability to be the handmaiden of other Areas of Knowledge.

The Language of Mathematics

Many people, mathematicians included, talk about the language of mathematics. We have already defined language as being uniquely human, as communicating and using symbols. Within that definition mathematics is certainly a language. What mathematics communicates in the form of axioms, rules of inference and theorems is restricted, but communicate it certainly does, clearly and precisely,

The symbols of the language of mathematics are as precise as the concepts embedded in them.

= equals = (or more mathematically = = =).

The symbol '=' was invented by Robert Recorde (c. 1512 – 1558), a Welsh physician and mathematician.

$3 = 3$. $3 = 2 + 1$. $\sqrt{2} = 2 \div \sqrt{2}$ (think about this one).

There is no bewitchment here. Mathematical symbols communicate specific statements that have precise meanings.

A language like this, with carefully defined symbols and rules for using those symbols, is called a formal language. Mathematics is a formal language. There is no danger of bewitchment in a formal language. What it communicates it communicates precisely, completely and unambiguously.

The language of mathematics is itself a bewitching phrase. It could mean the formal language of symbols used by mathematicians to communicate precisely with each other. It could be a metaphor for that precision. It could even be a metaphor for the relationships within mathematics. It could mean the specialised use of everyday words within a mathematical context. The formal language of mathematics is a tool perfected by mathematicians to communicate exactly and precisely what they want to communicate. When natural language is used to communicate mathematical ideas the precision of mathematics begins to fade.

Postscript

One of the most unusual figures in the History of Mathematics is Srinivasa Ramanujan 1887 – 1920.

Born in India and largely self-taught, Ramanujan was invited to work at Cambridge University, a singular honour. He was elected a Fellow of the Royal Society shortly before his early death at 32.

He is remembered as an intuitive mathematician who 'saw' rather than deduced theorems. His life was dramatised in the film *The Man who Knew Infinity* starring Dev Patel and Jeremy Irons. The film relates the story that, having ridden in a taxi with the licence number 1729 his visitor remarked that it is a dull number. 'Not at all' countered Ramanujan, 'it is the smallest number expressible in two different ways as the sum of two cubes'. $1^3 + 12^3 = 9^3 + 10^3$. 1729 is now a 'taxicab' number in Mathematics.

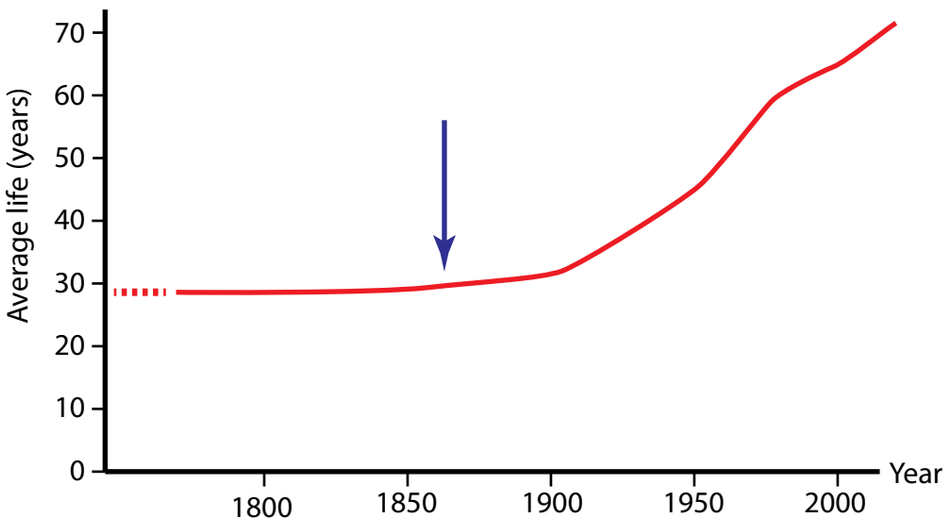
Chapter 9 Technology (option)

Technology means the application of knowledge to practical problems. Most commonly, this means scientific knowledge. We would, for example, regard the amplifiers and speakers used at a rock concert as technology, but not the music.

Technology has been in use for a very long time. The earliest tools were made using a technique known a 'flint knapping'. This involves splitting a hard rock (such as flint) with a softer rock hammer. The hard rock is split along fault lines (like the grain in wood). A skilled 'knapper' can produce a very sharp knife without any need to grind the edge. In common with much technology, the artefact preceded the scientific theory behind it - crystallography.

The next development, metal smelting, happened by accident as ore bearing rocks were heated in camp fires, producing small beads of copper, tin etc. that could be worked into bronze. This was achieved before any research into Chemistry led to an understanding of the principles involved and the development of the very specialised metal alloys that we use today.

A historical perspective on human development will show that it is comparatively recently that technology has had a significant impact on our lives. The graph illustrates that life expectancy (World Average) had remained static and below 30 years for almost the whole of human history. Something happened in the mid - 1800s.



The turbine blades used in jet engines are at the apex of scientific metallurgy

Transport

As we have said, it is clear that there was a 'game changing' event in the mid -1800s. Before then, life for the common people had essentially stayed the same for the whole of history. For example, when it got dark, you had nothing else to do but go to bed. Candles were too expensive for most people to be able to afford them.

The event that kicked off the 'Industrial Revolution' was the invention of the steam engine. Up until then, if you wanted anything moved, you relied on human and animal muscle power (plus a bit of wind). After that, machines started to take the load, freeing people up for other tasks.

Early steam engines, invented in the late 1600s, were very large and static. They worked with low pressure steam that filled a cylinder. Cold water was then injected, creating a vacuum. Atmospheric pressure produced the power stroke. Mainly they were used to pump water out of coal mines.

The real milestone was the development of high pressure boilers so that the power was generated when steam was injected into a cylinder. These made it possible for the engine to develop enough power to move itself and a payload.

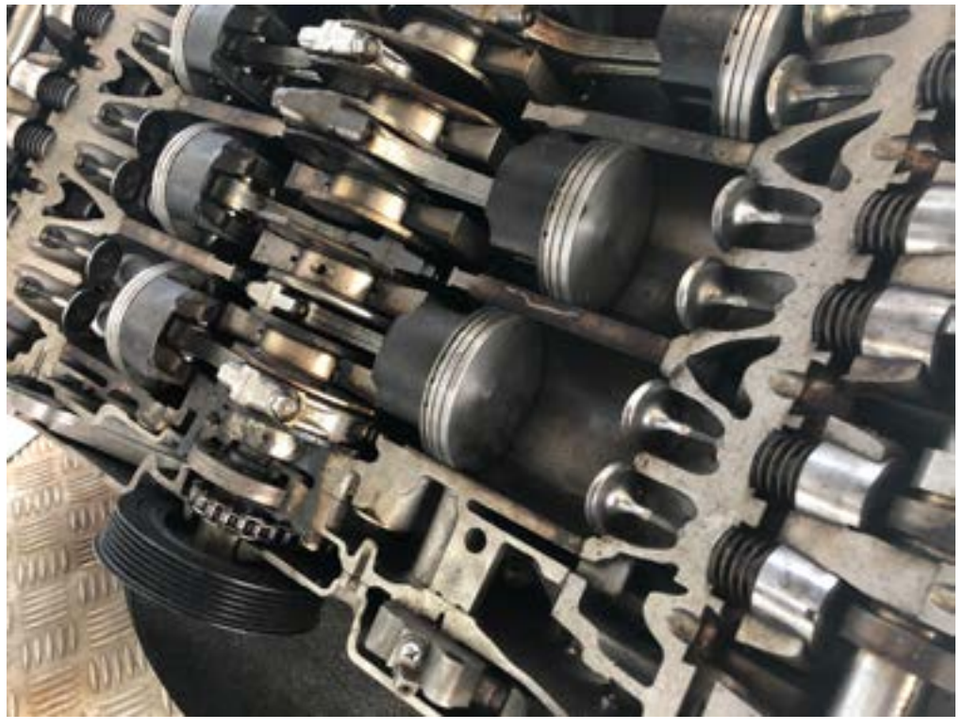
Pictured is the iconic 'Stevenson's Rocket'. This locomotive won the 1929 'Rainhill Trials' and set in motion the explosive development of steam powered railways across the World.

The only remnant of the muscle powered World is the term 'Horsepower'.

The scientific underpinning of steam engines (Thermodynamics) followed the technology and then improved engine efficiency.

Sadi Carnot (French: 1796 – 1832) is one of the most important figures in the development of Thermodynamics. His invention of the *Carnot Cycle* explained why early steam engines wasted so much of the energy put into them in the form of the combustion of coal.

The engines most familiar to us in the modern World are powered by diesel and petrol. These are direct evolutions of the steam engine with the high pressure being developed inside the cylinder by a controlled explosion rather than in a boiler. Car manufacturers have invested a lot of money into research to improve their engines. The fuel efficiency of passenger cars, vans etc. improved by about 50% in the period 1950 to 2010.



Finally, on the subject of transport, the development of powered flight occurred at a truly amazing pace - from the first flight in 1906 to Neil Armstrong's first footprint on the Moon (1969) was less than a lifetime.

Many people had succeeded in getting off the ground before the Wright Brothers achieved what has gone down in history as he first powered flight. Observations of birds and the long history of kites had made it clear what successful flying machines would look like. The Wright Brothers were very competent (bicycle) mechanics and were also avid students of the unsuccessful designs of their predecessors (many of whom were also predeceasors!). They realised that it is controlling the machine that is vital. Their 'Wright Flyer' is preserved in the Smithsonian Museum in Washington, DC (USA). The machine has the first engine that is light enough and powerful enough to sustain flight. More importantly, it has an elevator to control 'pitch', a rudder to control 'yaw' and flexible wings to control 'roll'. The only fundamental control surface used on modern aircraft not present on the 'Flyer' are ailerons to control 'roll'.

The science of Aeronautics followed the technology, but now leads it.

Materials Technology

Most of the materials we use to make things had to be 'invented' in some sense of that word. Even the blocks of stone used to build Stonehenge had to be quarried and transported.

Concrete is an interesting example of a synthetic building material. It was invented by the Ancient Romans. The *Pantheon* in Rome (built 128 AD) is still the largest unreinforced concrete dome in the World. The recipe for making concrete was lost with the fall of the Roman Empire. Building in the Middle ages reverted to wood, brick and stone. Not every change is progress!

After its re-invention, concrete was improved by pouring it around a skeleton of steel. Reinforced concrete was the first material capable of sustaining the stresses produced in building skyscrapers. There are no brick skyscrapers as brick is not strong enough.

Modern materials technology has made very large improvements in construction materials. Here are some examples:

Lamination: placing materials with different properties in layers that are glued together.

Plywood has layers of wood with the grain at right angles in adjacent layers. Plywood resists splitting.

Laminated glass often has two outer scratch resistant layers glued to a plastic inner layer that retains shattering.

Body armour has hard layers alternating with more plastic layers that absorb the energy of bullets.

Alloys: mixtures of metals that have properties specific to their use:

Bronze a mixture of copper and tin and much harder than either. The first 'wonder material'.

Steel is a mixture of iron and carbon (and some other metals). It is much stronger than iron.

Duralumin is an alloy of aluminium (which is quite soft) and mainly copper and is used in aeroplanes and ships.

Plastics: a range of artificial chemicals called polymers. They can be customised for specific applications.

Nylon, one of the first artificial fibres.

Polythene, often appearing as flexible sheets such as shopping bags.

Thermoplastics that go soft when heated and which can be moulded into practically anything.

Increasingly useful in the modern world are 'composites' which are intimate mixtures of various materials. Reinforced concrete is a composite which uses the strength in tension of steel and the strength in compression of concrete. The composite is stronger than either of its components. A typical composite is a mixture of carbon fibre, which is strong in tension, and thermoplastic. The result is stronger than steel and a fraction of the weight. The Boeing Dreamliner makes extensive use of composites (about 50% by weight) and has been reported as achieving as much as a 20% fuel saving over its less sophisticated predecessors.

As an example of the improvements in construction materials, we look at the three bridges over the Firth of Forth, Scotland.

Picture	Year Constructed	Main Materials	Construction accidents	Cost (in today's money)	Length	Design
	1882 - 1889 7 years	Steel	73 fatalities	£ 416 million	2,500 m	Cantilever
	1958 - 1964 6 years	Steel and concrete	7 fatalities	£ 235 million	2,500 m	Suspension
	2011 - 2017 6 years	Steel and concrete	1 fatality	£ 1,350 million	2,700 m	Cable-stayed

The most obvious improvements are that worker safety has improved dramatically and that the amount of construction materials used has decreased (they are stronger). The increased cost of the most recent bridge is in part due to the fact that it has been designed to last 130 years without major renovations. Both the earlier bridges have required expensive strengthening work.

Health

We began this section by looking at the large and recent improvements in human life expectancy. Where have these come from?

The technological improvements in construction and transport have certainly made a contribution, but mostly it has come from improved Health Care. This is a very complex issue and depends on almost every area of Knowledge you will consider in TOK.

Illness and injury are a part of the human condition and efforts to mitigate them are as old as history. Some just relied on kindness but others were drastic and better than nothing. Sawing off an injured limb (with no anaesthetic) and then cauterising the stump with fire was common and effective.

As far as illness was concerned, people had no idea what caused it or how to cure it. There were a number of 'Schools of Thought' including:

Priests who (relying on Faith) believed that illness was a punishment for sin.

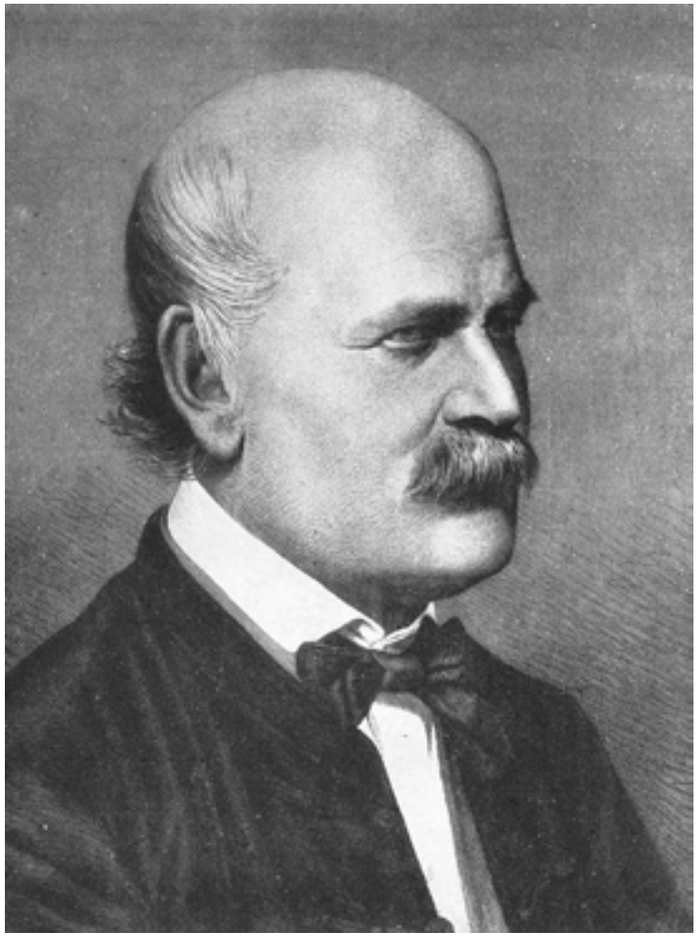
Herbalists (often women) who relied on long term (Indigenous) knowledge to prepare 'potions' some of which worked.

Physicians who relied mainly on observation and classification of disease - an early version of the Scientific Method.

All of these groups performed valuable service in mitigating the sufferings of the sick. It was the Religious Orders that were, for example, the most active in founding hospitals.

However, by the time the Bubonic Plague arrived in Europe in around 1340, people had no idea what caused it or how to save the lives of people infected with it. The village of Eyam in Derbyshire was, like most villages of its time, centred on its Parish Church (pictured) when the plague arrived in 1665. Under the leadership of the parish priest, The Reverend William Mompesson, the villagers arranged a series of measures that they hoped would minimise the impact of the disease. Obviously they were aware that the disease could be passed from person to person (actually by flea bite) as they decided to isolate the village from other surrounding communities. They also decided that families should bury their own dead. The church kept detailed records of the 273 victims of the disease from the approximately 800 inhabitants. These records are an early example of the importance of record keeping in expanding knowledge. This early 'lockdown' did prevent the spread of plague to the surrounding communities.

Other examples of 'Community Knowledge' also played their part in unmasking the causes of disease.



In the 1800s, Vienna was one of the principal cities of Europe and, along with Budapest, a capital of the Austro-Hungarian Empire. Vienna had one of the foremost hospitals in the World, the Vienna General Hospital. In 1846, a Hungarian doctor called Ignaz Philipp Semmelweis joined the staff.

The hospital had a high reputation and many pregnant women were opting to have their babies in the maternity wards of the hospital, one of which was run principally by the nursing staff. However, the hospital was starting to lose new mothers to a disease called Childbed Fever. The mothers would have a safe delivery but would soon develop a severe fever and die. This became 'known' in the city, so much so that mothers-to-be started to refuse to go to the hospital, some even preferring to have their babies in the street. Semmelweis started to apply deductive reasoning and quickly discovered that this 'common knowledge' was not just rumour. Worse still, the ward run by the nurses was safer than the ward frequented by the doctors. It must have been very difficult to draw this to the attention of his fellow doctors - particularly as Semmelweis was in some sense a foreigner. However, he, bravely, persisted and set about finding the explanation using data collection and deductive reasoning. Soon he noticed that, before visiting the maternity ward, many doctors had been performing autopsies. The did not wash between the two activities.

As a first step, Semmelweis started to insist that doctors wash their hands before examining the mothers. The results showed immediately in the statistics. When a solution of chloride of lime was used for the washing, Childbed Fever all but disappeared. Without knowing why it worked, Semmelweis had made a major contribution to that upslope on the graph with which we started this chapter. And now you know who to thank for the hand washing that formed the front line of COVID prevention measures!

Vaccination

There are three terms in common use for the prevention of infectious disease: **Inoculation**, **Vaccination** and **Immunization**. These are often used synonymously, though there are some technical differences between them. They all pre-date any understanding of the causes of infectious disease.

One of the most dangerous diseases of ancient times almost up to the present day was smallpox. This was painful, covering the body in sores that left the skin disfigured. Around half of those infected died. Many people started to notice that the disease was related to the much less serious cowpox. There are records dating from around 1500 from China, India and Europe of people deliberately acquiring cowpox in the hope that it would protect them against smallpox. One of the most commonly used methods was to collect skin from the scabs of infected individuals. This was dried and powdered before rubbing into a scratch on the skin of a healthy individual.

Acting on this 'Knowledge', Thomas Dimsdale (1712-1800) used an early vaccine to treat Catherine the Great, Empress of Russia in 1768. It is difficult to know who was the braver in performing this procedure, Catherine or Dr. Dimsdale! Edward Jenner (pictured 1749-1823) used individuals infected with cowpox to infect healthy subjects. When these developed the sores of the disease, Jenner collected samples of the pus from their sores. He then waited for the subject to recover and used the collected pus to reinfect the person. The second infection was less severe and afforded very good protection against the much more serious smallpox.

None of the people performing these procedures had any idea why they worked.

The 'Germ Theory of Disease' followed as it had become increasingly obvious that 'tiny creatures' that passed from person to person were the real causes of disease. The unmasking of these villains by an army of brilliant scientists including Louis Pasteur, Robert Koch, Kitasato Shibasaburō, Paul Ehrlich, Emil Behring and many others is an epic of detection.

The term 'vaccination' is derived from the Latin *vacca* - a cow. Smallpox vaccination has been so successful that the disease has been declared extinct.

A Warning!

We have just related two examples in which 'Common Knowledge' helped unmask the truth. However, there are examples in which accepted ideas have stood in the way of true progress.

Right up to the mid 1800s (again that date!) it was believed that disease was caused by bad air. As this was omnipresent, it was a theory that was difficult to falsify. Today, it is difficult to believe that 200 years ago, the streets of most cities were open sewers.

The shout 'gardyloo' (from the French *garde à l'eau* - beware of the water!) was shouted as a warning to passers by just before emptying the contents of chamberpots (loos) out of windows. The first proper sewage disposal system was designed for London by Sir Joseph Bazalgette, (1819 – 1891). It was opened in the 1860s - again that date. Mercifully, the idea was taken up by cities around the World. Bazalgette probably vies with Semmelweis as having prevented more premature deaths than any other human being. One made people wash their hands and the other built tunnels - two simple pieces of technology.

The sewers dealt with the bad air (miasma) but it was actually by cleaning up the drinking water that diseases such as cholera were mastered. Flu - influenza was believed to be caused by the 'influence' of the planets - probably because it is seasonal. Malaria is so named from the Italian for bad air.

Modern Technology

One of the interesting developments of modern technological knowledge is that it has become so complex that there is nobody who 'understands' it all. Who knows all the details of how to design a microchip? Most modern computer components are designed by previous generations of computers. Who or what are the true possessors of this knowledge? Can it even be said to exist?

The ABS braking system on most modern cars presents a slightly different question. Depressing the brake pedal in a car no longer sends the brakes directly into action. It is more like a 'declaration of the intention to slow down' than a direct act. This is because many drivers tend to 'over-brake' in emergencies. This stops the wheels rotating at all, sending the vehicle into an uncontrolled skid. The ABS system applies the brakes at an amount that prevents this, allowing the tyres to remain in proper contact with the road. But who is in command here?

As a footnote, marketing (the advertising of goods and services) is moving to an online based model. Have you noticed that the advertisements that 'pop-up' when you use the internet are geared to your interests. Try doing an internet search for holidays in, for example, Sri Lanka. Do you find that, over the next few days, you start to see advertisements for Sri Lanka?

It is easy to see how such directed advertising benefits service providers. But does it benefit you, the consumer? Who is the possessor of all this knowledge?

Chapter 10 Language (option)

> …all human activity seems bewitched by language. Language casts spells on all our communication, it bewitches with its connotations, flux, grammatical structures, origins, vagueness, contexts, implications, imperfections, irregularities, limited and unlimited vocabulary and because it is an enigmatic, imperfect human enterprise.
>
> Wittgenstein

Despite its bewitching powers, language is an important Way of Knowing. Knowledge is both constructed and made public by, and with, language. The IB Diploma curriculum designers were themselves bewitched by language. They have it in the middle circle of the TOK diagram as a Way of Knowing. Where they do not have it is in the outer ring of the TOK diagram as an Area of Knowledge. One expects it to be in the outer circle, along with maths, natural science, history and the arts, as a school subject. But it isn't there. They have it twice in the Diploma hexagon, as language A1 (group 1) and as a second language (group 2). There it is, taking up a third of the diploma time, and yet it isn't classified as an Area of Knowledge. Bewitching.

In the context of TOK, 'language' is a Ways of Knowing. There are three basic questions to ask about Language as a TOK Ways of Knowing.

Most languages are related to others. Hungary has a language that is believed to be unrelated to any other language. Its capital, Budapest lies on the River Danube

What is the role of language in creating knowledge?

How do each of the other Areas of Knowledge use language in creating new knowledge? Can, for instance, the natural scientists put accurately into language the ideas and relationships of physical phenomena? Do they need language to develop their new knowledge?

To what extent does knowledge depend on language?

When historians make historical claims are they restricted in the claim by the language they use or is it only through language that the claims become possible? When poets share their thoughts and feelings about a personal perception is that sharing inevitably distorted by the language used?

How does language affect thinking and creativity and imagination?

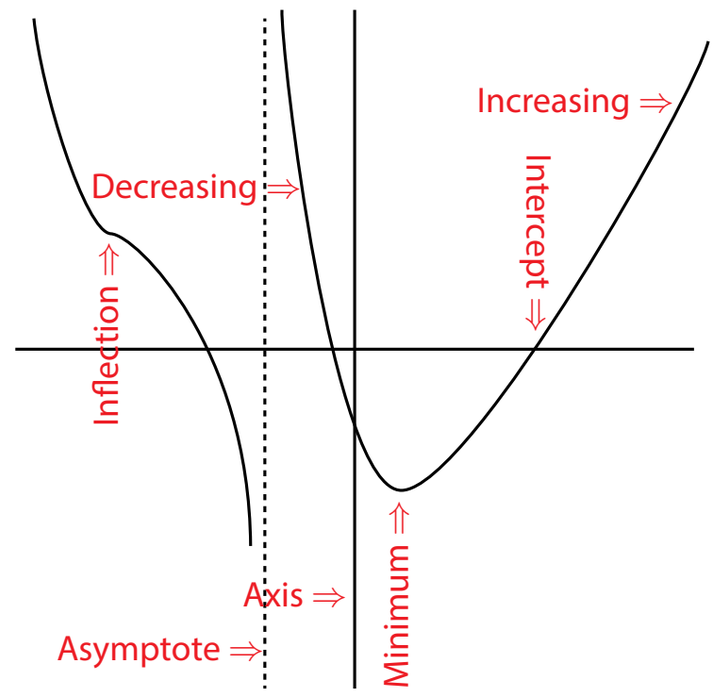
Can there be any thinking without language? Do we think in language? Does language shape thought?

