NANYANG GIRLS' HIGH

勤慎端樸

Myths About Science


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Myth One:
The Scientific Method

- Perhaps the most commonly held myth about the nature of science is that there is a universal scientific method, with a common series of steps that scientists follow.

- The steps usually include defining the problem, forming a hypothesis, making observations, testing the hypothesis, drawing conclusions and reporting results. In classrooms, students can be seen writing up the aim, hypothesis, method, results and conclusion.

Myth One:
The Scientific Method

- In reality there is no single method of science. Scientific inquiry is not a matter of following a set of rules. It is fluid, reflexive, context dependent and unpredictable. Scientists approach and solve problems in lots of different ways using imagination, creativity, prior knowledge and perseverance.

Myth Two:
Experiments are the Main Route to Scientific Knowledge

- Experiments are certainly a useful tool in science but they are not the main route to knowledge.

- True experiments involve a range of carefully controlled procedures accompanied by control and test groups and usually have as a primary goal the establishment of a cause and effect relationship.

Myth Two:
Experiments are the Main Route to Scientific Knowledge

- Science does involve investigation of some sort, but experiments are just one of many different approaches used. In a number of science disciplines, such as geology, cosmology or medicine, experiments are either not possible, insufficient or unethical.

- Science also relies on approaches such as basic observations (astronomy) and historical exploration (evolutionary biology).

Myth Three:

Science and its Methods Can Answer All Questions

- Science has achieved many amazing things, but it is not a cure-all for all the problems in society. Although it can provide some insights that may inform debate, science cannot answer ethical, moral, aesthetic, social and metaphysical questions.

Myth Three:

Science and its Methods Can Answer All Questions

- For instance, science and the resulting technology may be able to clone mammals, but other knowledge is needed (cultural, sociological and philosophical) to decide whether such cloning is moral and ethical. Not all questions can be investigated in a scientific manner.

Myth Four:
Science Proves Ideas

- Popular media often talks about *scientific proof.* However, accumulated evidence can never provide absolute proof – it can only ever provide support.
- A single negative finding, if confirmed, is enough to overturn a scientific hypothesis or theory.
- Rather than being proven *once and for all*, a hallmark of science is that it is subject to revision when new information is presented or when existing information is viewed in a new light.

Myth Five:
Scientific Ideas are Absolute and Unchanging

- Some ideas in science are so well established and reliable and so well supported by accumulated evidence that they are unlikely to be thrown out, but even these ideas may be modified by new evidence or by the reinterpretation of existing evidence.

Myth Five:
Scientific Ideas are Absolute and Unchanging

- Science knowledge is durable, but not absolute or fixed – a critical feature of science is that it is self-correcting – so we say that scientific knowledge is *tentative*.
- This can be most easily seen at the cutting edge of research and in areas like health and medicine where ideas may change as scientists try to figure out which explanations are the most accurate.

Myth Six:
Science is a Solitary Pursuit

- This myth fits the stereotypical image of a lone scientist working alone in a laboratory.
- In reality, only rarely does a scientific idea arise in the mind of an individual scientist to be validated by the individual alone and then accepted by the scientific community.

Myth Six:
Science is a Solitary Pursuit

- The process of science is much more often the result of collaboration of a group of scientists.
- Most research takes too long, is too expensive and needs more knowledge and expertise than an individual scientist working alone.

Myth Seven:
Science is Procedural more than Creative

- Many students see science as following a series of steps and being dry, uninspiring and unimaginative.

- The opposite is true. Creativity is found in all aspects of scientific research, from coming up with a question, creating a research design, interpreting and making sense of findings or looking at old data in new ways. Creativity is absolutely critical to science.

Myth Eight:
Scientists are Particularly Objective

- We often assume scientists are always objective, but scientists do not bring empty heads to their research.
- Their background knowledge, experiences and the existing concepts they hold means that they can not be completely objective.
- Like all observers, they have a myriad of preconceptions and biases that they will bring to every observation and interpretation they make.

Myth Nine:
Scientific Conclusions are Reviewed by Others for Accuracy

- Limited research funds and time constraints do not allow for professional scientists to be constantly reviewing each other's experiments.
- If experiments are repeated, it is usually because a conclusion has been reached that is outside the current paradigm.

Myth Nine:
Scientific Conclusions are Reviewed by Others for Accuracy

- However, ideas and methods are critiqued before and during publication and acceptance.
- Ideas and methods are debated and shared in the workplace, at conferences and in scientific journals.

Myth Ten:
Acceptance of New Scientific Knowledge is Straightforward

- The process of building knowledge in science is often portrayed as procedural, routine and unproblematic – leading unambiguously and inevitably to *proven science.*
- New interpretations for evidence are not automatically accepted by the scientific community.

Myth Ten:
Acceptance of New Scientific Knowledge is Straightforward

- A new idea that is not too far from the expectations of scientists working in a particular field would probably be accepted and published in scientific journals, but if the idea appears to be a significant breakthrough or is rather radical, its acceptance is by no means straightforward.

Myth Ten:
Acceptance of New Scientific Knowledge is Straightforward

- Some examples of scientific ideas that were originally rejected because they fell outside the accepted paradigm include the Sun-centred solar system, the germ theory of disease and continental drift.

Myth Eleven:
Scientific Models are Real

- Models are just explanations of perceived representations of reality.
- A good example is the particle theory of matter, which pictures atoms and molecules as tiny discrete balls that have elastic collisions. This is a model that explains a whole range of phenomena, but no one has actually ever seen these tiny balls. The model is useful and it works as a means to explain and to predict a phenomenon.

Myth Twelve:
A Hypothesis is an Educated Guess

- Everyday use of the word *hypothesis* means an intelligent guess.
- For science, it can be misunderstood to mean an assumption made before doing an experiment or an idea not yet confirmed by an experiment.
- A better definition of a hypothesis in science is “a tentative explanation for a scientific problem, based on currently accepted scientific understanding and creative thinking”.

Myth Twelve:
A Hypothesis is an Educated Guess

- Hypotheses are supported by lines of evidence and are based on the prior experience, background knowledge and observations of the scientists.

Myth Thirteen: Hypotheses Become Theories which Become Laws

- Hypothesis, theory and law are three terms that are often confused.
- This myth says that facts and observations produce hypotheses, which give rise to theories, which, in turn, produce laws if sufficient evidence is amassed – so laws are theories that have been proved true.

Myth Thirteen:
Hypotheses Become Theories which Become Laws

- Theories and laws are very different types of knowledge.

- Laws are generalisations, principles, relationships or patterns in nature that have been established by empirical data. Theories are explanations of those generalisations (also corroborated by empirical data).

Presentation on

The Nature of Science – Myths About Science

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