As a TOK student you need to look at how language as a Way of Knowing relates to the six Areas of Knowledge. How important is language in creating new knowledge in Maths? In Natural and Human Sciences? History? Ethics? The Arts?

Much of what you have read about Ways of Knowing has the 'Knower(s)' at the centre of the diagram defined as those scholars and artists who create new knowledge. Change this definition to you, the students as the Knower(s) at the centre. Ask yourself how you use language to create knowledge new to you. Think of a mathematical topic you have recently studied in your classes: graphs of functions perhaps, and analyse how you came to understand graphs of functions. What part did language play in developing your understanding? Was there a point perhaps when language even got in the way of your understanding? Try the same exercise with responding to a poem. Can you recall a time when your understanding and appreciation of a poem was confused by the language?

Use the three questions above to start your analysis. What role did language play in creating your understanding of graphs of functions (or whatever other mathematical topic you have recently learned.)? To what extent did your new understanding actually depend on language? And how did language affect your own internalisation of the topic? Do you see your understanding as a series of graphs or as language describing these graphs?

Perhaps it may help to understand Language as a Way of Knowing if you understand a little about language itself.

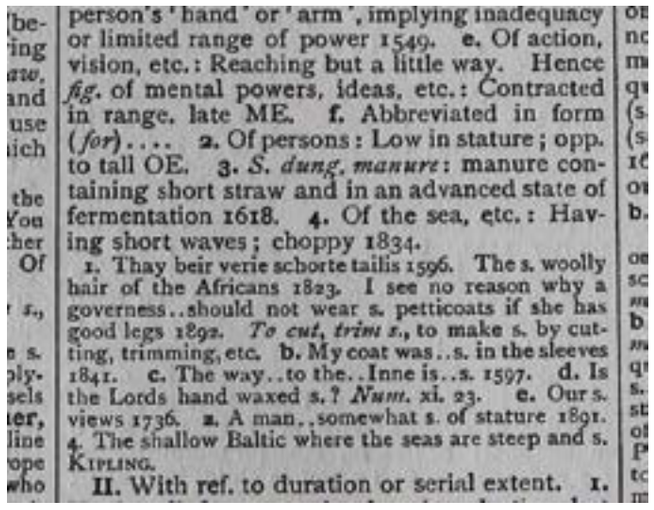


What is Language?

We all know what 'language' is, and yet we have difficulty in defining the word 'language'. When challenged we probably consult a dictionary and there we find an approximate definition, using more language. The New Shorter Oxford English Dictionary (NSOED) has bewitchingly five major definitions of the word 'language', divided into fifteen minor divisions. How do you know which one to select for your definition? You have to select the definition that is most appropriate for the context in which you are being asked to define the word.

This two volume edition of The Shorter Oxford English Dictionary was published in 1944.

The entry for 'short' covers half this page and one column of the next.



person's 'hand' or 'arm', implying inadequacy or limited range of power 1549. **e.** Of action, vision, etc.: Reaching but a little way. Hence *fig.* of mental powers, ideas, etc.: Contracted in range. late ME. **f.** Abbreviated in form (*for*) .... **2.** Of persons: Low in stature; opp. to tall OE. **3.** *S. dung, manure*: manure containing short straw and in an advanced state of fermentation 1618. **4.** Of the sea, etc.: Having short waves; choppy 1834.

1. Thay beir verie schorte tailis 1596. The s. woolly hair of the Africans 1823. I see no reason why a governess..should not wear s. petticoats if she has good legs 1892. *To cut, trim s.*, to make s. by cutting, trimming, etc. **b.** My coat was..s. in the sleeves 1841. **c.** The way..to the..Inne is..s. 1597. **d.** Is the Lords hand waxed s.? *Num.* xi. 23. **e.** Our s. views 1736. **2.** A man..somewhat s. of stature 1891. 4. The shallow Baltic where the seas are steep and s. KIPLING.

II. With ref. to duration or serial extent. **1.**

Each entry contains not only the many meanings of the word but remarks on its derivation.

Linguistics

Linguists study linguistics, a field of scientific research with language analysis as its focus. Universities began teaching linguistics in the 1960s.

Studies are divided into three main sections.

- **Theoretical linguistics** constructs general principles for the study of all languages.
- **Descriptive linguistics** defines the facts of a particular language system and
- **Comparative linguistics** examines the similarities and differences between languages.

At one point early in the planning of the IB Diploma it was considered that Linguistics be a compulsory subject. The planners believed that linguistics would teach a general awareness of the nature of language, which they described as 'a great tool of thought'.

Linguistics was rejected in favour of a second language.

Language Functions

One of the concerns of linguists is attempting to understand the nature of language by the functions it performs. There are almost as many classifications of the functions of language as there are books about it.

Wittgenstein gave one of the most comprehensive lists of the functions of language.

Language he writes, *can be used to give orders; describe the appearance of an object or give its measurement; report an event; speculate about an event; form and test a hypothesis; present the results of an experiment; make up a story; play act; sing catches; guess riddles; make a joke and tell it; solve a problem in practical arithmetic; translate from one language to another; ask, think, greet, cure and pray.*

Despite the many classifications of the functions of language most linguists agree on the significant features of language.

Language, they say

- is uniquely human
- communicates
- uses symbols.

The NSOED definition closest to this consensus definition is 'a system of human communication using words, written and spoken, and particular ways of combining them'.

Whether language is uniquely human or not is an interesting discussion, but is not really a TOK issue. But, language as communication, and the way language uses symbols, certainly is.

Language Communicates

Linguists classify communication through language into three groups: **transactional communication**, **expressive communication** and **internal communication**.

Transactional communication

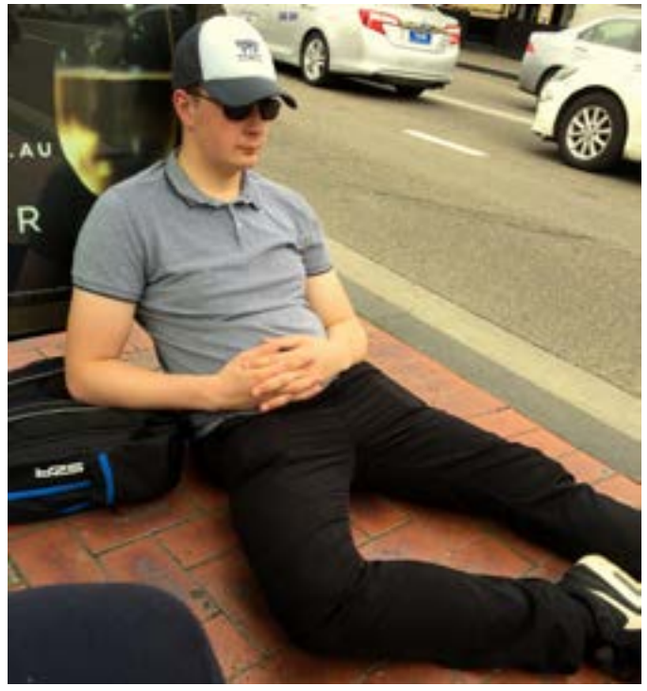
The most obvious function of language (i.e. of the messages it communicates) is that it is transactional. Transactional here means 'to get things done'. In this category it is used, amongst other things to:

- give information (Sun Yat-sen was proclaimed President of the Republic of China in 1912);
- give instructions (Stop when the light is red);
- set up a hypothesis (If these plants do not receive water they will die);
- solve problems (Add the lengths of the sides of the field together and you calculate the amount of fencing you need).

In these examples of the transactional use of language, the meaning of the language in the message, if the message is to communicate clearly, must be unambiguous. Inevitably when abstract ideas are part of the message, different understandings of the meaning of words and the way they are presented can interfere seriously with the communication, both with others and oneself.

Expressive communication

Language can also be used to communicate expressively, to express the feelings of the sender and to affect, not just inform, the receiver. In this kind of communication we pay special attention to the words themselves and the feelings and atmosphere they create. We find this kind of language used in poetry. Language used to communicate expressively the feelings of the sender of the message and to affect the listener, is often connotative. Connotative means imply more meaning to a word than its primary meaning. Obviously when meaning is implied the message is going to be open to interpretation, each receiver interpreting it slightly differently according to his or her own connotation.



Internal communication: Language as communication with oneself

When you sit at home in the evening and settle down to your homework do you organise the thoughts in your head using language? Do you say to yourself, in your mind 'First I'll do the Maths and then, if I have time I'll do the French, but before I do anything I'll just call Anna and see what she's doing'? Do you ever actually say your thoughts out loud or find yourself moving your lips as if you were speaking but not making the sounds? Do your thoughts, your communication with yourself, need to be put into language?

Some 'thinking' obviously doesn't need to be put into words. Visual artists and composers can 'see' and 'hear' what they eventually produce, without using words, and our response to the smell of freshly baked bread or the sight of a mangled car after a crash is independent of words, although the extent to which these last two examples are 'thinking' in any sense at all is questionable. If we can't put thoughts into words we can't be sure what it is we are thinking. This idea was summarised by Russian linguist Vigotsky who was quite clear in his opinion. 'Thought is born through words ... a thought unembodied[1] remains a shadow. We seem to need to put our thoughts into some sort of linguistic order and language seems to enables us to do that.'

1 'unembodied' here is interestingly bewitching: it means 'not put into words'.

The relationship between language and thought is a matter of speculation. There are two conflicting theories about the relationship. The first theory claims that thought and language are entirely separate, but dependent. This can mean that either language is dependent on thought or thought on language. The second theory claims that language and thought are absolutely meshed together: thinking without language is impossible. The most well known discussion of the language/thought relationship is The *Sapir-Whorf Hypothesis* that suggests that our thoughts are controlled by our language. Recently some psycholinguists have contested the *Sapir-Whorf Hypothesis*, arguing that thought and language are independent.

For the purpose of understanding ourselves as knowers it is not necessary to take sides although it is certainly worth spending a little time thinking (using language?) about the controversy. What is clear is that language is part of our thinking process. We use language to express our thoughts, to communicate and clarify our thoughts to ourselves and to others.

Language uses symbols

Humans can make certain things stand for other things. In maths you are familiar with this idea. In the statement

Let h stand for the length of the hypotenuse

'*h*' is a symbol for a finite number representing the length of all the hypotenuses you can imagine.

In English grammar you have probably found the formula for a simple sentence,

S>V>O,

in which the symbol

S stands for the subject,

V for the verb and

O for the object.

We can, by agreement, make symbols stand for anything we wish.

As part of our evolutionary development we have agreed that when we make certain sounds, when we use language, those sounds, language, are symbols. Those of us who speak English have agreed on one set of sounds as symbols and those of us

who speak Chinese have agreed on another set of sounds as symbols. The sounds are agreed symbols within our language communities. A member of the English speaking community might make a sound which we write as 'Look! A small green snake'[2]. Any members of the community who heard the sound could, if they so chose, look and see an object that they would recognise as a small green snake. The sounds **small** and **green** and **snake** are symbols that are meaningful to members of that speaking community and they would know what to expect when they looked. But there is not necessarily a connection between the sound symbol and the thing or idea it stands for. The sound symbol for snake is not the reality of the snake.

This may seem a fairly obvious statement to make and with the example of the snake of course it is. But at a more abstract level the difference between the symbol and idea or thing the symbol represents is not always apparent. The word or sound can become confused with reality and the spell of language can begin to bewitch. The words green and small are beginning this process. What does 'green' symbolise? You describe your new pet snake to me as 'green' and I have an approximate idea of its colour, based on my experience of green snakes I have seen, but your snake might be a bright lime green and the snakes I have seen may be dark bottle green. I might have entirely the wrong idea of the colour of your snake. And what about small? Now the last snake you had, which escaped into the local sewage system last week may have been a six metre long anaconda, and this one, a baby anaconda to replace the monster that escaped may be only one metre long. Sure, your new snake is small compared to the one that got away, but to me a metre long snake is huge. The words, the symbols, we are using to communicate mean different things to different people in different contexts. The sender of the symbol may be clear what message he or she is sending. The receiver may be clear what message he or she is receiving. But the received signal is fundamentally different from the sent signal. The words have bewitched our intelligences: we have begun to interpret the symbols as representing reality, but there is no reality. What is green? What is small? As our acquaintance with words — symbols of reality but not reality — grows more abstract and those ideas the words symbolise become more abstract, the more we are likely to be bewitched. Because a word exists we expect it to correspond to the reality we know. Scientists have pointed out this danger as they seek to name newly discovered phenomena with old words. Black Holes are neither black nor holes but for most of us these words cast a spell. We apply the everyday meaning of the words and struggle to understand how anything black and shaped like a hole (and what shape is a hole?) can be floating around there in outer space. We are bewitched into conceptualising a reality that doesn't exist.

It is not the individual words alone that bewitch. The pattern of the language, the way the symbols are joined together, can also cast a spell. 'This path leads to the banana plantation' is a realistic straightforward statement that symbolises reality. 'This path

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2 Writing is of course a set of symbols itself, symbols representing sound. Writing therefore is a symbol of a symbol.

leads to damnation' is a similar structure but the ideas implicit in it are quite different. The path of the second sentence is as different from the path of the first sentence as a banana plantation is different from damnation but the structure of the sentences can bewitch us into thinking they are quite similar: a path is a path is a path and a banana plantation is damnation. Beware the snake wrapped round the banana tree tempting you with the fruit of knowledge.

Further Bewitchment

That language communicates and uses symbols and that it both communicates and uses symbols in a variety of ways is clear. What isn't always clear is how well language communicates and uses symbols. This chapter begins with a quotation from Wittgenstein: 'Philosophy is a battle against the bewitchment of our intelligence by means of language.' It is worth staying with this idea of bewitchment. Language bewitches us all and the first bewitchment we should look at is implied in our original definition. Language, as defined by linguists is uniquely human, communicates and uses symbols. We have looked briefly at language as communication and seen how it can bewitch with its use of symbols. Here are more ways in which language bewitches us.

The Meaning of Words

It is a generally held belief that words have a true meaning and to be able to use a word accurately we must be aware of that true meaning. To appreciate this meaning we are advised to look at words, see how they are used, and then come to an awareness of the true meaning. What often happens is a word can mean so many things in so many situations we simply can't do this. Many words have no true meaning; rather they have so many different meanings that can only be appreciated in context. The potential power of such words to bewitch is immense: how can your intelligence function clearly if the words you use to think and to express your thoughts can mean many different things? Dictionary makers know this. They obtain their definitions from the way words are used. The full title of the Shorter Oxford English Dictionary is The New Shorter Oxford Dictionary on Historical Principles.

The historical principles are important. The editors of the dictionary read widely and they noted every interesting or unusual word and unfamiliar uses of common words within the context of the sentences they read. When the word is defined for the dictionary the editors look at all the uses of the word they have compiled, and the dates these usages were current, and come to their definition based on the meaning of the words in the context, both now and in the past. The changes in the meaning of a word are traced historically. In time the meaning of words shift and change for many reasons and we can only be sure of the meaning when we know its time context as well as its context within a sentence. Several hundred years ago the word 'lust' meant innocent delight. The entry for gay in the NOED has thirteen definitions, the first dating back to Middle English, (the language

spoken in England between 1150 and 1349)[3]. Only the last entry, from the mid-20th century, has anything to do with the meaning homosexual.

The importance of the sound of a word

If cockroaches were called cuddlebugs, would they seem nicer? If Hitler had used the original family name of *Schicklgruber* would he have done quite so much damage? According to Marshall Blonsky, a Wolfson Fellow in semiotics at the New School of New York, USA, "The sound of a word is of enormous importance. The sound is the lubricant that gets the signifier and its meaning into our consciousness".

"If you've got a lot of names for something," Blonsky says, "none of them euphonious, then it's as if you don't have any name. And if you don't have a name for a thing, then as far as most people are concerned, you don't have the thing at all."

When her teacher says Anna is a 'good' student she means 'diligent' but when the same teacher says Anna gets 'good' grades she means 'high'. When her mother says Anna is a 'good' daughter she might mean 'keeps out of trouble'. When Anna's friend says Anna is a 'good' friend she means 'faithful', when her grandfather says she has a 'good' deal of common sense he uses the word differently from when he says she is a 'good' girl. We must look at the context of each statement to understand the meaning of 'good'. A multitude of words have meaning only in context. When we isolate them to define them they become meaningless. Even in context they still bewitch. What could Anna's mother mean when she says Anna is a 'good' girl? It might just mean she doesn't smoke or that she brings her a cup of coffee every morning or it might mean Anna is a model of conventional morality.

Sometimes the meaning of words is so vague it is difficult to understand their meaning at all. We have already seen small and green. Giving instructions to someone is fraught with difficulties. What does 'Turn right just as you enter the village' mean? Does it mean turn sharply right or fork to the right? And 'just' means what? 'As soon as'? 'Immediately'? And does 'village' mean where the village boundary is signposted or where the houses begin?

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3 Old English is not the language used by Shakespeare. He used the Elizabethan form of modern English. Old English is the form of English spoken in England up to the middle of the 12th century. 'Old' here has a technical meaning within the history of language. Another example of the bewitching meaning of words.

Words that have almost the same meaning can also bewitch. Hint, intimate, insinuate, suggest, and imply can be very similar in meaning and we would probably not agree on the subtle differences, if any, in the meaning of each one unless we were aware of the exact context in which it is being used. Poets, of course, delight in the uncertainty of the meaning of words and weave them together in fascinating patterns to further reinforce their ambiguity. Here is the start of a poem by Gerard Manley Hopkins, a poem that bewitches with its choice of words and images.

Glory be to God for dappled things -

For skies of couple-colour as a brinded cow;

For rose-moles all in stipple upon trout that swim;

Fresh-firecoal chestnut-falls; finches' wings;

Landscape plotted and pieced fold, fallow and plough;

And all trades, their gear and tackle and trim.

You will not find rose-moles or chestnut-falls in a dictionary. All this bewitchment about the meaning of words doesn't mean dictionaries are of no use and we should throw them away. Dictionaries can indicate the possible meaning of words, a meaning the reader has to take and put in context. Beware of them, though. Dictionaries cast their own spell: you think you have the meaning, after all it is written there in the dictionary, and what you have is only a possible meaning.

Language Creates Reality

In the 1990s it became fashionable to mock 'politically correct' (PC) language. The classification 'politically correct' is itself an example of words bewitching. 'Socially correct' might be more appropriate, but that could be interpreted as a guide to good manners. In some ways that is what PC language is, an attempt to prune offensive, sexist, prejudiced, racist terms from the language because they create offence. But they also create reality. Recently I re-read Mark Twain's *Huckleberry Finn*, and as I was finishing it I visited New York and stayed with an old friend who had just retired. His wife still goes off to work everyday and at breakfast on the first day of my visit I asked him, as he sliced the bagels and perked the coffee, what it was like being the house n*gger. (Remember I was reading *Huckleberry Finn*). My friend stopped cutting his bagel; paused, and said very seriously to me, 'Don't use that word'. And such was the intensity of his command I have not used it since. The word is unacceptable, and for good

reason. It was offensive to the people it described and it reflected a social and economic status that no longer exists. And one of the reasons that status no longer exists is because the word is no longer used. The language that reflected reality also created and maintained it. The feminists are right, if we always read of doctors as 'he' and nurses as 'she', we eventually begin to expect reality to reflect that situation. The words create the reality and our intelligences are bewitched.

Language Infers and Judges

An inference is a conclusion you come to about the unknown based on something you know. 'Anna is clever', you might infer, from the facts you know. She always gets good grades and hands her work in promptly without any obvious effort. But your statement is not a fact but an inference. Anna may work very hard, she may struggle over every piece of written work she hands in and she may spend hours discussing her work with her parents or her brother. What you are saying when you say she is clever is simply that she gets good grades and hands her work in on time. Your inference that she is clever achieves a status it does not deserve. The words have bewitched you into believing something that is open to question is, in fact, a reality.

What you have done is made a judgment and the words of your judgement may imply a disapproval or approval that is not necessarily valid. The bewitchment is that judgements, once they have been put into words, obstruct thought. What does 'Anna is a wonderful human being' actually mean? The person who made the statement probably means that Anna's values, and the way she presents her values, are the same as their own In extreme cases the judgement is obvious. If someone is called a 'scumbag' or the 'sweetest person on earth' it is clear a judgement is being made. But often phrases and words are used which are just as judgemental but not obviously so. 'He was a typical Wall Street money trader', implies all sorts of judgements and stereotypes. The stereotyping bewitches the intelligence. This is a generalised judgement.

Language Classifies

'You know the problem with the cafeteria at lunchtime. It's those eighth graders. There are so many of them. They are so noisy and they jump the line. They are awful.'

When you describe the eighth graders in this way you classify them. The individuals belong to no class until we, with our language, put them in it. And in this case our classification will probably lead us to believe the worst of the eighth graders whenever we meet them. If one of them is noisy on the school bus — that's typical. If one of them doesn't work — that's typical. If one of them doesn't turn up for a basketball match — that's typical.

Classifying, frequently determines our attitudes and behaviour towards those things that are classified. Eighth graders are no different from ninth, tenth, eleventh and twelfth graders. They have just the same mix of lazy and hardworking, noisy and quiet, extrovert and introvert individuals as any other grade, but once they are classified in our minds as a particular set of abstractions the language of the classifications bewitches.

Jews, Arabs, socialists, communists, hippies, drop outs, saints, valley girls, republicans, these are all generalisations. Do any of these words really mean anything or are they just a set of sounds that trigger in us conventional reactions?

Language is Always Changing

Language is always changing; you know this from your personal experience, as I do. I often sit open mouthed in astonishment and awe at some of the vibrant language I hear used by Diploma students. I am well impressed.

Change in usage brings vibrancy and vigour to a language, but is often resisted by more conservative (or insecure?) members of the community. Each of the dialects of English — American, Canadian, Irish, Caribbean, Australian, etc. etc., has changed and still changes, and enrich the language. Slang and unconventional usage also brings dynamism to communication that standard usage doesn't.

I have only begun here to explore how language bewitches our intelligences, our Ways of Knowing and the ideas and concepts in those disciplines we study. Language is what the linguists define it as: it is uniquely human, it does communicate and it uses symbols. But it also bewitches your intelligence and casts spells on reason, emotion and sense perception. Use it as a Way of Knowing with great caution.

Chapter 11 Politics (option)

Firstly, should we say 'Politics is...' or 'Politics are...'? Is the word singular or plural? It seems both are correct. We will choose to use the singular.

Politics is often defined as 'The Art of Government'. So what is Government?

For all the other species on Earth and for most of Human History, Government has been unnecessary.

Humans existed in small tribal groups with a leader in much the same way as a Pride of Lions has a dominant individual.

Leaders decide everything and remain in power until a challenger becomes strong enough to knock them off - usually literally.

The change from the small groups of hunter-gathers to larger groupings came with the development of farming. This produced a number of things.

1. A need to keep seed from one year to the next and to guard it from thieves.
2. A food surplus and, again, the problem of thieves.
3. Larger population groups living in established 'villages'.
4. People with time on their hands to use for good (the Arts, Philosophy,...) or evil.
5. The acquisition of 'goods' and the growth of 'greed'.

Later, tribal leaders evolved to be 'Lords of the Manor' with armed Knights (Samurai etc.) to protect themselves and their Serfs. Friction between neighbouring Lords and between Lords and their Serfs, at least in part, led to the notion of Government.

How best to organise large groups of people and do they need to be organised at all?

There have been some attempts at living without Government: the Kibbutz movement in Israel, the Hippy Communes of the 1960s being examples. Can you find others?

Mostly, however, most large population groups have lived under some form of Government.

Early examples include:

1. The Pharoahs of Egypt (~3,000 BC to 30 BC)

   The fertile plain of the Nile Delta produced (and still does) more food than the population needed. The Roman Empire was largely fed by exports from this area. The regular flooding of the Nile both irrigated and fertilised the area. The yearly cycle of crop planting and harvesting produced periods of activity and comparative inactivity. The great building projects of the Pharoahs (Pyramids, Temples etc.) are thought to have been, in part, to keep the people out of mischief and to build a community spirit. Modern evidence suggest that these were not the work of slaves.

2. The Emperors of China (~2,000 BC to 1911 AD)

   Historians divide these into 'Dynasties': Xia, Shang, Zhou, Qin, Han etc. Each has its own 'style', but over the period, their civilisation produced a number of achievements: intellectual (arts, mathematics etc.), technological (ceramics, fabrics etc.) and political (a system of public servants). The civilisation was so productive that a trading route called the **Silk Road** has flourished for millennia linking China with Europe. In later years, Hong Kong (pictured) has acted as a gateway for trade and cultural exchanges between China and the rest of the World.

3. India

   Indian History began with the mysterious 'Indus Civilisation' (~3,000 BC to 1,000 BC) that flourished in what is now Pakistan. Very little detail is known about this period other than that it was advanced for its time showing town planning, metallurgical skills etc. The subsequent History of India is, to say the least, complex, with invasions (eg. Alexander the Great, Mongols), self rule (Maharajahs), foreign rule (Sultans, the British Raj) and has evolved into a modern Democracy.

Political Knowledge

So what Political Knowledge had been amassed by these Absolute Rulers of the Ancient World? You should make your own list, but consider these suggestions:

- rulers can demonstrate their power by constructing impressive buildings
- rulers remain aloof from the common people
- rulers claim divine authority
- ....

Political Theorists

It is likely that the Pharoahs, Emperors etc. learned from their predecessors. Many of them got the job because they were born to it and the knowledge of how to do the job was kept within the family. Humans being what they are, it was inevitable that individuals within the general populace would begin to have ideas that they believed would improve Government. And thus was born the Political Theorist. They are ten-a-penny today - it is not possible to attend a social event without meeting several - and they probably have always been plentiful. Only a few, however, have stood the test of time and are remembered today. This list of notables is, however, huge and we only give a few examples.

Confucius (China 551-479 BC). Confucius emphasized the importance of both personal and governmental morality. Confucianism is still an underlying principle of many governments. The importance of honesty, kindness, sincerity etc. is to be understood by both the rulers and the ruled.

Plato (Greece `430 to ~350 BC). Plato saw societies as divided into groups. Productive people were the bakers, farmers, builders etc. Protective people were the warriors. Rulers were taken from the Philosophers. Plato was, of course in the third group and was no doubt not the first person to think everything would be just fine if only s/he were put in charge!

Marcus Tullius Cicero (Rome 106 – 43 BC). Cicero was a lawyer during the period when Rome was a republic. Government was by an elected Senate and Law Courts dealt with crime, corruption, civil disputes etc. Many of Cicero's writings and speeches have survived intact.

Niccolò Machiavelli (Italy 1469 – 1527). Machiavelli is remembered for his short handbook on the skills of government, *The Prince* (1513). *Machiavellian* has come to mean devious and underhand. This is not quite fair as *The Prince* is a short book packed full of advice to Princes such as 'avoid flatterers' and the infamous 'it is better to be feared than loved'.

John Locke (England 1632 – 1704). Locke was a philosopher and physician, and a leader of what became known as 'The Enlightenment'. This movement emphasised the power of reason as a way of expanding Knowledge. Locke advanced the notion that good Government relies on a 'Social Contract' between the rulers and the people.

Karl Marx (Russia/England 1818 - 1883). Marx was the originator of Marxism, one of the forms of communism. This is often summarised as 'from each according to his means, to each according to his needs'.

You should pause here and make your own list of the most influential thinkers on the subject of 'governance' as you see them.

Before moving on, consider the Political Thinkers who dealt with 'special issues' such as:

- Feminism
- Campaign to end Slavery
- Imperialism
- ...

Politicians as Political Thinkers

We have been dealing so far with political theorists who have been 'outside the tent' peering in. What about those who were actual practitioners of government and who contributed to knowledge about the best way to govern a country.

It has become obligatory for all retiring politicians, good, bad and indifferent, to publish their memoires the moment they lose office. We can only choose a few of the more prominent contributors.

Henry II of England (1133 – 1189) and his wife **Eleanor of Aquitaine** (1122 – 1204). Henry is remembered for his dispute with his close friend Thomas Beckett. Beckett had been a senior Government Official. When Beckett became Archbishop of Canterbury, a row erupted over the role of the Church in Government which saw Beckett murdered in Canterbury Cathedral and the principle of the separation of Church and State established in England and, later, elsewhere. Henry and Eleanor also instituted travelling magistrates to improve the administration of justice.

Grímur Geitskör (Iceland ~900 AD). Fed up with the endless Viking feuds, the Nordic settlers of Iceland charged Grímur Geitskör with the task of finding a site to set up an assembly (Althing) which would govern the young country. He chose Þingvellir (pictured) for what is credited with being the first modern Parliament. The site is now on the World Heritage List.

Lee Kuan Yew (Singapore 1923 – 2015). After a stellar academic career at Cambridge University (UK), Lee Kwan Yew became the first Prime Minister of Singapore a small island with a large and disparate population and no natural resources. The country was on its own and devastated after World War 2. Using controversial methods including large penalties for minor offences 'LKY' led his country to become one of the most successful in the World.

Abraham Lincoln (USA 1809 – 1865). Lincoln was the first Republican President of the USA, elected to arrest the spread of slavery to States newly admitted to the Union. The immediate secession of Southern States led to America's bloody Civil War (1861 - 1865). Originally about restoring the Union, Lincoln gradually altered the Union aims of the War to include the complete abolition of slavery in America and finally to demonstrate that democracy as a form of government is robust enough to survive a major internal dispute. He is remembered for his ringing use of language - '...that government of the people, by the people, for the people shall not perish from the Earth'. The Union victory in the Civil War is one of the most important events in forming the Modern World.

Emperor Meiji (Japan 1852 – 1912). The Meiji era saw Japan evolve very rapidly from an isolationist, feudal State to a modern industrialised power. Meiji demonstrated that rulers can benefit from being open to ideas from outside their immediate circle. His legacy is evident in modern Japan and his two 'nicknames' Meiji the Great and Meiji the Good remember this. Very few rulers have succeeded in being seen as both 'great' and 'good'.

Next, can you add your own example to this list? Think first about your own country and its traditions:

- who are the major leaders in your local history?
- have any of them achieved fame on the World Stage?
- what political systems have been tried in your country?
- which system has worked best?
- politics has been a man's game until recently. What about Sirimavo Bandaranaike, Margaret Thatcher, Golda Meir....?

Other contributors to Political Thought

Politics is all pervasive and everyone thinks they can contribute. Some people have, however, made major contributions to good government without really intending to. Mostly they have done so by actually 'picking up a shovel' and doing it, thereby shaming the political class into action.

We have already mentioned the campaign to abolish slavery (still on-going), led by a group motivated by religious convictions, many of them Quakers. Here are some others:


ELIZABETH GASKELL

Elizabeth Gaskell (England 1810 – 1865) in her novel *Mary Barton*, Gaskell shocked Britain with her graphic depiction of the poor conditions experienced by the country's working class. She is an influential figure in the development of the idea that Government had responsibilities towards the welfare of its people.

Mary Bickerdyke (USA 1817 – 1901). This extraordinary woman must stand for the many whose energy and commitment have seen the improvement of health service provisions across the World. During the American Civil War, she was responsible for setting up around 300 field hospitals that made large improvements in the survival rates of wounded soldiers. She was famous for her brusque put-downs of those who tried to stand in her way by questioning her authority - "On the authority of Lord God Almighty, have you anything that outranks that?". At the end of the war, the hard-bitten General Sherman remarked "she [out]ranks me".

Henry Dunant (Switzerland 1828 – 1910). Dunant witnessed the Battle of Solferino (1859) and was shocked to see that the departing armies left over 20,000 dead and dying untended on the battlefield. He wrote *A Memory of Solferino*, a book that led directly to the founding of the Red Cross, the Red Crescent and the Red Crystal. All these organisations are largely volunteer. Their influence led to the development of the Geneva Conventions that have forced (some) governments to control themselves and their armed forces during wars.

Again, we ask you to construct your list of the 'doers' in the construction of political thought. What about Picasso's *Guernica*, Tolstoy's *War and Peace*, Kurt Hahn, the educator who set up The United World Colleges, many of which do the IB?

Political Knowledge

So what do we conclude from all this? Is there such a thing as Political Knowledge or is it all just opinion? If it is not just opinion, why do so many countries hold elections? Surely, if the best way of running a country were a matter of Knowledge, why don't we just let them get on with it with minimal oversight?

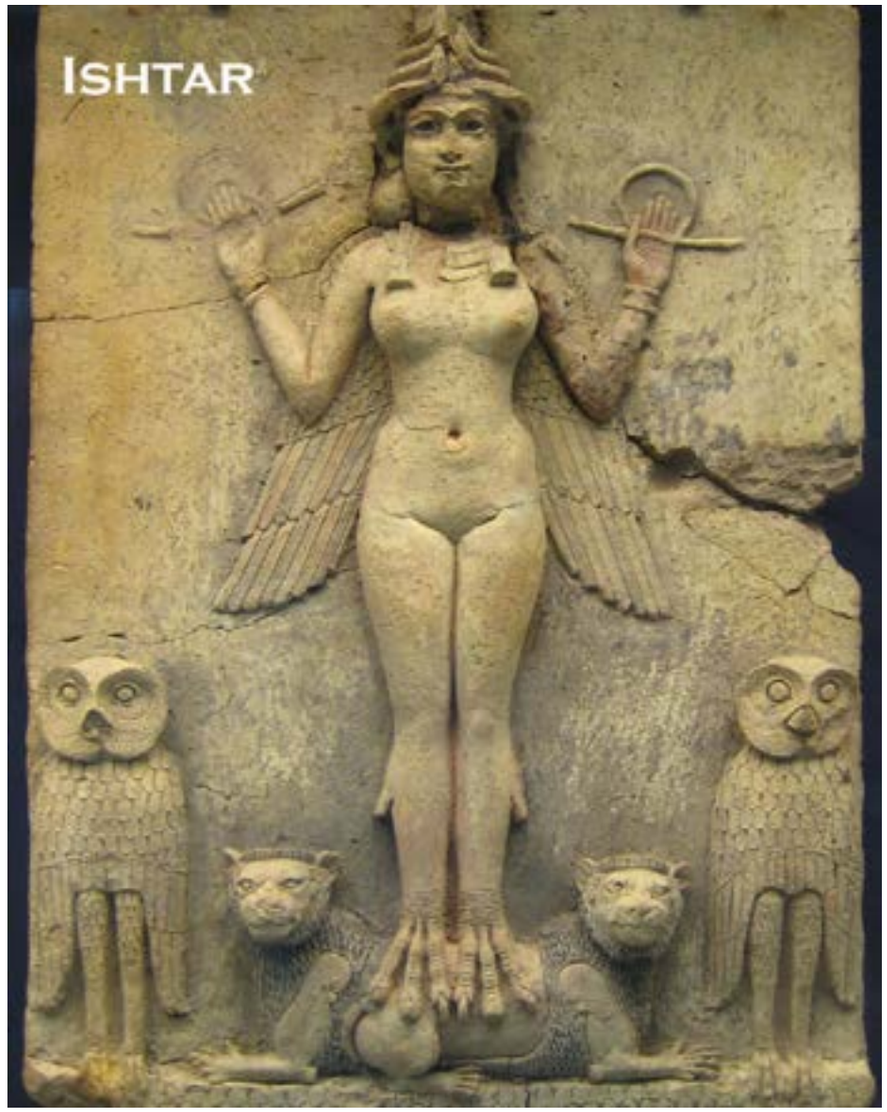
There are several answers to that and here is one of them.

Chapter 12 Religion (option)

Faith is certainly a powerful force in the 21st century and it is likely that for many IB Diploma students faith is a major Way of Knowing. But in what Sense should we consider things in which we have Faith as matters of Knowledge?

Humans started to worship God (or gods), to have faith, as soon as they learned to stand upright. This faith arose from their wonder and awe of the natural world they inhabited and an attempt to find meaning and value in their lives, and their place in that world. And, gods helped them find this meaning and value. Gods, and peoples' faith in them, is probably the most powerful force in the history of the human race. The studies of ancient religions (Mythology) and current religions (Theology) are both huge and we can only present brief snapshots of them.

The Earth Mother



In the Palaeolithic period, when agriculture was developing, the cult of the Mother Goddess expressed a sense that the fertility that was transforming human life was sacred. Artists carved statues showing her naked and pregnant and these statues have been found all over Europe, the Middle East and India. The Mother Goddess remained important for centuries. She was called Inana in Sumeria, Ishtar in Babylon, Anat in Canaan, Isis in Egypt and Aphrodite in Greece. In each of these cultures she was worshipped and stories about her abounded. The stories were not taken literally but helped people to be aware of the sense of what they perceived as the unseen forces surrounding them and controlling their lives.

These 'unseen forces' are at the heart of faith. People wanted to get in touch with these forces, to work with them and to admire them. When we personalise these unseen forces and see them as gods we are expressing our sense of affinity with them and the world in which they live.

Throughout history we have experienced this dimension of life that goes beyond our everyday, pragmatic existence. However we choose to interpret this transcendence, as it has been often called, it is a fact of our historical

development. Many societies have called this transcendence God and have been awed by the concept they have created. Jews are not allowed to pronounce the sacred name of God; Moslems must not depict the divine visually. Despite the rejection of the idea of God by modern, western secular society, a recent survey shows that 80% of Americans believe that God created the universe. Both in the past and in the present, faith is a very potent way of knowing.

An example of faith: Newman and 'conscience'

One of the great western explorers of the nature of faith was the 19th century cardinal, John Henry Newman. The foundation of Newman's approach to faith lies in the concept of conscience. His deep respect for conscience is perhaps best seen in a short passage from his novel *Callista*, published in 1855. *Callista* describes the conversion to Christianity of a North African sculptor and her eventual martyrdom. She describes her burgeoning awareness of conscience in conversation to a non-Christian philosopher:

I feel that God within my heart. I feel myself in His presence. He say to me, 'Do this, don't do that'. You may tell me that this dictate is a mere law of my nature, as to joy or to grieve. I cannot understand this. No it is the echo of a person speaking to me. Nothing shall persuade me that it does not ultimately proceed from a person external to me. It carries with it its proof of its divine origin. My nature feels towards it as towards a person….I believe in what is more than a mere 'something'. I believe in what is more real to me than sun, moon, stars, and the fair earth, and the voice of friends. You will say, Who is He? Has He ever told you anything about Himself? Alas! No! more's the pity. But I will not give up what I have, because I have not more. An echo implies a voice; a voice a speaker. That speaker I love and fear.

We will now look at a few gods from the past and the parts they played - or at least the parts people thought they played.

Gods of Nature

Nature is unpredictable and it is understandable that people believed that events such as Earthquakes, storms etc. were controlled by wilful beings who, if annoyed, would take it out on humanity.

God of Fire: Zhurong (China), Agni (India), Ra (Egypt), Ogun (Africa), Loki (Nordic). Gods of fire were both positive and negative or both. Some doubled as Gods of cunning, summoned to get people out of tricky situations.

Gods of Water: Ezili (Africa), Nymphs, Neptune (Greece), Poseidon (Rome). The role of a water god depended to some extent on the area the inhabited. The Japanese god Ebisu was mainly a god of the fish in the sea, reflecting the country's tradition of fishing. Poseidon was a more unpredictable fellow - a summoner of storms and earthquakes.

Forest Gods: Forests can be dangerous places (wolves, bears, getting lost etc.). A very persistent belief is that forests are inhabited by numerous little creatures. The trolls of Nordic culture, for example. Some Scandinavian farmers still maintain the custom of leaving food out for their troll in the hope that it will watch over their farm. Walt Disney's *Seven Dwarves* are versions of this.

Weather Gods: Since weather affects our lives to such a large extent, weather gods were inclined to be high status. Indra (India), Jupiter (Rome), Umvelinqangi (Africa) were all 'high-ups'. The Norse God Thor called up thunder storms by striking a rock with his giant hammer. Thor has his own day, Thursday. In Germany, he is Donner and his day is Donnerstag.

Have a look at the mythology of your own country. Does your tradition have gods specific to the conditions in your country. Do you have a lot of desert? Is it very rainy? Do you get a lot of Earthquakes? How have these characteristics been reflected in your mythology?

Gods of Human Behaviour

Humans can be unpredictable and it would be nice if we could say a prayer and make the boss like us. Or so our ancestors thought!

Goddesses of Love: and they are mainly female. Freia (Norse), Aphrodite (Greece), Venus (Rome). Many languages have words relating to love that derive from these deities. You may have spotted aphrodisiac. What about erotic, voluptuous, hedonistic...?

Gods of the Home, Loyalty and Faithfulness: Again, often female motherly figures. Parvati (India), Hestia (Greece), Vesta (and the Vestal Virgins) (Rome), Fricka (Norse).

Gods of Contract: Odin (Norse) is a clear example of this type of god. Odin carried a spear upon which all the Nordic World's contracts were engraved. Odin had a second persona, that of the Wanderer. The Wanderer did just that and was liable to turn up in any community to check up on things. An early version of The Government Inspector.

Paradise

An important part of many religions is the notion of an afterlife in which we all have the chance of perpetual happiness. Or, if we have been bad in our lives, perpetual misery. Some religions have the notion of reincarnation. This is a particular characteristic of Indian religions, the two largest of which are Hinduism and Buddhism. Reincarnation is the belief that on death, we return to life as a different creature. It is this belief that drives these cultures to be kinder to animals than many others.

The religions that believe in an afterlife all have some concept of heaven (nice) and hell (nasty). These are not all the same and tend to be driven by the prevailing conditions experienced by the devotees.

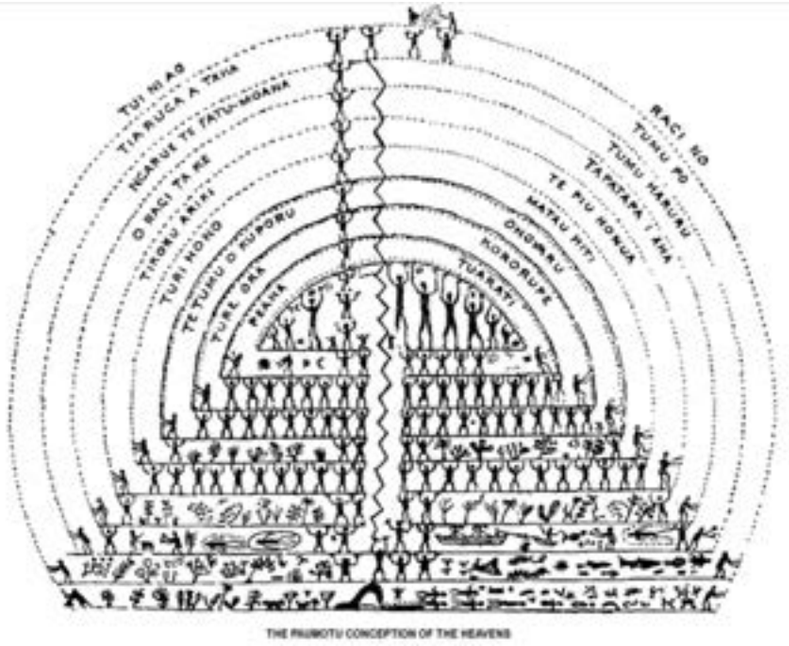
Judaism: A key feature of the Jewish Heaven is that it is inhabited by God. Its perfection therefore needs no further detailed description.

Christianity: This religion developed from Judaism and its picture of Heaven derives from it. Another important feature is that the Christian vision of Hell is spectacularly unpleasant.

Islam: This religion originated in the deserts of Arabia and its picture of Paradise is of shady areas with cool fountains.

Buddhism: The goal of this religion is enlightenment/nirvana.

Norse: The Viking paradise was called Valhalla. You only got into Valhalla by dying in battle. Your body was then collected by the Valkyries and taken to Valhalla where your days were spent fighting and your evenings 'carousing'. Overnight, your wounds healed and you woke up to do the whole thing again.



THE PAUMOTU CONCEPTION OF THE HEAVENS

A Polynesian view of Paradise with Nine Heavens

The Function of Paradise

Many people do not accept the existence of Paradise even though they may be otherwise religious. The notion does, however, afford considerable comfort to those in distress and therefore can be said to have utilitarian value (it is useful).

The bereaved find solace in the idea that their lost loved ones have 'gone to a better place'.

It is also indisputable that people living in bad conditions can find comfort in the idea that the future will be better. The most extreme example of this is the music of the African Slaves in the USA - *The Spirituals*. These are amongst the most moving pieces of music in any genre. One of the best known is *Swing Low, Sweet Chariot*. This was not published until just after the ending of slavery, but it does express the agony of those trapped in it. The meaning is biblical and the singer is asking that at the next pass of the Chariot of the Lord, it fly low enough to sweep him to heaven (in the manner of Elijah).

https://www.youtube.com/watch?v=GSb273c9tm4

Now, dry your eyes and read on.

Of course, the notion of a better future can make people inclined to accept the unacceptable when they should rebel.

Social Control

They idea of reward and punishment in the afterlife is a powerful incentive to people to behave ethically. Particularly as it is backed by the idea of an unseen police force with unlimited surveillance powers.

Does it, however, have the effect of silencing legitimate dissent and reasonable debate?

What are the beliefs about Paradise in your culture? Do you agree with them?

Christian Symbolism in the Arctic Circle.

The Arctic Cathedral, Tromsø, Norway.

Modern Religion

By number of adherents, the largest religions in the Modern World are:

Religion	Percentage of the Population
Christianity	31.2
Islam	24.1
Unaffiliated	16.0
Hinduism	15.1
Buddhism	6.9

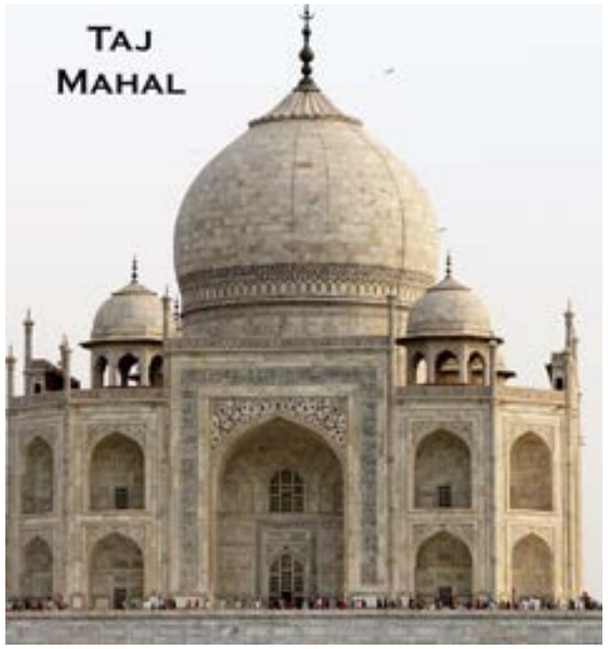
We can only give brief descriptions of the four main religions. It is an essential qualification before one can consider oneself educated to have an understanding of these religions, particularly if one is an atheist.

CHRISTIANITY

The Christian faith was founded by Jesus of Nazareth who lived two thousand yeas ago, in what is now Israel. Christian belief and practice is based on the writings contained in the Holy Bible. Divided into two parts, the Old and New Testaments. The first four books of the New Testament tell the story of Jesus and his teachings as recorded by four of his contemporary followers, or disciples. Christians believe that Jesus was the son of God, sent to save the world from wickedness. They believe that Jesus, who was crucified by the Roman rulers of that time, died and suffered and in so doing atoned for evil in the world. The ethical code of Christians is based on the Ten Commandments of the Jewish Old Testament and the Sermon on the Mount, a speech Jesus made which is reported in the New Testament. In this speech Jesus advocates, amongst other things, humility and neighbourly love and understanding. Equally important is the 'greatest commandment' of Luke 10:25-28 'You must love the lord ... with all your heart ... and your neighbour as yourself'. The two major Christian festivals are Christmas, in which they celebrate the humble birth of Jesus in a stable, and Easter, which commemorates his death and his living on with a new reality.

ISLAM

Islam was founded, in the 6th century AD, in what is now Saudi Arabia. Islam, which means submission to the will of God, has over 700 million followers, or Muslims, world wide. Islamic practices and beliefs are based on the text of the Holy Qu 'ran which is regarded as containing the infallible message of God as revealed to his prophet, Mohammed. There are five essential practices for every Muslim, known as the Pillars of the Faith. The First Pillar is *Shahada*, which is reciting the creed which is at the heart of the religion: There is no God but the One God; and Mohammed is the messenger of God. The Second Pillar is *Salat*, the ritual of prayer. Muslims must pray five times a day facing in the direction of Mecca, the birthplace of Mohammed. The Third Pillar, *Zakat*, emphasises compassion and mercy and the sharing of wealth. The Fourth Pillar, *Sawm*, makes it obligatory to fast during daylight in the Holy Month of Ramadhan, at the end of which is the festival of *Id-ul-Fitr*. The Fifth Pillar, *Haj*, states that Muslims are expected, once in their lifetime, to undertake a pilgrimage to the sacred city of Mecca.



HINDUISM

Hinduism, the major religion of India, is one of the world's oldest religions, dating back almost 4000 years. It is difficult to define because there is no single founder or text which is acknowledged by Hindus as being the source of their faith. They refer to their belief as *Sanatama Dharma*, which translates as 'eternal law'. *Sanatarna Dharma* suggests a commitment to an ideal way of life which is dependent on knowing the duties of one's class and station.

A major belief of Hinduism is the passage of a person's soul from body to body determined by one's actions or *karma*. Hindus also believe the universe is populated by many gods, and they may worship several. The image of one of these gods, usually a family, is often worshipped in a small shrine within the house. Hindu festivals include *Dipavali*, the Festival of Lights, at which burning lamps welcome *Lakshmi*, the goddess of prosperity into the house; *Holi*, a festival of springtime; and a ten-day period in autumn which ends with *Dashara*, a day of processions and celebrations.

BUDDHISM

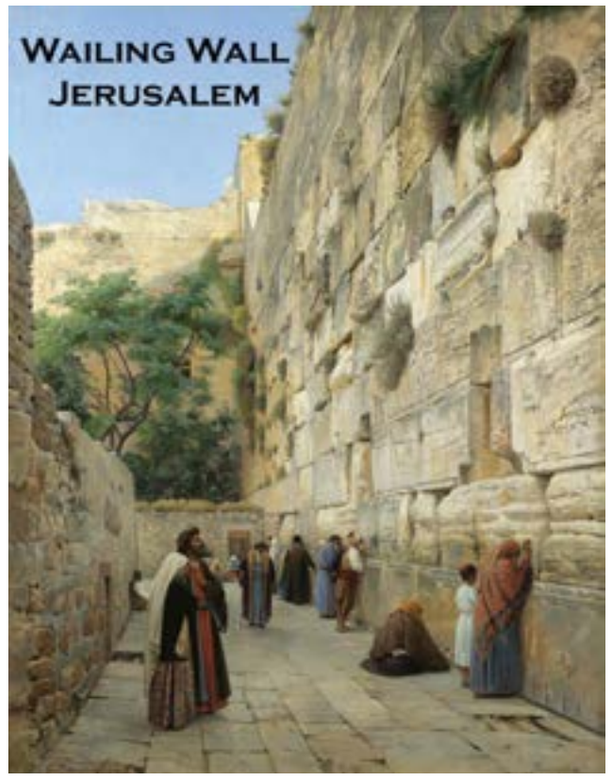
Buddhism, started in India in the 6th century BC by Siddharta Gautama, the Buddha, is practised throughout the world, especially in Asia. There are more than 300 million Buddhists worldwide.

The Buddha's teachings are based on what he called the four Noble Truths. The first Noble Truth is *duhka*, or suffering: human existence is occasionally painful but all living things, humans, animals and the gods are in a cycle of rebirth, in which their karma (actions) keeps them wandering. The second Noble Truth is the understanding that suffering has a cause, and that everything is part of a chain of events, each event creating further events. The third Noble Truth is that this chain can be broken, and the end of suffering can be reached. The fourth Noble Truth is that, through meditation and ethical practices, enlightened wisdom can be achieved.

Buddhist monks and nuns live in celibate communities relying on support from their followers. Through their generous acts the monks, the nuns, and the laity, are reborn into a life which could lead to enlightenment.

JUDAISM

Adherents of Judaism are not particularly numerous. It is included as the antecedent of Christianity and Islam.

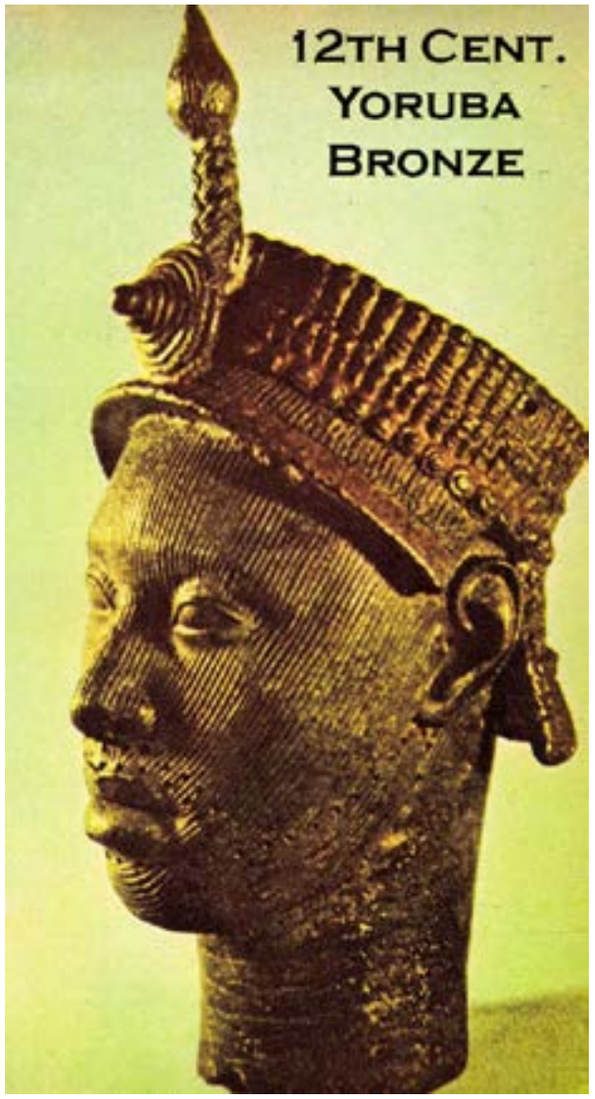


Judaism is the religion of the Jews. According to the Bible Judaism is based on the covenant made between God and Abraham. This covenant ordained the Jewish people's special relationship with God.

The first five books of the Bible, the *Torah*, reveal God's laws and the ways in which they should be obeyed. Judaism is a religion strong on ritual centred on the synagogue and the home. The central time for worship is the Sabbath (sunset on Friday until sunset on Saturday).

Annual festivals include *Yom Kippur*, (or Day of Atonement), *Rosh Hashanah*, (the Jewish new year), *Hanukah*·(commemorating the rededication of the temple in 165 BC after its desecration by the Syrians), and *Passover*, (celebrating the release of the Jews from Egyptian slavery)

Chapter 13 Indigenous Knowledge (option)



Indigenous means 'originating in and occupying a particular place'.

Hominids first appeared in Africa and so the non-migrant population of Africa is the only truly indigenous population on Earth. From Africa, a very small group crossed into Arabia and thence in various waves and over a long period of time, spread across the globe. The only unpopulated part being Antarctica. Today, the term is applied to groups that are thought to be the descendants of the first people ever to arrive in a particular place. This can be difficult to establish as the spread of humans occurred in multiple waves often controlled by climate events such as Ice Ages. These lowered the sea level (by more than 100 metres) and opened up land bridges between, for example, Asia and North America.

Indigenous Knowledge

If we interpret this a meaning knowledge specific to particular indigenous groups and not shared by others, what examples can we find?

1. Finding and preserving scarce resources

In harsh environments such as deserts, finding reliable sources of commodities such as water can mean the difference between life and death. Australia's Indigenous people revere Uluru (Ayer's Rock). This may be due to the fact that the rock is porous and acts like a giant sponge absorbing and storing large amounts of water when it rains. This feeds reliable waterholes at its base. Legends that these are inhabited by serpents may result from the need to deter people polluting this precious resource by bathing in it (or worse). The dot paintings so characteristic of these people are thought to have their origins in maps drawn on rocks which depict paths to the next waterhole.

2. Building Techniques

Building techniques are often very specific to an area of the world and can be determined by the availability of building materials - stone, wood etc.

Also important are local conditions. Experience of these is developed over extended periods of time. The people of Papua New Guinea build using a strong timber frame. Because the area is prone to violent tropical storms (cyclones) which generate high winds, the frame is covered with a light cladding such as palm leaves. This is designed to blow away in high winds. The frame remains and is re-thatched after the storm has passed.

The problem faced by the Incas of South America was that stone was plentiful, but stone buildings crack during earthquakes, which are common all around the Pacific Rim. The Incas developed a building style that has seen their buildings survive while the brick buildings of European migrants have collapsed. There are several secrets to this. The blocks were cut to fit very closely. The pattern is irregular. The loss of any one stone will not cause the wall to collapse. Not visible are the foundations which often rest on spherical river stones. These act like ball bearings, absorbing Earth tremors.

Timber framing was also common in Europe.

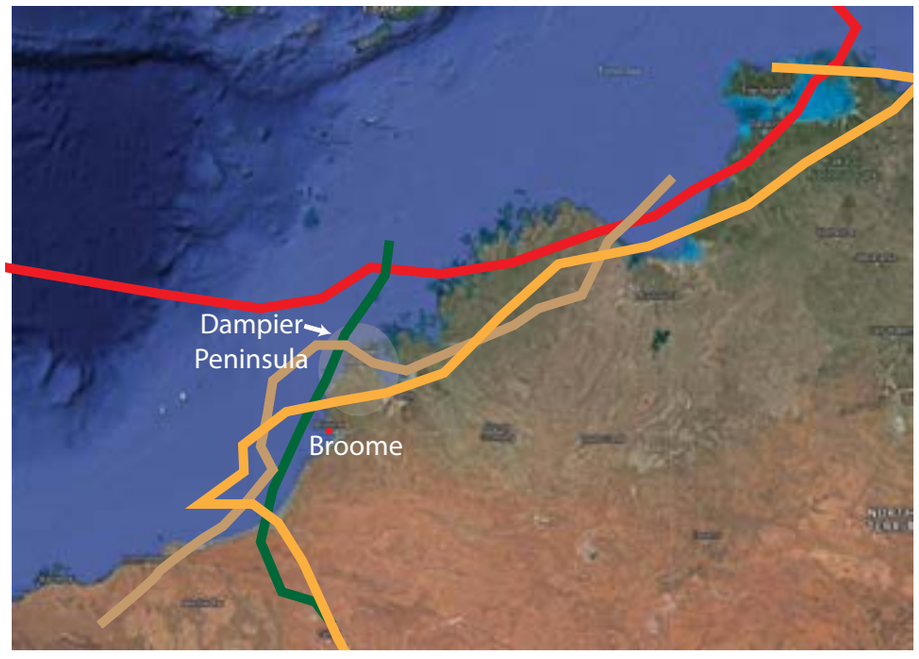
The framing was often oak which was easy to work when freshly cut but, when dried out, became very hard. There were different joints used in different places depending on whether the joint would be under tension or compression. This has made the buildings very durable. This one is around 500 years old and will last at least as long again. Like the palm hut example, the gaps between the framing are cheap and easily replaced or repaired. They are filled using a mixture of twigs, mud and horsehair known as ‘wattle and daub’.

3. Japanese Metallurgy

Japan is one of the few countries left whose population is almost entirely indigenous. Japanese ceramics and metallurgy are world famous for their high quality. Many of the techniques used are closely guarded secrets and are unique to Japan. These secrets are handed down by master craftsmen to their apprentices.

One of the non-secret phases of Japanese metallurgy is heat-hardening. Knife blades need to have two seemingly incompatible qualities. They need to be able to bend without snapping. They also need to have a very hard edge that will stay sharp. This is achieved by coating the blade with a layer of fine clay mud. This is allowed to harden. The blade is then heated to white heat in a forge. The room is then darkened, the blade is removed from the fire until it has cooled a bit and glows 'like the rising sun' - a call made by the master. It is then rapidly cooled by quenching in cold water.. The uncoated edge cools more rapidly than the coated spine. The difference between the crystals sizes in the hard edge and the softer spine is visible in the finished knife.

4. Weather



The map shows the North West part of Western Australia. Some of the Aboriginal people living on the Dampier Peninsula will tell you that it is not safe to live to the south of the place where the town of Broome now stands. They maintain that cyclones (tropical storms) tend to cross the coast there and not to the north of it (the Dampier Peninsula). There are certainly a number of aboriginal communities there including Beagle Bay, Bobieding, Djarindjin, Ardyaloon (One Arm Point) and Ngardalargin, along with numerous other smaller communities and outstations. There are many fewer to the South of Broome. The map shows the cyclone tracks in the 2017/18 season. Is this enough evidence to form a proper judgement on the claim? The fishing around the Peninsula is good. Is this a better reason for the locations of the communities?

Can you find any example of knowledge specific to the indigenous people of your region?

Here are some more pictures to set you thinking.

Do the indigenous people of your region have any distinctive:...

Foodstuffs

Ways of greeting strangers.

Decorative styles.

Religious insights.

National Dress.

Tribal symbolism.

Learning from Nature

The Vikings

The Vikings colonised Iceland and Greenland and crossed the Atlantic Ocean in their Longships. In reality, these were not much more than open boats. What led them to believe that they would find land if they sailed west from Scandinavia?

The answer is almost certainly that they followed the paths of migrating birds. They also carried caged birds which they observed on release. If the birds did not return they were encouraged to believe that they had found land.

The Sami

The Sami are an indigenous people who inhabit the northern parts of Scandinavia and Russia. This is, to put it mildly, a harsh environment that lies inside the Arctic Circle. The people live by fishing, hunting and 'herding' reindeer. The inverted commas are there because it is the reindeer who decide where they will go and the Sami follow them. The people are using the foraging skills of the reindeer.

Many indigenous communities have been devastated by contact with the outside World. Not so the Sami who have adapted while retaining the essentials of their culture. Their dog sleds have been supplemented by Snowmobiles and many of those juicy reindeer steaks end up in the gourmet restaurants of New York. Likewise, these fearsome giant crabs are likely headed for Asia.

Managing the intersection between indigenous people and the technological world is one of the most pressing problems facing us in the present and future. Sadly, the Sami are one of the few success stories. The remainder of this chapter will look at some issues that will face you as you take over the reins of power.

Conservation

It is often stated that the traditional lifestyles of indigenous people have less impact on the environment than those in the developed countries. There are several sides to this argument.

1. Population Density

Traditional communities are often low density and this can make it appear that they have a small environmental impact. Is this the case on a 'per person' basis? Some traditional methods of hunting involve setting fire to large tracts of forest or grassland in order to capture quite small amounts of food.

2. Energy

The consumption of energy per person in traditional lifestyles is a tiny fraction of that used by a car-driving, air-conditioned city dweller. However, that energy is often produced in smoky indoor fires that are known to produce respiratory problems. Even the widely reviled coal fired power stations have emissions scrubbers that mean they produce almost no 'smoke' at all.

3. Effluent Disposal

The disposal of human waste in modern cities is now so sophisticated that even a large city's sewage can produce almost no pollution at all. The rivers that flow through many of the great cities on Earth used to be open sewers. Now, many of them have fish and water birds again. The Singapore River (pictured) used to be filthy, but is now part of the city's water supply, feeding into the Marina Reservoir.

4. Protected Species

A number of species have been hunted close to extinction as a result of thoughtless behaviour by our forebears. The conservation movement is very much a western phenomenon. Indeed, some indigenous communities have special dispensations to hunt protected species such as whales, sea turtles etc. What is your view of this?

Health

Many indigenous communities have health outcomes that are considerably worse than those of their non-indigenous neighbours. This is a complex issue with no easy answers. Indigenous knowledge often had no understanding of the effects of alcohol. The results of that issue alone have been devastating in some areas.

The inter-mixing of peoples from around the World has meant that populations have been exposed to diseases to which they have no natural immunity. It is well known that the arrival of Europeans in the Americas resulted in huge death tolls to diseases such as influenza that were considered minor by the Europeans. It is worth recalling that the Europeans were hit pretty hard by tropical diseases such as Yellow Fever and Malaria. The events of 2020 and COVID have reminded us that travel has its health cost.

Problems remain in the modern World as the disparities in outcomes from modern evidence based medicine and traditional methods are large and it is widely accepted that even remote traditional communities are entitled to some level of modern medicine. There are, of course, large difficulties in actually delivering this in a country such as Australia with its huge distances. Our picture shows an Aboriginal patient being loaded onto a Royal Flying Doctors Air Ambulance at Coober Pedy for transfer to Adelaide Hospital. The flight will likely take between 2 and 3 hours (the road trip is 10 hours). And remember that, for the staff, the trip is two way. On the bright side, noting that COVID is most dangerous to old people, at least one Aboriginal community decided to isolate its old folk in a remote outstation. Maybe not indigenous knowledge, but certainly wisdom.

We are considering 'Indigenous Knowledge' and it is clear that disparities in health outcomes will not be corrected until there is a wider knowledge of the importance of:

- diet
- preventative medicine such as vaccination
- ... please add to this list...

Education

We are engaged in an educational activity (TOK) and need to reflect on the core values of the educational enterprise. One of these is that every child has the right to fulfil their potential. This means exposing them to a wide range of opportunities. Our picture shows the sort of seemingly idyllic surroundings many of us associate with indigenous lifestyles. Calm weather, beautiful scenery, one fish for lunch, one for dinner and one for the dog. A mango from the tree followed by a perfect sunset.

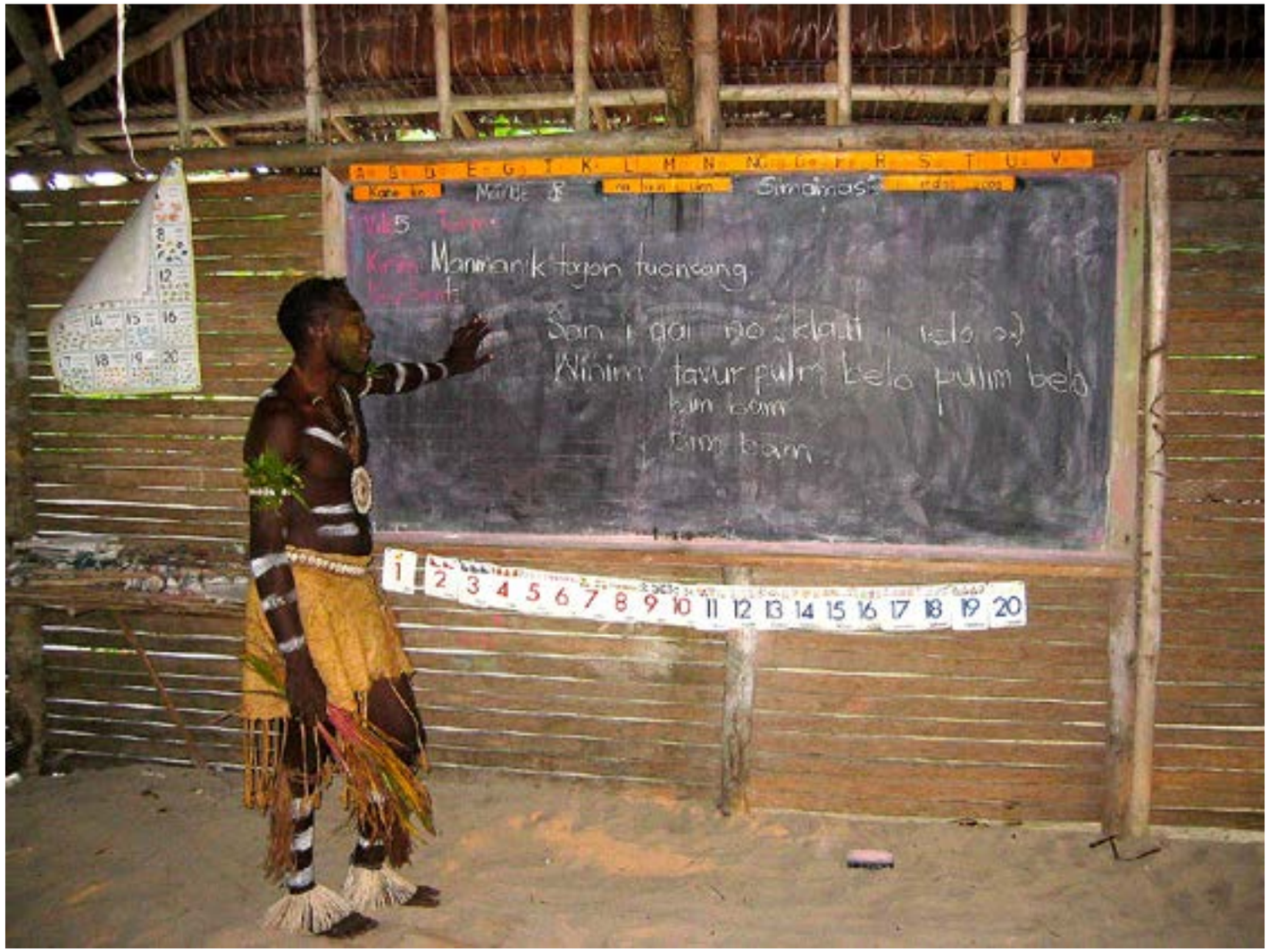
Even if we know that this is not exactly the truth, many of us who have visited these communities come away with some level of envy.

But what about the children?

What if one of them has the potential to become another Einstein or Mozart? Don't we owe it to them and to the wider World to give them the chance?

As with the Health issues we have just discussed there is no correct answer here - no Knowledge, Indigenous or otherwise. Much of this is evolving and it is certain that the question will still be open when some of you reading this occupy positions of responsibility and are able to affect policies.

We finish the chapter with an example from an island in the western Pacific that is a part of Papua New Guinea. Let me begin by introducing the teacher and his primary level classroom. I will call him Tija, though that is not his real name.



Tija is wearing traditional dress in honour of visitors. His normal dress for the working day is less formal - as you will see. He qualified as a teacher in Australia but he is a full member of his village community and understands its values. He also understands the objectives of education in a western sense. He has both Indigenous and Scientific Knowledge.

What does the picture tell you about this school? The floor is sand and the walls and roof are the structure discussed earlier - a strong frame with light cladding, typical of tropical areas. This is fine as schools are human institutions, not impressive buildings.

The Pacific islands with their large number of widely spread communities have a considerable number of different languages. Papua New Guinea (PNG) is the most linguistically diverse area in the World with over 800 live languages. To cope with this, the

islanders have evolved a common language. In PNG it is called *Tok Pisin* and is one of the official languages. In other parts of the Pacific it is called *Pidgin, Bislama* etc. It is designed to have a small vocabulary, making it easier to learn than, for example, English. To make up for this, new objects have to be explained rather than getting new words. *Nambawan pikinini blong Kwin* is 'number one child belonging to the Queen - Prince Charles'. Tija has written some ToK Pisin on the board. You can probably get some of the meaning - and that is the point!

Can you think of another example of a language that evolved to help groups with different languages communicate. If not, *oy veh*![4]

In addition, to *Tok Pisin*, the children must learn their local language. Note that the writing on the board uses the Roman Alphabet and the numbers below use Hindu-Arabic notation. However, Tija has decided not to use western spelling books (C is for car) and has made his own 'flashcards' that refer to things with which the children will be familiar.

Tija has also made his own school books.

4 "Oh woe" in Yiddish, a language spoken by about 1.5 million mainly Jewish people. Yiddish is so evocative that many of its words have found their way into other languages: *schlock* - poor work, *nosh* - snack, *klutz* - clumsy person etc.

Tija's objective is to give his children the opportunity to go on to Secondary and Tertiary Education if they so wish. If they do, it will mean long periods at boarding school away from their families and home. That cannot be an easy decision.

In addition, the children must learn to survive in their environment.

This means learning how to make a traditional canoe and how to fish from it.

They must learn about dangerous animals, venomous fish and which Fruits of the Forest are safe to eat.

Equally important, they must hear the stories and legends of their tradition.

Part Three: Assessment

Chapter 14 The Essay

We begin by reminding you of the Course Objectives:

Having completed the TOK course, students should be able to:

- demonstrate TOK thinking through the critical examination of knowledge questions
- identify and explore links between knowledge questions and the world around us
- identify and explore links between knowledge questions and areas of knowledge
- develop relevant, clear and coherent arguments
- use examples and evidence effectively to support a discussion
- demonstrate awareness and evaluation of different points of view
- consider the implications of arguments and conclusions. ©IBO 2020.

In writing your Essay, we begin by reminding you that your Essay will be the umpteenth that the Assessor has read.

Try to:

MAKE IT EASY TO READ

and

INTERESTING

Both of these are easier said than done.

Readability

We presume that you will be using a Word Processor to work through the drafts up to the final version. Some people like to begin with a skeleton such as Science - Biology - Darwin's *Origin of Species* - Religion - Dispute about Theory of Evolution - Conclusion. They then set about hanging the flesh on the skeleton. This can help in giving the Essay a structure. Other people Draft - Read - Draft etc. until they are satisfied. Listen to your teachers on this! Choose the strategy that suits you best.

There are three things to watch:

1. Don't use very long and complex sentences. These only work if you are a true Master of Language.
2. Don't use long and pompous words if you have a simple alternative. Don't say 'obfuscate' when you mean 'confuse' or 'notwithstanding' instead of 'despite'.
3. Beware of repetition inside a sentence. 'There is a large chance of a large payout' is better as 'There is a high chance of a large payout'. You really do have to be Shakespeare to get away with 'Tomorrow and Tomorrow and Tomorrow...'.

That is not to say you should never do these things. Just be careful.

Interest

This is the really difficult one and the reason why there are so many people who think they are great writers and so few Great Writers.

Here are some tips:

1. Use actual examples in your essay. Avoid entirely theoretical treatises.
2. Research your examples properly. It is very irritating reading dogmatic pieces by people who are unable to support their claims with evidence. Avoid 'Twittering'.
3. It can help to use examples that are inside your particular areas of interest. If you play a musical instrument and are discussing the Arts, why not make that Art - Music.

Some examples. The IBO will give you six titles to choose from and there are some examples in the documentation that you can practise on. We have paraphrased some of these in developing these comments.

1. **How important are the opinions of experts in the search for knowledge? Answer with reference to the arts and one other area of knowledge.**

It is essential that you address the question. You must use the Arts as one of your areas of knowledge. This essay must also focus on experts and 'Knowledge by Authority'. Do not wander off and discuss two examples from Science.

We have suggested that you 'hang' your essay on some concrete examples. We suggest something like the Turner Prize.

This is an annual prize given in the UK to a British visual artist. If you are going to use an example such as this, make sure you research the topic properly.

You would, for example, need to know that the award is named after J. M. W. Turner (1175 - 1851). Turner's work was considered revolutionary during his lifetime and the award reflects the search for the 'new' in Art. He lived at a time when muscle power was giving way to steam and photography was coming to prominence. Many of his greatest works reflect these transitions. If you have a spare half hour take a look at this talk on *The Fighting Temeraire*, one of Turner's most famous works.

https://www.youtube.com/watch?v=8O-fna8HrWw

Now that you have set the scene and explained why the expert judges are looking for novel works, you can look at some of the more controversial winners such as Martin Creed's *installation Work No. 227:* (2001 winner) - an empty room in which the lights were switched on and off periodically.

The Turner Prize is a good example as, like other art prizes, it is always accompanied by unofficial rulings - peoples' Turners which you can set against the expert 'Knowledge'.

As a science example, you might take a topical event such as the COVID-19 episode. Governments around the World took some very extreme measures as a result of a range of very pessimistic predictions by expert Epidemiologists. As before, you must collect proper evidence before forming your commentary. What was known about COVID-19 in the first half of 2020 and what predictions were actually made? Early *post-facto* assessments are that some these of predictions were very seriously wrong and have resulted in over-reactions by Governments. But get your facts right!

In summing up, you may conclude that the experts get things wrong in both these cases. Beware of drawing the conclusion that no experts are to be trusted. Look at the objectives of the course which include:

- develop relevant, clear and coherent arguments
- use examples and evidence effectively to support a discussion
- consider the implications of arguments and conclusions.

2. To what extent do you agree with the claim that "knowledge is of no value unless you put it into practice" (Anton Chekhov)? Answer with reference to two areas of knowledge.

This claim is quite difficult to argue in favour of. It is much easier to look for knowledge that has value but no utilitarian value.

As before, you should seek out examples that you understand to illustrate the points you are trying to make. Mathematics stands out here as it has the right sort of ethereal quality to start with. There are, for example, a number of unsolved problems existing that are accessible to most of us.

Goldbach's Conjecture is:

Every even integer greater than 2 is the sum of two primes.

At right is a letter from Christian Goldbach to Leohard Euler dated 1742 in which he raises the matter.

Recall that primes have no factors other than themselves and one: 2, 3, 5, 7,11, 13...

1 is not considered prime.

Even numbers are 2, 4, 6, 8...

The conjecture is easy to check for particular examples:

$4 = 2 + 2$ $6 = 3 + 3$ $8 = 5 + 3$ $10 = 3 + 7$ $12 = 5 + 7$

However, the conjecture is about an infinite number of cases and so cannot be proved by trying them all.

Fame awaits the mathematician who proves the truth (or falsehood) of the conjecture. But would such a proof have any use?

Since we are talking Mathematics, it is worth pointing out that to prove the falsehood of the Conjecture it is only necessary to find ONE even number that cannot be written as the sum of two primes. Have we already proved the falsehood of Chekov's claim?

As a slight deviation from the exact meaning of the question, Science does offer several examples of Knowledge that appeared at the time to have no use but which subsequently became very useful.

In his 1917 paper *On the Quantum Theory of Radiation*, Albert Einstein explained that microwaves and light could be amplified using energised atoms. The observation remained just that until 1951 when Joseph Weber took the matter up again and proposed that microwaves could be amplified in the way Einstein had suggested. Then in 1953, Charles Townes and graduate students James P. Gordon and Herbert J. Zeiger produced the first working microwave amplifier. This was after a number of experts such as Niels Bohr and John von Neumann had assured them their device violated physical principles and could not work. One of the first demonstrations of Microwave Amplification by Stimulated Emission of Radiation (MASER) was conducted live on TV. This author was watching. Though, as microwaves are invisible, the camera focussed on a meter whose needle moved to the right. It might have been a turning point in Applied Science, but it was not that exciting (to a 6 year old).

Our picture shows laser welding - one of the literally thousands of applications for lasers.

3. Are there fewer ethical constraints on the pursuit of knowledge in the arts than in the human sciences?

Before starting an essay on a subject such as this, make sure that you understand all the words used in the question. For example, 'ethics'. The word has more than one meaning.

From Wiktionary - an online Dictionary.

1. The study of principles relating to right and wrong conduct.
2. Morality.
3. The standards that govern the conduct of a person, especially a member of a profession.

We have been given two areas of Knowledge to focus on: The Arts and Human Sciences. Everyone is governed by the standards of general ethics - murder is wrong etc. However, some professions have codes of behaviour that are specific to their occupation. Thus, it is considered unethical for doctors to treat members of their own family. This does not apply to, for example, librarians.

Are there specific ethical structures for Human Scientists? For Artists? You will need to familiarise yourself with these and the bodies that oversee them. The third of our definitions is the most fertile ground for your discussion.

You should, for example, discover that most Universities have Ethics Committees that approve research proposals on all sorts of grounds including ethics. What sort of criteria do they apply?


Now he fears even Santa Claus

An example of a early (~1920) project in the Human Sciences is the *Little Albert Experiment*. The object was to investigate phobias (irrational fears). The subject was a baby whose mother worked in the institution and whose permission was not obtained (or so most sources state). The experiment tried to induce fears of stimuli such as exposure to rats (and Santa Claus!). It is difficult to imagine what was in the minds of the researchers in even proposing such an experiment, let alone actually conducting it.

A later, but still controversial example is the *Milgram Experiment*. This had the noble cause of trying to unravel what had converted a cultured and civilised (Beethoven, Goethe, Gauss) German population into people capable of the crimes of the Nazis.

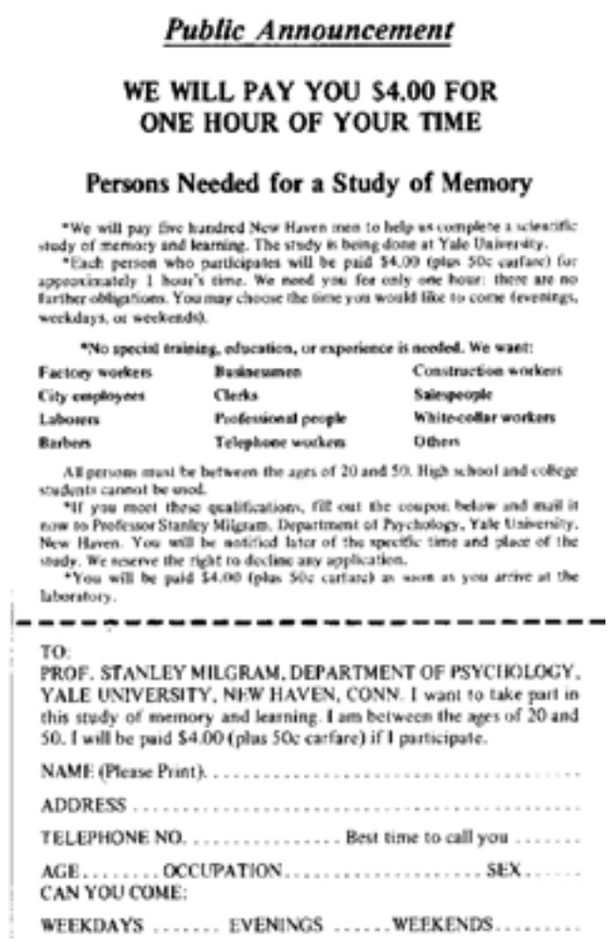
A brief description of the methodology can be found at: https://www.youtube.com/watch?v=fCVll-_4GZQ

Gaining knowledge about this in case it might serve to prevent a recurrence is a noble cause. But did it justify misrepresenting the objectives? See the announcement. $4 is about $35 today.

The results of the experiment are also the subject of controversy. Many Human Sciences experiments can be criticised on the grounds of sampling methods (small samples chosen from restricted populations). Milgram's work has, however, been replicated to an extent unusual in the Human Sciences.

These examples are from the past. What is the situation today?

How do you research the result of stress on people without subjecting them to stress?



Public Announcement

WE WILL PAY YOU $4.00 FOR ONE HOUR OF YOUR TIME

Persons Needed for a Study of Memory

*We will pay five hundred New Haven men to help us complete a scientific study of memory and learning. The study is being done at Yale University.

*Each person who participates will be paid $4.00 (plus 50c carfare) for approximately 1 hour's time. We need you for only one hour: there are no further obligations. You may choose the time you would like to come (evenings, weekdays, or weekends).

*No special training, education, or experience is needed. We want:

Factory workers	Businessmen	Construction workers
City employees	Clerks	Salespeople
Laborers	Professional people	White-collar workers
Barbers	Telephone workers	Others

All persons must be between the ages of 20 and 50. High school and college students cannot be used.

*If you meet these qualifications, fill out the coupon below and mail it now to Professor Stanley Milgram, Department of Psychology, Yale University, New Haven. You will be notified later of the specific time and place of the study. We reserve the right to decline any application.

*You will be paid $4.00 (plus 50c carfare) as soon as you arrive at the laboratory.

TO:
PROF. STANLEY MILGRAM, DEPARTMENT OF PSYCHOLOGY, YALE UNIVERSITY, NEW HAVEN, CONN. I want to take part in this study of memory and learning. I am between the ages of 20 and 50. I will be paid $4.00 (plus 50c carfare) if I participate.

NAME (Please Print). . . . . .

ADDRESS . . . . . .

TELEPHONE NO. . . . . Best time to call you . . . . . .

AGE . . . . . OCCUPATION . . . . . SEX . . . . .

CAN YOU COME:

WEEKDAYS . . . . . EVENINGS . . . . . WEEKENDS . . . . . .

What of The Arts?

Are there any committees overseeing the conduct of artists?

One of the restraints you will encounter is 'Censorship'. This can be imposed by Government or be voluntary, such as the British Board of Film Classification (formerly, The British Board of Film Censors) which is a creation of the industry itself.

Literature has always been the subject of episodes of banning and some authors have been persecuted for propagating views their governments found unacceptable. Boris Pasternak, author of *Doctor Zhivago*, was the subject of rolling sanctions by the Soviet Union and his book was banned.

As we have observed, we suggest that you use examples. Suppose you choose literature, you will want to choose examples that exist on the edge of these invisible boundaries. If you base your essay on a book, make sure that you have read it.

Our examples are:

A Clockwork Orange (Anthony Burgess, UK , 1962). The novel centres around a violent youth gang. Its leader, Alex, engages in an escalating cycle of violence that ends with him murdering a woman. Alex is, however, a devotee of the music of Beethoven ('Lovely Ludwig Van').

Alex is caught and in prison is subjected to an aggressive program of aversion therapy. This cures him of his violence, but also robs him of his love of music. He now makes as much sense as a 'clockwork orange'.

The novel has occasionally been the subject of local bans, though these have mainly been triggered by Stanley Kubrick's graphic film of the book.

Both the book and the film have been criticised for excusing violence by portraying it as a part of creativity. The film, for example, portrays violent scenes as if they were some elegant ballet accompanying them with classical music. The book is distinguished by its frequent use of an invented slang (Nadsat) that the reader is left to decipher. Read the book and decide where you stand. Is Burgess condoning or condemning or providing a dispassionate commentary on violence?

Lord of the Flies (William Golding, UK, 1954). William Golding was a School Teacher and this book is his first. Initially it sold slowly, but has become a classic. There is a fair chance you have already been required to read it. Golding received the Nobel Prize for Literature and was Knighted by the British Crown. Peter Brook made it into a very evocative film. The book's subject is the thinness of the veneer of Civilisation.

A group of school children are marooned on a desert island. Very quickly, a pecking order is established and one child in particular is bullied mercilessly. The children are eventually rescued. The book can make the reader uncomfortable as it describes civilisation's descent into a brutal dictatorship and the perpetrators are children.

Catch 22 (Joseph Heller, USA, 1961). The novel is set on an island off the West Coast of Italy during World War II. The author, Joseph Heller, had been aircrew in Italy and knew of the events he was writing about.

The novel's main protagonist, Yossarian, is a bombardier who has recognised that flying bombing missions is dangerous and 'wants out'. He claims insanity and insists he should be sent home. The response is that if he has realised that flying missions is dangerous, he cannot be mad and must continue to fly. Yossarian is, as a result, a realist: 'The enemy is anybody who's going to get you killed, no matter which side he is on'. Expressing the opinion that one's own side might be more dangerous than the enemy at the height of the Cold War was controversial.

The book uses a comic style to discuss the violence of war. Is this ethical?

History has now judged each of these books to be classics, but does this mean their authors acted ethically?

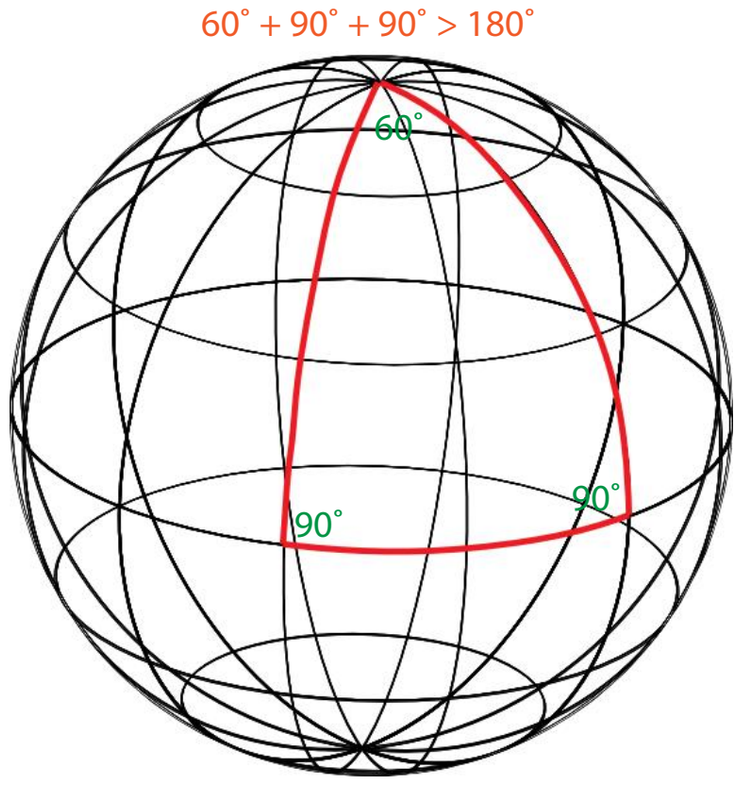
4. Is the division of the natural sciences and mathematics into separate areas of knowledge artificial?

Don't choose a topic like this unless your studies are directed to these areas!

As we have said before, make sure that you have understood the question before trying to answer it.

Natural Sciences. At school, this is usually considered to be Biology (the study of life), Physics (the study of matter and energy), Chemistry (the study of the way atoms combine to form molecules). There are a number of other disciples such as Geology (the study of the Earth's materials), Cosmology (the study of the origins and structure of the Universe). There are also intersections between the main disciples such as Biochemistry (the study of the chemistry of life), Thermodynamics (the study of the heat changes in chemical reactions), etc.

The governing rule of Science is that its Theories must match Reality. If they don't, there is no argument, Reality wins.



Mathematics. Many people confuse Mathematics with Arithmetic (the use of numbers). There is much more to it than that - Geometry, Algebra, Topolgy, Logic etc. Your essay would need to address that.

A 'Mathematics' is a set of axioms with rules of inference that do not lead to contradictions. If it is possible to prove that A = B, it cannot be possible to then go off and prove that A ≠ B. Apart from that it is 'open season' on truth in mathematics. There is nothing wrong in a geometry in which the angles of a triangle do not add up to 180° (as they do not with triangles drawn on a sphere like the surface of the Earth).

Is this distinction alone sufficient to justify the separation of Mathematics and the Sciences into two separate areas of Knowledge?

Here is a second difference to consider. The term 'Theory' as used in Science is often confused with the general use of the term. "Leo has a theory that all his phone calls are monitored by the CIA" probably has no supporting evidence at all. Newton's **Theory of Gravity** has a whole wealth of supporting evidence. That does not mean that it is the last word on the subject - it isn't.

In Mathematics, however, there are statements that can be made with absolute certainty. In arithmetic, the statement that 'there is no fraction exactly equal to the square root of 2' can be made with absolute certainty. That is not to say that all statements in Mathematics can be classified as being either true or false. They cannot.

Finally

Read your Essay carefully.

Watch out for spell-checkers and auto-corrections such as 'Leaning Tower of Pizza'.

Show it to someone else such as a family member.

Hand it in on time.

Once you have handed it in, that is it. Don't worry about whether or not you could have done it better.

Chapter 15 The Exhibition

You are required to create an Exhibition of three objects and to present a commentary on these. This means addressing the objectives of the course (see the beginning of the previous Chapter). The IBO have also provided these 'prompts':

What counts as knowledge?

- On what grounds might we doubt a claim?
- Are some types of knowledge less open to interpretation than others?
- Is bias inevitable in the production of knowledge?
- Should some knowledge not be sought on ethical grounds?
- What role do experts play in influencing our consumption or acquisition of knowledge?
- How can we distinguish between knowledge, belief and opinion? ©IBO 2020.

Try to address at least some of these in your choice of object and, more importantly, in the commentary you provide.

We have already suggested that you take a look at the BBC's *History of the World in 100 Objects*. Where else might you look?

1. Talk to some family members. The World is changing rapidly and some items that you may take for granted have made their appearance fairly recently. It is, for example, highly likely that your Grand Parents completed their schooling without electronic calculators. Ask them if they can tell you about 'Log Tables' and 'Slide Rules'.
2. Look at some old books from your School Library. We are going to suggest, in a later Chapter, that a vintage Atlas can provide a fascinating snapshot of a past era.
3. The Internet, of course, provides a gigantic reservoir of jewels and dross for you to select from.

In what follows, we will use **bold type** to highlight Areas of Knowledge as they emerge.

Object 1 - A Credit Card

We provide notes only. You should make similar notes on your object and then use them to construct a concise narrative that will interest your audience.

American Express are known for their 'charge' cards rather than credit cards. This is a credit card which does not require complete repayment of all purchases within a fixed period (usually a month). Credit cards (VISA, Mastercard etc.) allow deferred instalment payments.

The **History** of the credit card reflects some changing attitudes in Society (**Ethics - Human Sciences**). Shakespeare puts these words into the mouth of his character Polonius (*Hamlet*) who is advising his son:

Neither a borrower nor a lender be,

For loan oft loses both itself and friend,

And borrowing dulls the edge of husbandry.

He is warning that if you lend a friend money, you run the risk of losing both your money and your friend. 'Husbandry' means the proper management of your life. Borrowing to cover living expenses was frowned upon. If you wanted to borrow money, you had to have a good reason such as buying a family home. Loans were only issued after an interview with a Bank Manager or similar.

Some **religious traditions** also banned some of the practices of money lending. Christianity used to, and Islam still does, ban the charging of interest. It is for this reason that banking became a speciality of Jewish Communities. They did not choose it, it was virtually forced on them.

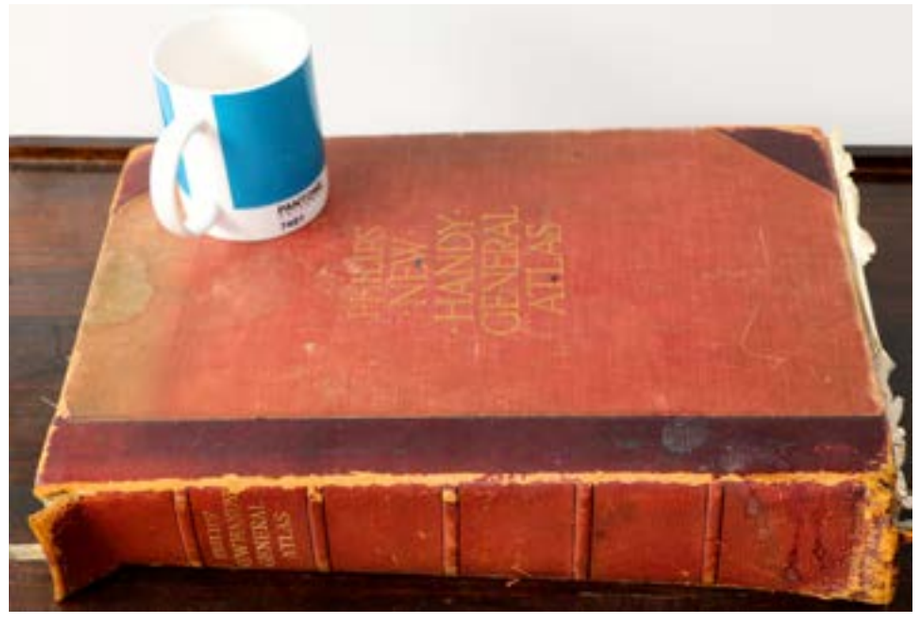
The arrival of the first credit cards in the 1970s changed all that. A credit card is a pre-approval for borrowing and users would probably take offence if their card company told them they could use the card to buy food, but not wine.

Physically, the card is plastic (**Science** - Chemistry). The artwork (**Arts**) is there for corporate identification and to make the card hard to copy. Many cards now carry holograms that look like shimmering rainbow images. These are very difficult to counterfeit.

The silver square is a passive radio-frequency identification chip (**Technology**). This means that it does not have a battery. It is powered by the energy of incoming radio waves. When it gets a radio input it recognises it 'skwarks'[1] a response. This enables the card to make contact free connection with the ATM machine or shop pay terminal. The COVID-19 episode has given this method of payment a huge boost as it enables contact free payments and reduces the chances of cross infection.

The exchange of information between the card and the banking system needs protection for security and privacy reasons. Banks are understandably reticent about how they achieve this, but some level of Pubic Key Encryption (**Mathematics**) is probably involved. The theory behind this is surprisingly simple and a brief outline in your commentary would be advisable.

Object 2 - An Atlas



This object is an Atlas that was owned by a school girl in the 1920s. The title 'New' was true in 1920 when the book was published. It is doubtful if the book could ever have been correctly described as Handy.

Overleaf is the classic School Atlas World Map. What do you notice about it? Here are a couple of hints:

The Map shows (in pink) the British Empire (on which the Sun never sets) at its height.

The Map uses Mercator's Projection.

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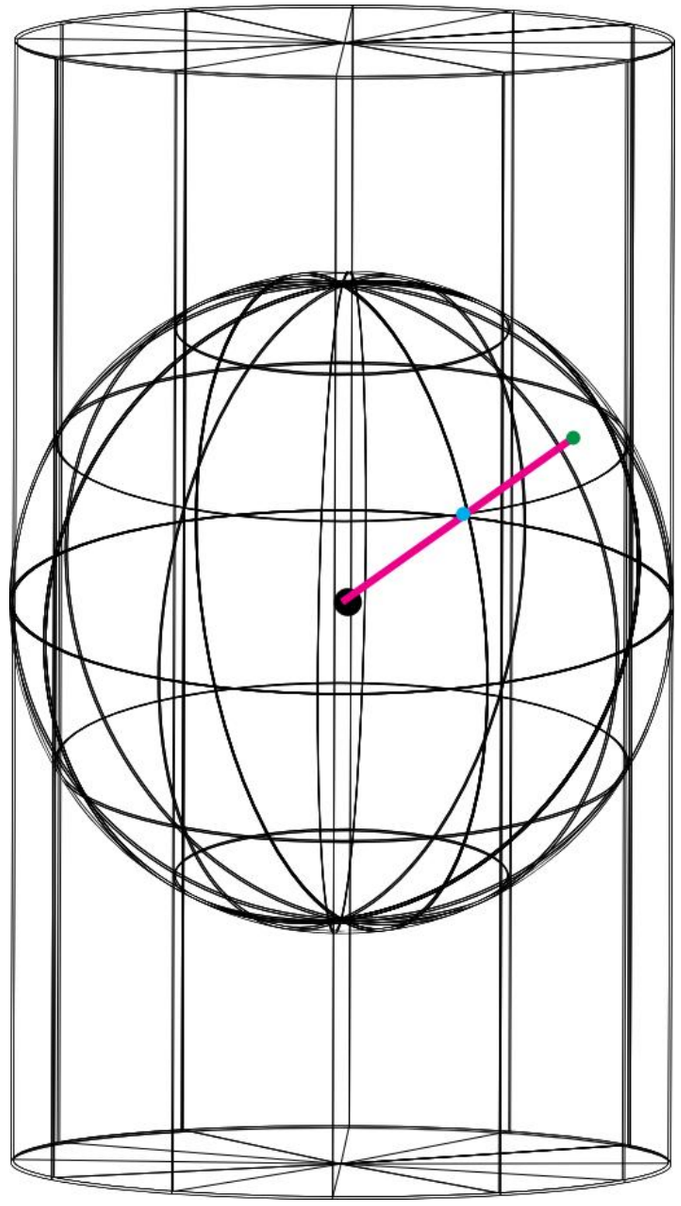
1 The term 'skwark' comes from aviation. Aeroplanes carry a powered transponder that 'skwarks' a reply when it detects a radar pulse. The reply identifies the aeroplane and enables air traffic control to track it. The original RAF device was codenamed 'Parrot'.

What Knowledge goes into a map?

1. Projection



The Earth is a sphere (nearly). Most maps are printed on flat sheets of paper. It is a fact of **Mathematics** (Topology) that it is not possible to correctly 'map' a sphere onto a plane. By 'map', a Mathematician means 'set up a direct correspondence between reality and the map'. If two places are nearby in reality, they must be nearby on the map. Whatever we do, we will always introduce distortions.

A very common projection is due to Gerardus Mercator (Belgium, 1512 – 1594). The Mercator Projection imagines the Earth surrounded by a giant sheet of paper that has been rolled into a sphere. Features, such as a town on the Earth (blue dot) are placed on the map (green dot) by drawing a line from the Earth's centre, through the town, onto the cylinder. The cylinder is then unrolled to become a flat map.

Lines of longitude (circles through the poles) are mapped to vertical straight lines and lines of latitude are mapped to horizontal straight lines. Points near the poles have no representation on the map.

The projection is, however, very good for marine navigation. If you want to sail from Lisbon to New York, measure the bearing on the map (with a protractor), sail that course (using a compass) for the whole trip and you should get there following what is known as a rhumb line. The resultant improvement to safety in the days of sail must have been huge.

The Mercator Projection does, however, distort distances and areas. This is why the map has no scale. Landmasses near the poles have their size exaggerated. India looks a lot smaller than Greenland. In fact, the area of India is about 3.3 million square kilometres and that of Greenland is 2.2 million square kilometres, Some modern historians have suggested that this is a deliberate plot to make the countries being colonised look small. Not really the case!

If you are using a map, make sure that the projection matches your intended use.

2. Purpose

The Mercator Map we have been looking at had the purpose of displaying the political alignments of the World's countries.

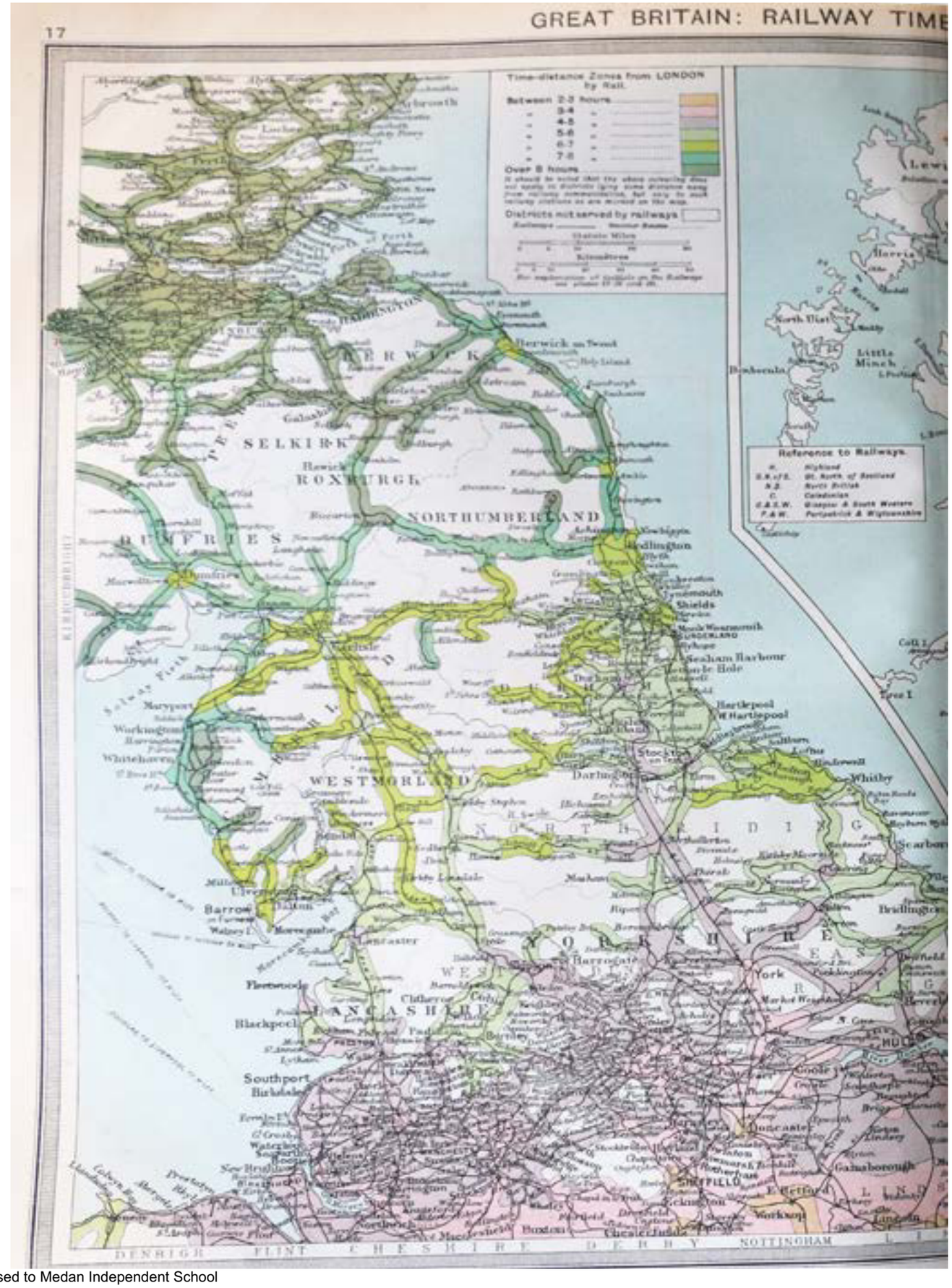
We have chosen to highlight one of the more unusual maps in this vintage Atlas. This shows a part of Britain and uses a projection that allows a distance scale (in the middle near the top).

However, the point of this map is to display the times it will take to travel by train to London.

In addition to the mapping skills already discussed, this map has also employed the skills of **artists**.

However, the unusual feature of this map is the light it throws on the period of **History** to which it belongs. This is the period immediately following the First World War.

Transport was dominated by Steam Trains. The road system was still the old stage coach tracks. Private cars were almost unknown. An expert had opined that there would never be many private cars because the supply of chauffeurs was limited! How easy was it to get around in the England of the 1920s? Find the city of York. It is in a pink area and so has a time of 3-4 hours to travel to London. As I write, it is 6am in the UK. If I had to travel to London, according to Google maps, it would take 2 hours 11 minutes by train or 4 hours 13 minutes by car.



Object 3 - A Road Sign

Roads probably began as animal tracks. Humans would have followed these when travelling on hunting expeditions. Traffic on these compacted the earth and they would have got very muddy when it rained. Paved, all-weather roads appeared quite early on. For example, the ancient city of Ur (4,000 BC) and ancient Egypt (2,500 BC) built paved roads. Corduroy roads made from logs have also been dated to 4,000 BC.

Long distance travel on these early roads was probably rare and most travellers almost certainly knew their local roads intimately.

The Roman Empire was at its hight about 2,000 years ago and was famous for its paved road system. Many of these roads are still in use and are noted for their straightness. The system was very large and stretched for thousands of miles from the Middle East through North Africa and Southern Europe to Hadrian's Wall in Northern England. Messages could travel at 50 miles per day and a legion marched 25 miles a day. This meant that news of trouble was disseminated rapidly and the legions to quell it could arrive before things got out of hand.

The system had some signage such as distance markers telling travellers how far they were from the next town. These can still occasionally be found. These signs have impacted **Language** as well. Terms such as 'road-map', 'signpost' and 'milestone' have expanded meanings to include project management and important points in our lives.

Most of the early signs had written information. As car speeds increased, it became obvious that expecting drivers to read warning information was not the best way of getting guidance to drivers.

In the UK (where our sign comes from) the Government set up a Committee (The Warboys Committee) which reported in 1963.

The Committee made a number of recommendations and, as a result, two Graphic Design (**Arts**) experts were appointed to design the new signs. There are two very surprising aspects to this decision. The first was that the job was given to two people. The second was their area of expertise - Graphic Design. Today, a job of this importance would attract an army of experts, a multi-million budget and a timeline of years.

The two people who got the job were Richard "Jock" Kinneir (1917 – 1994) and Margaret Calvert (born 1936). They made a number of decisions based on their knowledge of Human **Perception** and Graphic **Arts**.

Their choice of colours: red, white and black was already known to be 'eye-catching'. Some of the images they chose had already been used either in the UK or in other countries. However, their detailed designs have rightly been recognised as outstanding examples of visual communication.

Our chosen image - children crossing - is used at schools and other places. Often there is a panel under the sign such as 'School'. The font used was also designed by Calvert and Kinnear and is known as 'Transport'. It is the graphic image, however, that has the impact. Note that the graphic not only conveys the message 'children' but also a reminder that children can be impulsive and run across roads. There is no way of knowing how many young lives have been saved by this simple graphic.

As a footnote, a second committee was set up in the '80s to re-examine road signage. They made no suggestions for improvements.

Margaret Calvert talks about her work with lettering (for the Anderson Committee) and one of the graphic signs which she wishes they had done a bit better:

https://www.youtube.com/watch?v=pyBrrmDw6-k

Object 4 - A Bowline

This object is simple, but immensely powerful. We have been unable to find any description of its origin other than 'Ancient'. It is a piece of **Indigenous Knowledge**.

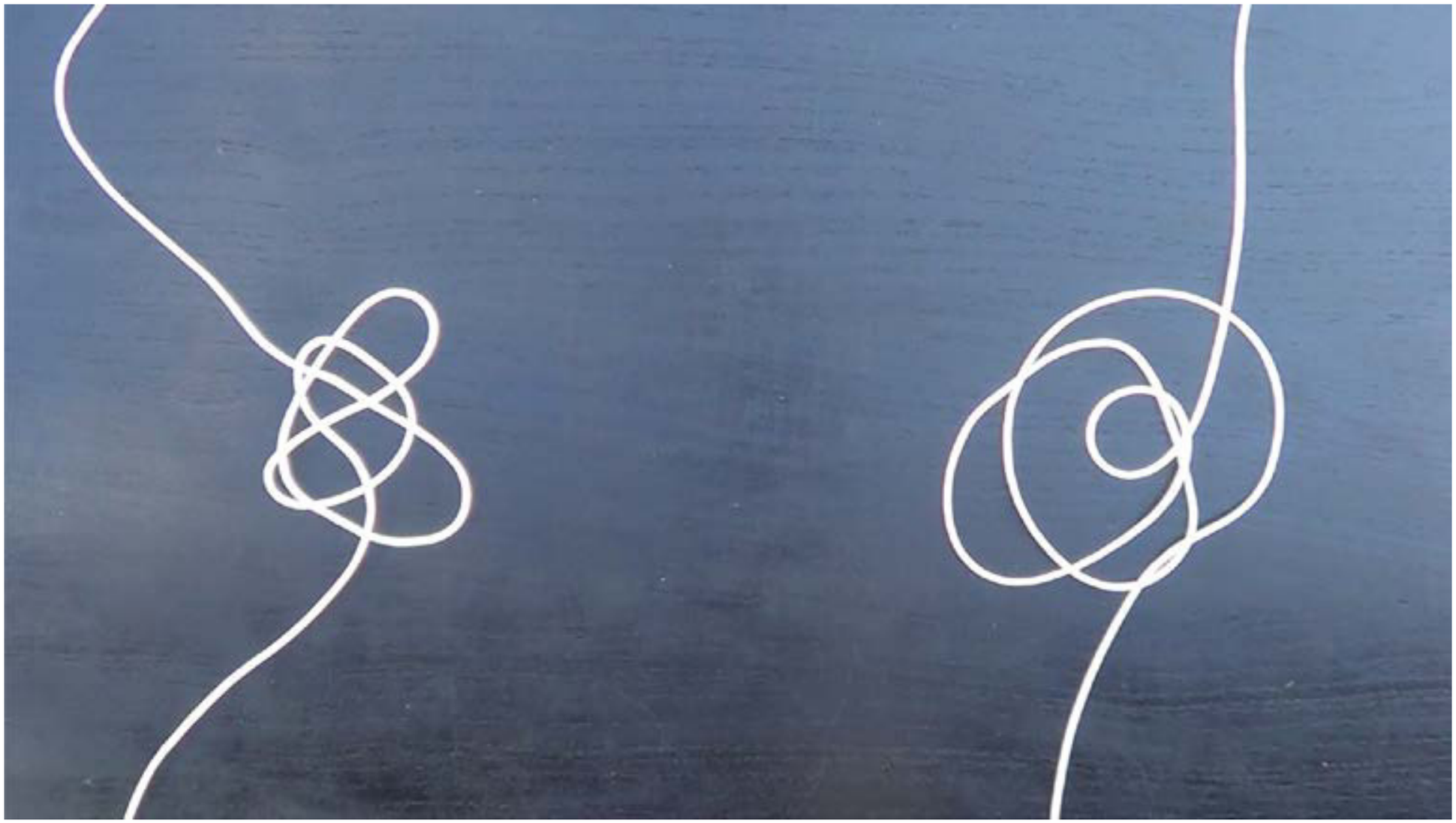
The Bowline Knot is used by mariners (think about the name) and many others such as rock climbers, construction workers and just about anybody who needs a simple and reliable way of securing things with ropes.

The word is pronounced 'bolin'. If you can manage a nautical accent, so much the better.

It is often described as the 'King of Knots' and it is our intention to explain why.

Firstly, what is a knot? There is a branch of **Mathematics** known as the Theory of Knots. This discriminates between knots and tangles. It is not connected with the observation that we have all made that even the most orderly set of wires behind a computer desk will spontaneously form into the most hideous tangle!

It is not our intention to go into the mathematics of knots and their classification. However, here is a taster. Mathematically, knots are made in bits of string that are either loops or are nailed down at either end. Look at these two 'knots' and decide if they are essentially different. Hint: you are looking at where and how many times the string passes over or under itself.

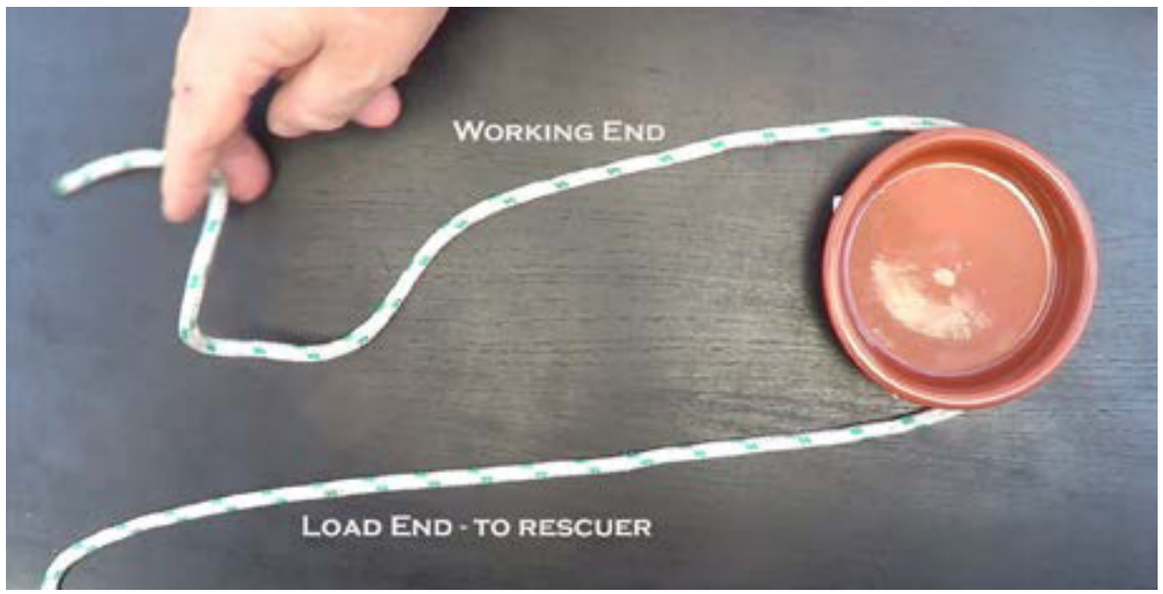
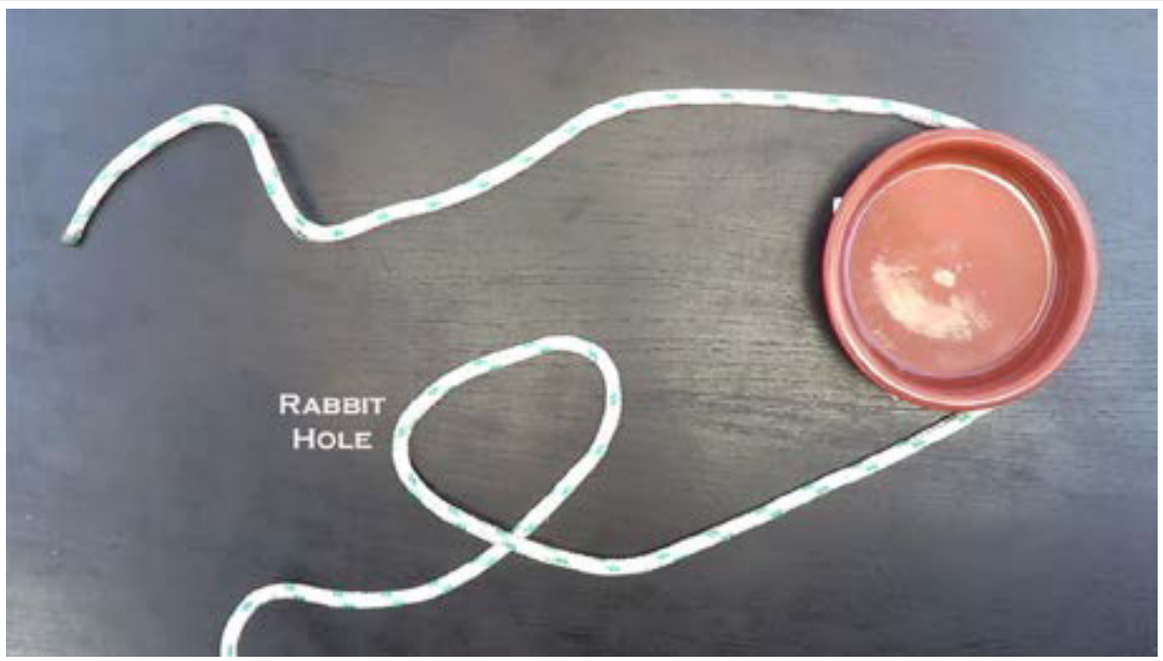


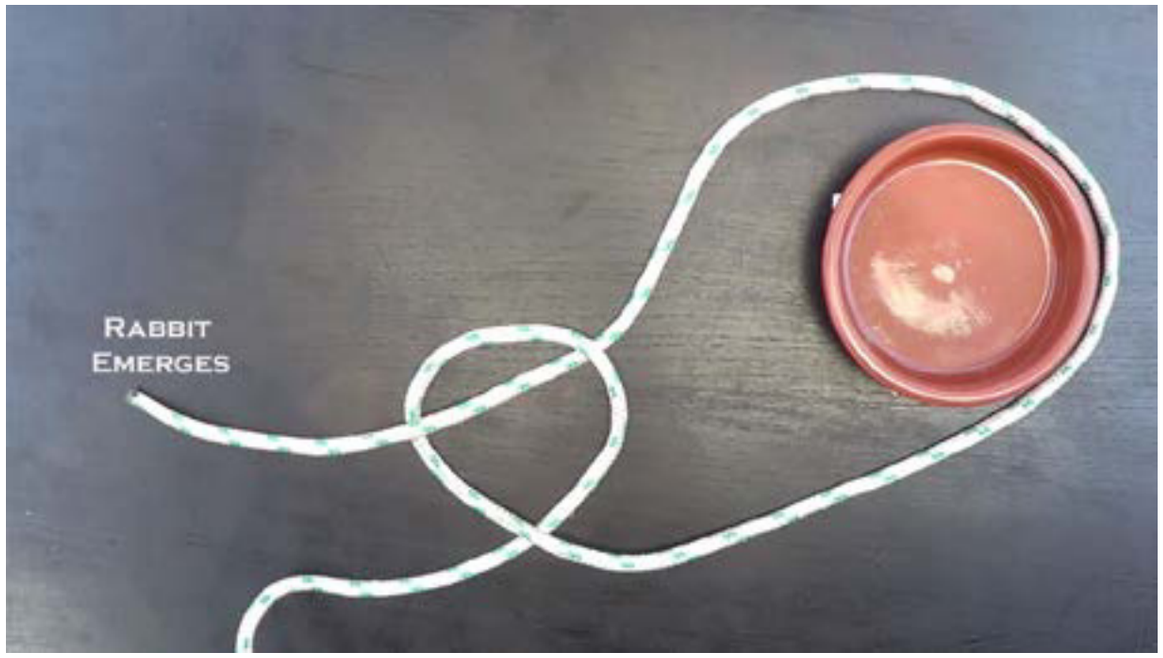
The answer is on this video: https://www.youtube.com/watch?v=G68ifH-NcMs

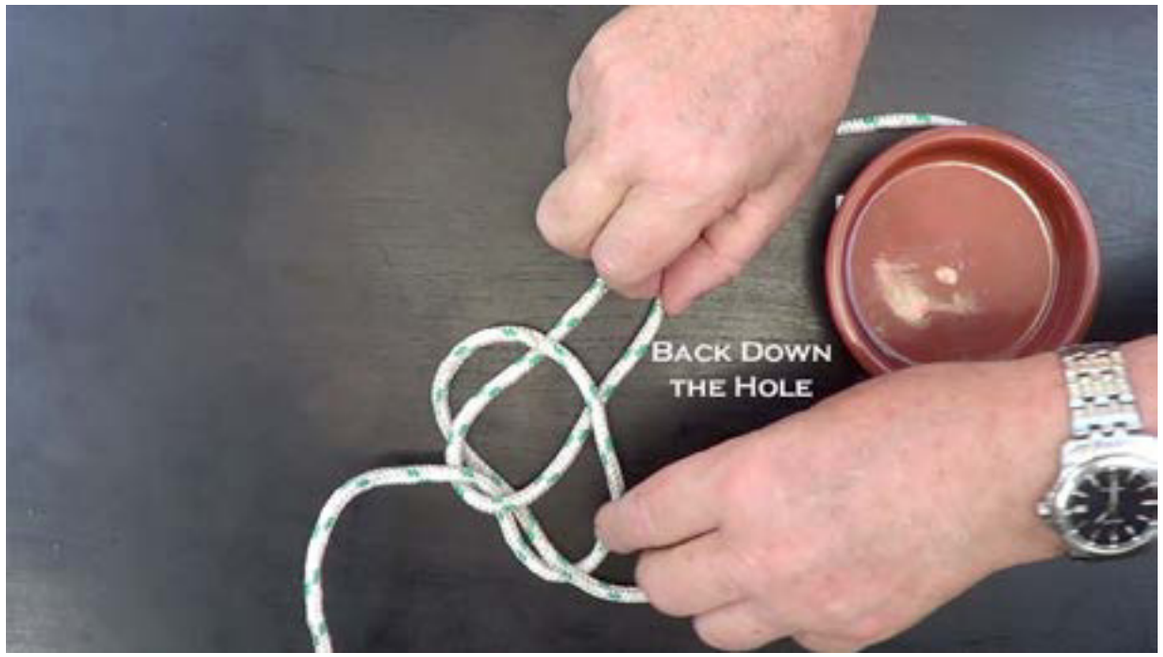
Now we will look at the bowline, how it is tied and why it is the King of Knots.

Imagine you have fallen into a river and are being carried downstream. A potential rescuer throws you a rope and you catch hold of it. The safest thing to do is loop it around your chest and secure it with a knot. The trouble is that most people tie knots that either slip or come undone. If they slip, they tighten painfully around you like a noose. If they come undone, they are useless. The bowline does neither.

Here are the main steps in tying it using the common 'rabbit-hole - tree' mnemonic.

Beginning	
Make the rabbit-hole	

Out pops the rabbit	
Runs behind the tree	

And back down the hole	
Pull tight	

Try tying one for yourself. Observe its simplicity and its strength.

Video of the traditional bowline tie: https://www.youtube.com/watch?v=hNPcGH_2JL4

With a bit of practice, the bowline can even be tied one handed: https://www.youtube.com/watch?v=H85cMlvwwXA

Object 5 - A Rock Crystal

Rock crystals form when molten minerals cool and solidify. Sometimes they are produced when solutions of minerals dry out.

Whichever way they were formed, it does not seem 'right' that the order of crystals, all those sharp edges and planes, should have arisen spontaneously our of the more chaotic liquid.

Indeed, it is one of the most 'secure' laws of **Science** that disorder must spontaneously increase - The Second Law of Thermodynamics. One of the reasons why this law is considered to be an unbreakable rule is that it is based on **Mathematics**. There are many more ways that a system can be chaotic than there are in which it can be neatly arranged. Chaos is massively more probable than order.

In gases and liquids, the atoms and molecules are rushing around and colliding at random. The hotter the gas/liquid, the more rapid the motion. We illustrate this with ball bearings in a tray. Remember, however, that the real motion is in three dimensions.

https://www.youtube.com/watch?v=yaTdPGTJqv4

The chance that the balls will spontaneously arrange themselves in a regular pattern as a result of this random motion is vanishingly small.

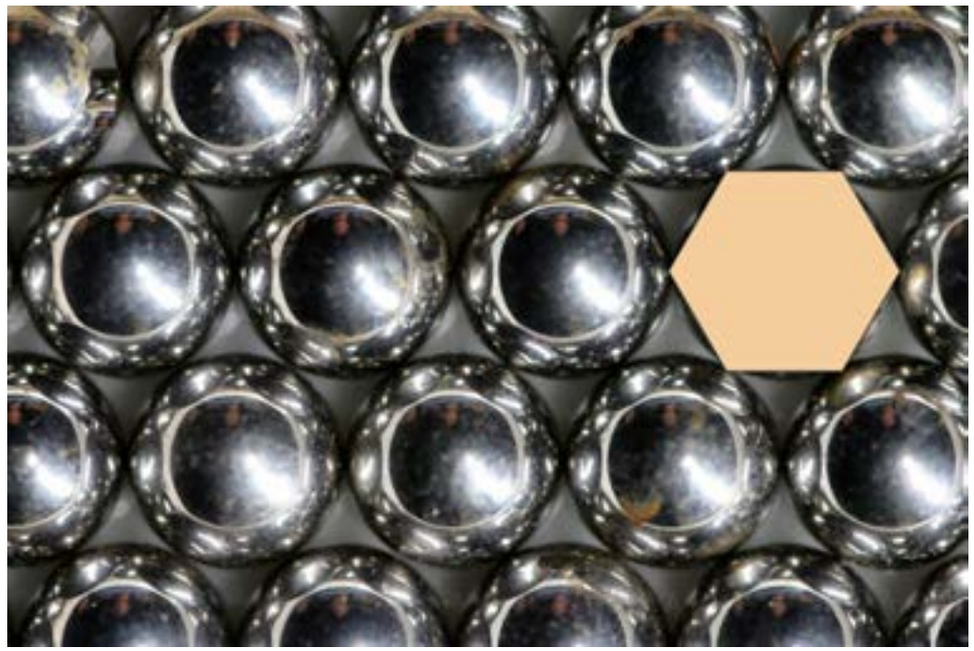
When the liquid or gas cools, the particles slow down and start to clump together as we illustrate here.

https://www.youtube.com/watch?v=PYL7G1JEPEk

The 'close-packing' pattern that you have seen has arisen because energy has been spent. In the case of our model, this is the energy lost as the balls run down a slope. In real crystal formation, chemists call this 'heat of crystallisation' (if the crystal forms from solution) and 'latent heat' if the crystal forms from molten rock. Either way, the disorder in the Universe is increased even though a small area of order has arisen. The Second Law of Thermodynamics is not violated. Because all our balls are identical, we are looking at a model for a liquid that contains only one type of atom, such as molten iron. If there is more than one type of atom or molecule, the situation is more complex.

Now that we have seen that pattern can arise spontaneously, the question arises: Can it be any pattern? The answer is 'no' even if we stay with our single atom/molten iron example.

If we stay with a one layered pattern and pack our ball bearings as closely as possible, the result is as shown. The fundamental pattern is tessellated hexagons. This is the pattern seen in basalt columns such as the Giant's Causeway in Ireland.



There is one way to add a second layer - with each ball sitting above a gap in the bottom layer. However, when it comes to adding a third layer, there are two ways of doing this. If you are interested in pursuing this, you are advised to make your own stack using, for example, tennis balls.

This leads to two structures that we can expect to see when a molten metal solidifies.

What knowledge might we infer from this rock crystal exhibit? Should it have helped the Ancient Greeks answer their question about whether matter is infinitely divisible or whether it is made of atoms?

Aside from the questions it raises about order spontaneously arising out of chaos, what other Knowledge could our exhibit stimulate?

Does it have artistic merit or, since it had no human input, none? Was the work of abstract artists such as cubists influenced by such regularity in nature?

Appendix

Chapter 15 Linking Concepts

We began this book with a recap of the background to this unique part of the Diploma. The early versions of the TOK diagram provide useful insights into the connections betweens seekers after knowledge, the investigative techniques they use and the areas into which we collect their acquired knowledge.

Linking Concept 1: BELIEF

Philosophers, from the ancient Greeks to the present day, concern themselves with the question: What can we claim we truly know? And the follow up question: How can we separate what we truly know from what we believe?

These **epistemologists**, as philosophers who study knowledge are called, have come to an awareness that there are two kinds of belief, **justified belief**, which they claim is certain knowledge and **unjustified belief**, knowledge we cannot be certain off.

Justified Belief

For you to be sure you know something, philosophers claim, for you to have certain knowledge, your knowledge claim has to fulfil three conditions.

- Your knowledge claim has to be true.
- Your knowledge claim must be justified.
- You must believe your knowledge claim.

Example: Knowledge claim: I know that TOK is a compulsory component of the IB Diploma course

Is this true?

The answer is clearly yes. (Truth is also one of the TOK linking concepts).

Can you justify this truth?

Again the answer is yes, but justification here needs to be understood in a TOK context.

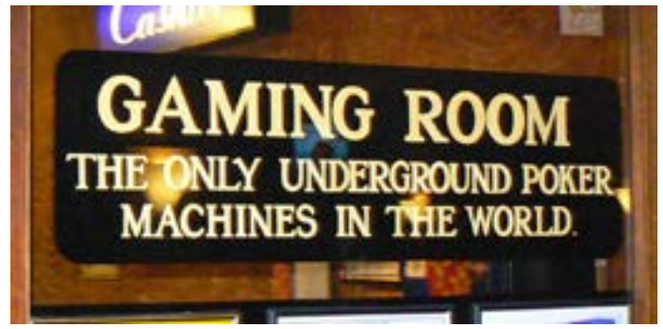
True Justification, for our TOK purposes, can be achieved in two main ways: by reason and by sense perception. (Reason and sense perception are also Ways of Knowing in the TOK diagram.)

Justification 1: Reason

The first source of evidence for your being justified in your belief is reason. **Reason** is the basis of much of our knowledge. As a TOK student you need to understand certain things about reason. Think of it now as simply correct, universally accepted, reasoning. The kind of reasoning which tells you if you were at school last Friday at 3 p.m. you could not have been at home (Unless, of course, home and school are the same place). All reason is not as simple as this.

Justification 2: Sense perception

The second source of evidence for your being justified in your belief is through your own **sense perception**. What your senses perceive, your sense perception, is one of the main sources of your knowledge of the world. Your five main senses are, of course sight, touch, taste, smell and hearing.



Sign at Coober Pedy, Outback Australia. Do you believe this claim? Is it true? Does it matter? Would you believe the 'Last petrol for 250km' sign at the nearby Petrol Station? Would that matter?

You might think that the example of the compulsory aspect of TOK is rather superficial. So, try substituting a rather more controversial and personal statement which might be relevant to some of you using this book.

Knowledge claim: I know that at the end of my twelfth grade I will obtain an IB diploma with at least forty points. Is this knowledge claim true?

Is it true that at the end of my twelfth grade I will obtain an IB diploma with at least forty points? Can you be sure of this? Is there any possible doubt you will get such a Diploma? Is it possible to know the truth about the future?

Can you justify this truth?

Is your belief that you will get a diploma with forty points justified? Now, here we have to weigh the evidence. What are your predicted grades? Have you completed all the necessary course work? Are you a conscientious and talented student? Can you

really justify the notion that you will get a diploma with at least forty points? Will your justification be through reason and/or sense perception?

Do you believe this knowledge claim?

Do you believe that at the end of your twelfth grade you will obtain an IB diploma with at least forty points? If you don't believe this then you cannot know it. It would be ridiculous to claim you know you are going to get a diploma with more than forty points if you really don't believe you are going to.

To what conclusions do these three questions lead you? Test the statement step by step. If you do not believe your claim, if your claim is not true, and if your claim is not justified and you do not believe it, then you do not have knowledge that is justified true belief. So now you have a formula that can be used to test the different kinds of knowledge you meet in the various disciplines you study.

The examples of the application of this formula have been chosen to apply to you as a TOK student. In terms of the creation of knowledge by scientists and historians and other scholars the formula is still valid. Astronomers announcing their newly acquired knowledge of a new solar system in deep space must justify their claims by sense perception/empirical evidence and reason and must believe their new knowledge is true. Historians writing the life of Nelson Mandela and analysing his influence on contemporary Africa must give evidence, obtained by perception and reason, to justify the truth of what they believe is his influence.

Unjustified Belief

Unjustified belief, epistemologists argue, is all that belief that cannot be justified by reason or sense perception.

The difference between unjustified believing and knowledge is obvious, you might claim. If you want to believe the sea is made of raspberry juice and all the fish swimming in it are juice drunk fairies, well go ahead and believe. People might be interested in hearing your arguments for believing the sea is raspberry juice but your claim is only that you believe it to be raspberry juice, not that it is raspberry juice. And providing you don't start collecting it and selling it as genuine raspberry juice, or expecting anyone else to think it is raspberry juice, why shouldn't you believe it? People on the whole are fairly tolerant and provided your belief doesn't harm you or them, why shouldn't you believe what you want to? There is an obvious difference between unjustified belief and knowledge.

Or is there?

Are you quite sure where the boundary is between your knowing something and your believing something? For hundreds of years people 'knew' the world was flat. And we know now that it is approximately spherical. Perhaps a lot of our knowledge is 'flat earth' knowledge and we are unaware of it. Perhaps there are many things we think we 'know' that are unjustified belief.

Ancient Greek scientists knew that the Earth is spherical and even had a figure for its radius. The knowledge was then 'lost'. 'Earthrise from Apollo 8.

Knowledge is one of those words that bewitch our intelligences. For many philosophers 'knowledge' is certain and communicable understanding provided by justified true belief. But there are other kinds of knowledge, knowledge by acquaintance, knowledge by faith, by empathy, by introspection, by conscience, by instinct, by intuition. We still call what we know in these ways 'knowledge'; much of this knowledge is created by our Emotions. Emotion is a Way of Knowing in the TOK diagram. Emotion may not create justified true belief but it is a very powerful Way of Knowing.

Beware then of underestimating the importance of unjustified belief as a way of knowing. What people believe can sometimes be much more important to them than what they know. For many ancient Greeks the belief that gods controlled their destiny was more important than anything else in determining their actions. Even though you think your beliefs are under your control and are a matter of choice, they are often not recognised as beliefs. The Greeks didn't just believe the gods controlled them, they thought they knew, in the same way as people thought they knew the world was flat.

Recent TOK prescribed essay questions included 'What criteria do you use to distinguish between knowledge and opinion?' and 'Discuss the importance of reason and emotion in distinguishing between belief and knowledge?' The implication in these questions seems to be that 'knowledge' is that justified true belief epistemologists want it to be and that it does not include other kinds of knowledge such as knowledge by acquaintance, conviction or faith. The ambiguity is there for you to explore. As with many words you have to examine 'knowledge' in context to attempt to understand its meaning. If in doubt make clear your understanding of the word, based not on a dictionary definition but your awareness of it in the TOK context.

Linking Concept 2: CERTAINTY

Certainty is one of those words you know already. If you ask your friend when the next TOK assignment is due and she says 'Monday 29th' and you reply 'Are you certain?' you are asking her if she is absolutely sure of this, if the knowledge she is passing on to you is (a) totally free from error and (b) without doubt.

So it is with 'certainty' in TOK: certainty is knowledge without error and totally free from doubt. Epistemologists of course, can't just leave it at that. They claim there are various kinds of certainty. One of these kinds of certainty is psychological certainty, when a person believes they know something for absolute sure and will never give that belief up regardless of the justification.

The kind of certainty we need to concern ourselves with in TOK is not psychological certainty but knowledge certainty. This is certainty about knowledge that is absolutely indisputable.

Some philosophers, known as Sceptics, claim it is impossible to be certain of anything. These Sceptics hold the view that certain—'certain' here in the sense of 'undisputable'— knowledge may be sought but will never be found. Sceptics believe you can never be sure of anything.

Absolute sceptics claim that we cannot know anything. Absolute Scepticism would seem to be impossible: if you don't know anything how can you know you don't know anything?

Relative sceptics claim that, well, perhaps we can know something but we must be very careful in our claims to know.

Scepticism may seem strange: it may be obvious to you that you do know certain things so why should anyone suggest or argue that you don't know these things?

Sceptics have three main arguments for their attitude.

- Our senses often deceive us.

Sceptics argue we can never know for certain when we are being deceived by our senses and when we are not. So, if we can't be certain of our sense perception we can't be certain of our knowledge of the external world that we receive through our senses.

- We can never be sure if we are dreaming or not.

Sceptics maintain that we can never be sure whether at any moment we are dreaming or not. If, they claim, you can't be sure you're dreaming then you can't be sure you are experiencing reality either.

Perhaps after all you are not reading these words, you are dreaming that you are reading these words. If we don't know whether we are dreaming or not, how can we be sure of anything?

- Our thoughts are an unreliable interpretation of reality.

Our thoughts are the only things we can really be sure of and our thoughts may be completely different from the reality they attempt to interpret.

The most celebrated argument for scepticism is to be found in Descartes' *First Meditation On Doubt & Certainty*. Like Plato, Descartes wanted to establish what it was possible to be sure of knowing. Before he could begin to undertake this task he believed it essential to free himself from all his existing beliefs because they might be incorrect, and he had no way of knowing whether they were correct or not. Once he had got rid of all his beliefs, he claimed, he could then start to build up a body of knowledge, which was acceptable to him as certain.

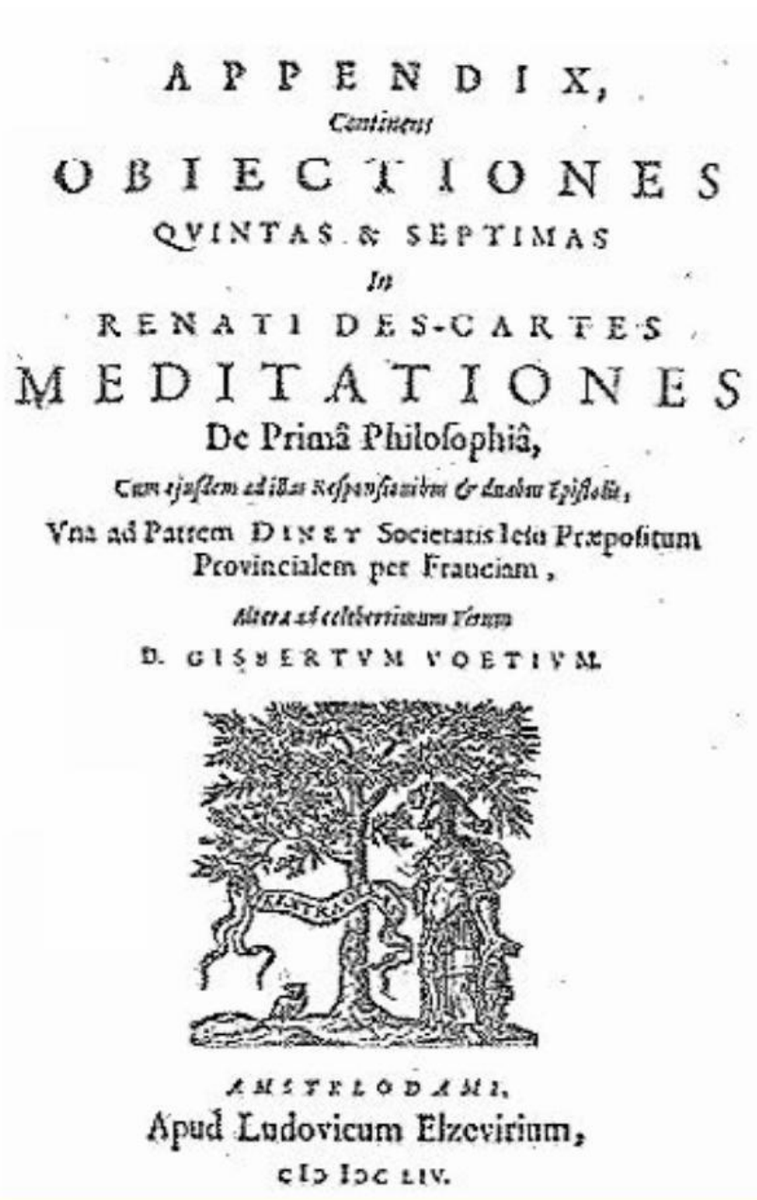
René Descartes (1596-1660).

The father of modern philosophy, René Descartes was born in central France in the town of Le Haye, which is now named Descartes in his honour. He studied at a Jesuit College, but was so discontented with the philosophical ideas of the time that were taught there he joined the army of the Duke of Bavaria and travelled widely across Europe. In Bavaria, in the winter of 1619, cooped up in his military billet, he conceived the idea of reconstructing the whole of philosophy anew, with mathematical reasoning as the model of all 'rational' knowledge.

After leaving the army he developed his philosophical ideas in Paris, and later, from 1628, in Holland. As well as developing philosophical 'rationalism' he was the founder of analytical geometry. His most celebrated work is a series of essays, the Meditations, published in 1641, the first of which is called On Doubt and Certainty. The essays are written in the first person singular and the reader is invited to identify with the 'I' and become personally involved in the arguments.

As well as being known as the creator of the phrase ***Cogito, ergo sum***, Descartes is also popularly known for his Method of Cartesian Doubt: treat all your beliefs as if they were false. This, and only this, he argues, will enable you to discover knowledge you can be certain of. He came up with the idea that he should pretend a cunning evil demon was trying to deceive him; and all the information he was receiving through his senses was created by this evil demon only to deceive him. He would then be able to force himself not to believe the information because it was created by the evil demon.

After taking the sceptical argument to its limit in the *First Meditation* he establishes, in his *Second Meditation*, that there is one certainty, the certainty he exists. He exists because he thinks. He argues that even if there is a demon trying to deceive him, he, Descartes, must exist, solely because he is able to think about the demon. His thinking alone was evidence for his existence. His thinking doesn't have to be profound, it just has to be thinking. His body may be the creation of the demon, but his thoughts are not. His thoughts are independent of external things, independent of any sense experience. His thoughts must exist independently of anything the demon could create. Hence the famous '*Cogito, ergo sum*', 'I think, therefore I am'.



APPENDIX,
Continens
OBIECTIONES
QVINTAS & SEPTIMAS
In
RENATI DES-CARTES
MEDITATIONES
De Primâ Philosophiâ,
Cum ejusdem ad illas Responsionibus & duabus Epistolis,
Vna ad Patrem DINET Societatis Iesu Præpositum
Provincialem per Franciam,
Altera ad celeberrimum Virum
D. GISBERTVM VOETIVM.

AMSTELODAMI,
Apud Ludovicum Elzevirium,
CIↃ IↃC LIV.

As an IB Diploma TOK student you will be expected to apply the concept of certainty to the Ways of Knowing and Areas of Knowledge. You might consider, for instance, in what ways reason and sense perception can or cannot give certainty, or whether certainty is a concept that can be exercised in evaluating the 'truth' in a work of art or a mathematical equation. When you think about questions like these ground your thinking in specific examples from the Ways of Knowing and Areas of Knowledge in the TOK diagram.

Linking Concept 3: CULTURE

Culture is one of those words, which bewitches the intellect; you have to put it into context to understand what it means. There are three 'culture' questions in the TOK Guide and the word is used only once in the last six sets of prescribed essay titles. In this context the meaning is clear. Culture in the context of TOK means those values, attitudes and practices shared by communities or groups of people.

The IB mission statement that is printed at the beginning of many of the IB documents makes a clear cultural statement.

Does the culture of your school reflect the values in this mission statement? Does the school purposefully and positively develop intercultural understanding and respect? Does it promote the idea that 'other people, with their differences, can also be right?'

The TOK perspective on culture emphasises, of course, the relationship between knowledge and culture, the extent to which different cultures value reason, emotion and the status of say psychology and literature.

The Lion of Lucerne is both a memorial to Swiss soldiers killed in 1792 during the French Revolution and a Work of Art

As a Knower at the centre of the TOK diagram you should be prepared to consider seriously the values attitudes and practices of your culture in the context of the IB mission statement and in particular your culture's values underpinning the different Areas of Knowledge in the TOK diagram.

Linking Concept 4: EVIDENCE

You are probably most familiar with the word evidence being used in connection with court scenes on television. Evidence is the thing prosecutors place in a plastic bag and label 'Exhibit A'. Exhibit A is brought before the court to demonstrate the truth of a claim.

Evidence in its TOK context is exactly the same, the knowledge that is presented by knower(s) to demonstrate the truth of their claims to know. A fundamental TOK knowledge issue is what is considered evidence in each of the areas of knowledge. In the natural and human sciences and history the evidence is clear. In the sciences the evidence is information obtained by sense perception, by observing the 'phenomena' of the universe. In history the evidence is the primary and secondary sources. The evidence is the objective 'facts' of the scientists and historians, the 'hard' data on which they build their theories. The theories themselves are not evidence. What the knowers use this evidence for is something else. The deductive and inductive reasoning or the imaginative interpretation of the 'knowers' is not evidence.

The Supreme Court of the USA is a comparatively modern building that channels classical architecture and materials to emphasise the 'majesty' of the Law.

To understand where history and science evidence comes from is relatively easy. Evidence in the arts is a little more problematic. TOK examines where the artist—the painter or poet or musician gets the evidence on which his knowledge is based. The answer as we have suggested is that mixture of reason and sense perception and emotion that is individual to the artist. This is clearly quite a different kind of evidence from the objective evidence of the scientist and historian.

Mathematics present a different problem with evidence. Mathematicians agree on the axioms which underpin their discipline and form the basic evidence of mathematics. These axioms come from *a priori* reasoning which hard line empiricists would argue is not evidence at all. The deductive reasoning that mathematicians use in their 'proofs' could also be regarded as evidence, evidence that the mathematical conclusions are correct.

The TOK area of knowledge, ethics, brings different 'evidence' challenges. Mathematicians agree on their axioms but moral philosophers seem not even to be able to do that. Ethicists are seeking evidence for how we should behave, rather than how we do behave. Clearly a different kind of evidence is necessary.

In the TOK context it is helpful to think that evidence can come from the various ways of knowing and that these ways of knowing give access to different kinds of evidence. A wise person, it has been claimed by many a lawyer, proportions his belief according to the evidence. One of the things TOK aims to do is to look at the ways of knowing and areas of knowledge and recognise there is much knowledge other than that generated by reason. Understanding the nature of the evidence is a key TOK concept.

Linking Concept 5: EXPERIENCE

Experience is another of those bewitching words. One of the past TOK prescribed titles began: To understand something you have to rely on your own experience and culture. The meaning of experience here seems straightforward. It means something you have personally encountered, undergone or lived through. If, for instance you have a passionate interest in gorillas and you have read every book and seen every movie and documentary about gorillas you may understand a lot about gorillas but you have not experienced them. You have experienced books and movies and documentaries. If you have trekked up the Ruwenzori Mountains in western Uganda and have spent time personally observing a gorilla family face-to-face, watching their reactions to each other and to your presence, and smelled the distinctive smell of their 'nests', and heard the sounds they make when they warn you keep your distance, then you have experienced gorillas.

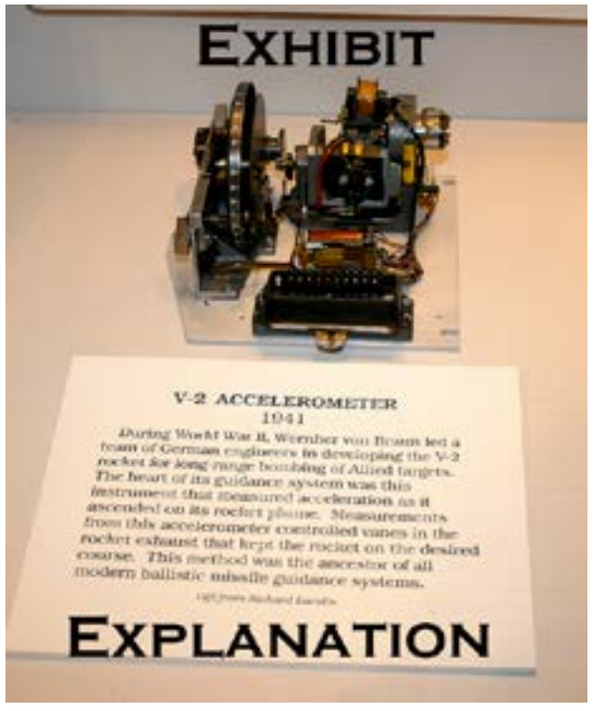
Photo Credit: By Kbnp - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=32271048

If you look at the experience questions in the TOK guide you might be forgiven for thinking this direct personal experience is what TOK experience is about but this might be oversimplifying the knowledge issues embedded in the word 'experience'. The second question in the Guide—What kind of knowledge can be gained through experience?—gets to the heart of TOK. You are now being invited to explore how experience is created in the six areas defined in the TOK diagram. Knowledge

obtained by direct observation is knowledge by experience, the kind of knowledge you get when you visit the gorillas. So the sciences and the arts, which begin with observation, sensory perception as the TOK diagram calls it, are those that are experience based. But, of course, there is another kind of experience, the kind of thought experience you have when dealing with abstract concepts like grammatical constructs in language or calculus in maths. Experience can be abstract and rational as well as sense based.

CAS is an important part of the Diploma Programme. The knowledge you acquire through CAS is acquired by experience but it is not the experience alone that makes the knowledge. It is your processing of that experience in a way similar to the way scientists and artists process their experience to construct new knowledge. An important aspect of TOK is making you aware, as a critical thinking 'knower', how your cultural and value laden 'self ' processes experience and makes it your own 'knowledge'.

Linking concept 6: EXPLANATION



Explanation is, of course, another of those bewitching words. Aristotle for instance defined four different types of explanation.

For TOK purposes the concept of explanation is rooted in the different Ways of Knowing and Areas of Knowledge. An 'explanation' is that which produces understanding how or why something is as it is. One recently prescribed essay, for instance, invited students to compare how historians and scientists explain something and if explanation in these two disciplines meant the same thing. One of the questions under the heading 'Explanation' in the curriculum guide directly asks what characteristics must an explanation have to be considered good within the different Ways of Knowing and Areas of Knowledge.

'Explanation' therefore is at the heart of TOK. What academic knowers and artists do is to explain the phenomena of the world about them. As we have seen in earlier parts of this book different disciplines use Ways of Knowing in different ways. But all the disciplines attempt to explain. The processes used by natural scientists to explain the phenomena of the physical world use Ways of Knowing differently from the mathematicians explaining their Area of Knowledge. When you understand the processes of the construction of knowledge in different disciplines then you understand that 'explanation' differs in TOK's Areas of Knowledge.

Linking Concept 7: INTERPRETATION

Interpretation in its everyday sense means offering an explanation and is therefore closely related in meaning to the previous linking concept.

Within the context of TOK, 'interpretation' must be related to Ways of Knowing and Areas of Knowledge. One question opens with a challenge to explore how interpretation occurs within Areas of Knowledge and then goes on to ask if some Ways of Knowing are less open to interpretation than others. A prescribed essay question (2007) indicated the same understanding of the concept of explanation by asking if some Ways of Knowing are less open to interpretation than others.

The knowledge issue implicit in these questions is the constancy of the knowledge generated. The Knower having assembled the data, or the evidence then examine alternative interpretations of these data/evidence until they arrive at what they consider the most, perhaps the only, sound explanation. In the sciences, natural and human, there is often little room for interpretation: the 'facts' point the way clearly to a theory. In history, as you have seen, interpretation is an important part of the process of creating new knowledge. Historians interpret and evaluate the evidence. In the arts we are often challenged to interpret. There may be several interpretations of a work of art, all of which may have some validity but it can also be claimed that there is only one valid interpretation. For example, one theory of interpretation in art calls for the viewer or reader to identify what it is the artist intended to accomplish, interpreting the art accordingly and asking the question, To what extent has the artist accomplished this aim?

One of the aims of TOK is to get you, the student, to critically consider such issues across the Ways of Knowing and Areas of Knowledge. In general the less open knowledge is to interpretation the firmer should be our trust in that knowledge.

Now is the winter of our discontent

Made glorious summer by this sun of York;

are some of the most famous opening words of any drammatic work. They are spoken by Shakespeare's Richard III. Remember that these words are spoken, not read from a book. Does Shakespeare mean 'sun' or 'son'? Or is he asking the audience to come to their own conclusion? It is one of the hallmarks of Shakespeare's work that he often asks his audiences to question what his characters mean when they speak - to interpret. Richard goes on with the meteorological theme:

And all the clouds that lour'd upon our house

In the deep bosom of the ocean buried.

Linking Concept 8: INTUITION

Much has been written by epistemologists, those philosophers who study the nature of knowledge and knowing, and more recently psychologists, about intuition.

Epistemologists have labelled *a priori* knowledge, the knowledge that, for instance, creates axioms in mathematics, intuitive knowledge. This intuitive knowledge is knowledge which is not based on sensory perception but which comes from an alternative intellectual insight. This is obviously a specialised use of the word but one of which TOK students should be aware. In ethics, as well as mathematics, the intuitive knowledge of epistemologists it has been argued, underpins significant ideas in those disciplines and has no sensory justification.

This intuitive knowledge of epistemologists is not the same as the intuition that is the study of psychologists. Psychologists see intuition in its more popular understanding as ideas and thoughts that come to mind quickly and without much reflection.

Elephants may never forget, but they also have a reputation for intuitive wisdom. During the 2004 Indian Ocean Earthquake, they are said to have moved to higher ground before the tsunami arrived.

The questions in the TOK curriculum guide and the prescribed essay are concerned with the psychologists' definition of the word rather than the epistemologists'. One question in the guide specifically refers to 'what is commonly called **intuition**' and another quotes Germaine Greer as referring to "the frequently celebrated female intuition", indicating that the word intuition is used in TOK in its more popular meaning rather than the technical way that epistemologists might use. Any student attempting an essay presentation centring on the word intuition would be wise to consider carefully the relationship between *a priori* knowledge and intuitional knowledge before dismissing a philosophical interpretation of the word.

The fundamental TOK intuition questions must be about what part intuition plays in Ways of Knowing and the different Areas of Knowledge. There are many examples of knowledge created apparently by intuition that on close scrutiny are not really intuitive at all, but the result of a well prepared mind suddenly coming upon an understanding. Einstein for instance claims that his basic insight into the relativity of time came to him one morning just as he got out of bed but added that this moment of truth—of intuition some might call it—had been preceded by ten years of thinking about the subject.

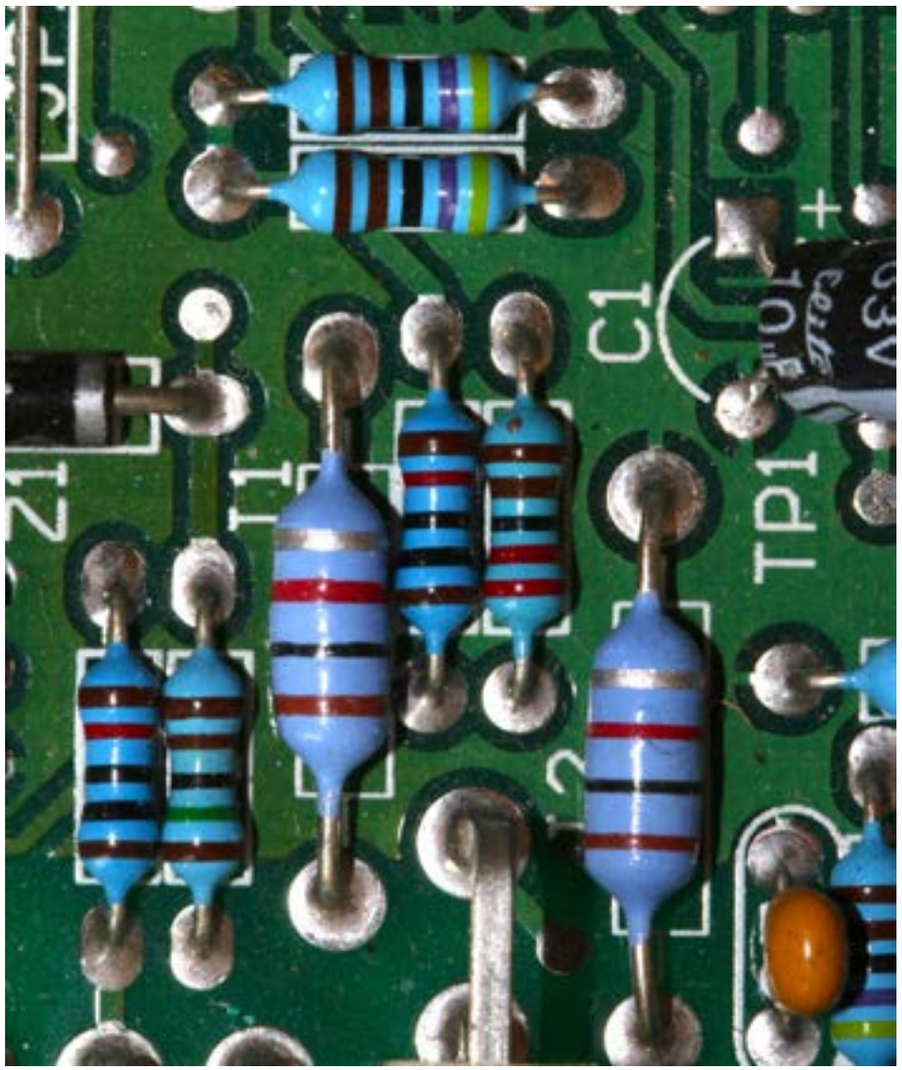
Intuition certainly has a role in the creation of certain kinds of knowledge but any claims to be taken seriously must be carefully examined case by case.

Linking Concept 9: TECHNOLOGY

A prescribed essay title which was by far the most popular of its year (2006) was 'Can a machine know?'. The examiner's comments on this essay take you right to the heart of TOK: 'The intention behind this question was to explore what we mean by **knowledge** in different contexts and essays structured by Areas of Knowledge or Ways of Knowing, tend to retain this focus.'

When you consider technology in a TOK context have in your mind the TOK diagram. Consider how technology can influence or change the Ways of Knowing and how this affects the knowledge, which is created and how we value that knowledge.

An obvious way in which technology affects the expansion of knowledge is through its ability to expand our sense perception. Radio telescopes can 'see' further into outer space, 'colliders' can show us what happens to matter in extreme conditions, carbon dating can give precise time patterns, DNA can indicate migrations that took place thousands of years ago. Computers can also reason with a speed and accuracy that even ten years ago was impossible.



Technology has also revolutionised communication. At the press of a button or two we have access to unlimited amounts of information and data and the 'knowledge' this information and data imply. A major knowledge issue for TOK is where this information and data comes from and its 'truth' or reliability. The language of computers can cross-conventional linguistic barriers and perhaps influence the way we use language to develop ideas or even to 'think'.

Perhaps the Way of Knowing least affected by technology is emotion. But even in claiming this in TOK terms it is necessary to establish why machines do not have emotions and what kinds of 'knowledge' might therefore be inaccessible to machines.

Linking Concept 10: TRUTH

The word 'truth' appears frequently in the prescribed titles. Usually the student is asked to compare truth in different Ways of Knowing and Areas of Knowledge. Typically such a question would ask directly for a comparison: are some Ways of Knowing more likely to lead to the truth than others? The knowledge issues here are clearly those which touch on the way the knowledge is created, how truth can be different, for instance, in history and maths or art. Similar questions include a quote from Picasso: "Art is a lie that brings us nearer to the truth", which students are invited to discuss relative to a particular branch of art.

Other questions are more specifically related to the concept of truth itself although students will still be expected to illustrate their ideas through Areas of Knowledge and Ways of Knowing. One question asks how can Ways of Knowing help us to distinguish between something that is true and something that is believed to be true, concentrating on the Ways of Knowing rather than the Areas of Knowledge.

For TOK you should certainly be familiar with certain basic ideas of truth: Plato's concept of truth, of the ideas of absolute and relative truth and of three (of the many) theories of truth philosophers have developed over the years.

The Chicago Picasso - modelled on Picasso's Afghan Hound, Kabul

Plato's Truth

According to Plato (See Linking concept 1, Belief), anything less than justified true belief cannot be knowledge. His first condition of justified true belief is that knowledge must be true. Truth for Plato, has three characteristics: it has to be public, it has to be independent and it has to be eternal.

Plato's Truth 1: Truth is public

Truth is public. Truth is true for everybody. You cannot say 'What is true for me is true for me and what is true for you is true for you'. No matter how strongly you believe your watch keeps time perfectly if it does not keep time perfectly your belief is not true: you cannot, truthfully, claim your watch keeps time perfectly. You could, truthfully claim that your belief is it keeps time perfectly. But that is a different truth. That is a truth about your belief. There are two truths here.

- Your watch keeps time perfectly
- Your belief that your watch keeps time perfectly. .

Both of these statements are true both for you and everyone else.

Plato's Truth 2: Truth is independent

Truth is independent of anyone's beliefs. The truth of the statement 'Your watch keeps time perfectly' is independent of whether you think it is true or not. You could persuade all your friends that your watch keeps time perfectly; indeed you could persuade the entire world your watch keeps time perfectly, but that doesn't mean your watch keeps time perfectly. The statement can be false even though everyone you know, indeed everyone in the world, believes it to be true.

Plato's Truth 3: Truth is eternal

Truth is eternal. Now here we have a slight problem with your watch. It might be that as your watch gets older it no longer keeps time perfectly (if it ever did). But the current proposition, your watch keeps time perfectly (if it does) is true for now and will be true for now forever. If your watch changes, the truth that it once kept perfect time will not change. Truth is not a watch.

This simple, many would say too simple, definition of truth is a very limited definition. Much philosophical thinking has taken place since Plato's day and his definition of truth is now considered a little naïve.

Absolute Truth and Relative Truth

Plato saw truth as absolute. He was quite clear on this: you must be absolutely certain before you claim to know the truth. Truth for him, and many later philosophers, is a straightforward, simple matter: plain objective fact, transparent and open, empirically and logically proven. It describes objective and rational reality.

Other philosophers claim there is no such thing as absolute truth. All truth is relative, they argue. For them nothing is plain or objective, there is no one truth, there is no one reality. Reality is different for each of us, people and different groups of people have different understandings of reality. Truth for you is different from truth for me. The greatest relativist of them all, Nietzsche, wrote 'There are no facts, only interpretations'.

Absolute truth

This seems the common sense approach. Truth is what really is out there. Reality is objective. It does not depend on what we think it to be. The room you are sitting in now either has a door or doesn't have a door. You went to school this morning on foot, in a car, on the train, by some other method of transport or a combination of all those methods.

Relative truth.

Relativists claim everything is subject to human interpretation. We are forced, they argue, whether we want to or not, to see the world from our own partial and therefore restricted perspectives. Simply put, your understanding of the physical circumstances you are now in is a different understanding from anyone else's. Anna, who is sitting opposite you in the room, perceives the room quite differently from you or anyone else. Anna's interpretation of reality, her truth, is quite different from yours.

That example is about a physical 'truth'. Consider an ethical example: Anna has asked you to help her with her final TOK essay, the one that she has to sign as being all her own work.

She wants to discuss some ideas with you. How much help can you give? She says you can give unlimited help because in the end it is she who writes the essay and it will be her work. Is there a clear-cut line between her work and what she makes of your reactions to her ideas? Where is the truth?

Relativist tools: Language, culture and experience.

Relativists insist there are many different ways of understanding the world and none of them really reflect the Way Things Really Are. We understand the world, they claim, by inquiring into it and reaching an understanding of it. That understanding is our 'truth'. There are many different ways of making that inquiry and the tools we use influence the 'truth' we arrive at. The tools we use to make our inquiry, our language, our culture and our experience, they argue, make truth relative, absolute truth is unattainable.

Over the centuries philosophers have debated the nature of truth and developed many 'theories' about it. Three of these theories are mentioned in the Curriculum Guide: the Correspondence Theory, the Coherence Theory and the Pragmatic Theory.

The Correspondence Theory

Plato and his Athenian friends were the first to formulate this theory and it is still the most easily understood and accepted theory of truth.

Truth, according to this theory, is what propositions have when they correspond to reality. (Note it is the proposition that is true, not the reality).

Put simply:

For any proposition (p) — p is true if, and only if, p corresponds to the facts.

So here is a proposition : Bishkek is the capital city of Kyrgyzstan.

This proposition is only true if Bishkek is the capital city of Kyrgyzstan.

A closer to home example (unless you live in Bishkek) is a proposition based on the belief that all TOK students arrive punctually for class.

Here is the proposition: All TOK students arrive punctually for class.

That is true if, and only if, all TOK students really do arrive punctually for class. If they are all in class when the class is due to start the truth of my proposition, according to the Correspondence Theory, is established. The proposition is true because it corresponds to the facts.

The Coherence Theory

The Correspondence Theory claims you have truth when a proposition corresponds to reality. The Coherence Theories (there are a lot of them) claim you have truth when a proposition is compatible with other propositions you accept as established truth. When all your established truths cohere, when no truth contradicts another truth, then you have it.

Here is an example. Anna's mother wakes her up an hour earlier than normal and tells her not to use the bathroom she normally uses because there is a python in there which has come in during the night through the toilet waste pipe and she (the mother) is waiting for the health authorities to send someone to take it away. Using the Coherence Theory (probably without consciously knowing she is) Anna assesses the proposition There is a python in the bathroom that has come in through the toilet waste pipe. She does this by rapidly reviewing what other beliefs she accepts as true which cohere, or not, with the proposition. These might include:

- Pythons can't enter bathrooms through waste pipes
- The area she lives in is not an area where pythons live
- There is not a zoo, or snake park, near her from which it could have escaped
- Her mother would be panicking it there really was a python in the apartment

And most of all,

- Her mother thinks she should get up earlier than she habitually does.

So her mother's proposition fails to cohere with many other things she has good reason to believe are true, so knowing it is not April 1st Anna somewhat bluntly tells her mother to shut the door and go away.

With the 'All TOK students arrive punctually for class proposition', what cohering propositions might allow this as true?

- All TOK students are conscientious and reliable
- They love coming to the TOK class
- The class is never the first class of the day, so there is no problem with arriving late at school

- They are reliably punctual for all other classes
- They hand in their assignments on time

Coherence theory, to summarise, states that a proposition is true if it is consistent with other established truths.

The Pragmatic Theory

The Pragmatic Theory of Truth is based on the ideas of American Philosopher, Charles Sanders Peirce (pictured - 1839-1914). His Pragmatic Theory claims that a proposition is true if it is useful to believe. Beliefs that are most useful to us, beliefs that are the best justification for the things we do, beliefs that promote success, are truths. Truth is proved, or disproved, by our subjective experience.

Let's stay with Anna. She also believes that she is surrounded by people who love and care for her. So the pragmatists say her proposition 'I am surrounded by people who love and care for me' is true if she finds it useful. Her belief justifies what she does and promotes success for her. Until such time as she finds, through her subjective experience, that the proposition is not useful, it will be true, for her.

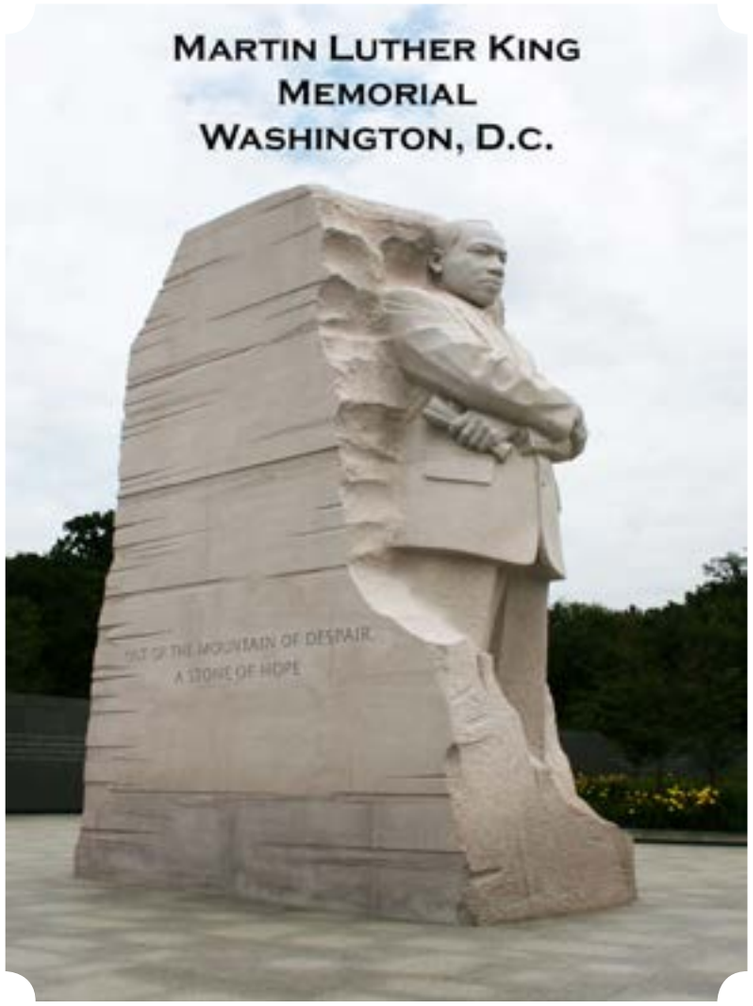
Examine the proposition 'All TOK students arrive punctually for class' through the lens of the Pragmatic Theory and what do you get? The Theory says the proposition is true if it is useful to believe. It is useful for the teacher to believe if the teacher wants the students to be punctual. If they are not punctual, and the teacher still believes they are, where does that leave the truth? Is it useful for the teacher to believe students arrive punctually even when they do not? The pragmatists would say, you have to be pragmatic. If it is useful for the teacher to believe students arrive on time, then the teacher must, pragmatically, accept that they do arrive on time. If it is useful for the students to believe the truth is they arrive on time, then they arrive on time. Our beliefs promote success. Pierce would say they enable us to predict experience.

Truth and TOK

Whatever your own ideas are about the nature of truth, TOK truth is best put in the context of Areas of Knowledge and Ways of Knowing. You must come to your own conclusions about the nature of truth in the Areas of Knowledge and Ways of Knowing

and you can only do that if you have a good critical awareness of the way knowledge is constructed in those Areas of Knowledge and Ways of Knowing. You must also come to some awareness of what, for you, in the TOK context, is truth. You may come to the conclusion that different Areas of Knowledge use different theories of truth, or perhaps a mixture of all three theories. You may decide that absolute truth is the standard by which knowledge must be judged and relative truth is simply a compromise.

Linking Concept 11: VALUES



Even it we come from the same country and go to the same school and take the same IB Diploma subjects we each have our own unique culture and our own sense of what is important, our own values. The circumstances in which we were brought up, our age, our race, our gender, the languages we speak, our religious beliefs and many other things influence us. Our values determine what we believe is good or bad and how we should treat other people. Much of your interpretation of what is acceptable ethical behaviour will depend on your personal values.

Values too are often shared with the people we live and work with, and are cultural. Think for a moment of the values of your own school. Is academic success valued more than sporting prowess? What groups of students do other students hold in high esteem? What groups of students do teachers hold in high esteem? ? Is there anything about your school, which makes you and your students proud to be part of the school? Answering these question will help you understand your shared cultural values.

Knowers, in the TOK context, can be expected to have their own values. Mathematicians can have a shared set of values, as can historians, and an obvious TOK knowledge issue would be to what extent these values overlap. The TOK Curriculum Guide and prescribed essay questions approach values from two opposing perspectives. They mainly ask how values influence, and are used in, the different Ways of Knowing and Areas of Knowledge, inviting students to consider, for instance, what and why certain research is undertaken by Knowers and what values they bring to their work. But the questions also invite students to consider what values are implicit in Ways of Knowing and Areas of Knowledge and to explore the ways in which they influence the way we think and act.

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