

Activity 8: Science in society

This activity asks students to respond to common public objections to the high level of scientific confidence in the theory of evolution by natural selection

Overview of learning activity

Activity 7 was set in the context of scientists needing to communicate about their work to the public. Activity 8 develops this link (“It is the responsibility of scientists to explain our work to the public who ultimately fund our research”), and concerns public unease with ‘gene technology’, and more extreme views about the status of evolution (i.e. by natural selection) as a scientific theory. Students, working in groups, are asked to suggest how to respond to a letter from a pressure group (CAMMUL – the campaign against man-made unnatural life!) which denies that life on earth could have evolved: “Please read the arguments put forward by CAMMUL carefully, and think about how we can counter these arguments. You need to identify each of the points that CAMMUL are making, and identify what scientific ideas or information need to be used to challenge each point.”

During the ASCEND project this activity, and the preceding one, were undertaken by groups of students during the same 90 minute sessions. They may easily be separated and used independently.

Rationale for the activity

As with the previous activity, this activity is set in the context of the public understanding of science. Also, as with the previous activity, the topic (natural selection) has been chosen because experience suggests that even able students may fail to see the ‘whole picture’ and take away from school science a partial understanding of the key arguments used to support evolutionary theory. As the students are told in the briefing information: “the reasons so many people doubt evolution are that (a) it has occurred over such a long time scale, and (b) evolution only makes sense when someone understands how a number of separate key ideas fit together”.

This activity, then, develops ideas from previous ASCEND activities on the need to integrate different ideas (Activity 7), and the nature of a scientific explanation (Activity 4), as well as – like most of the ASCEND activities - involving team work and a form of modelling activity.

The activity is set within a ‘science and public affairs’ context. Ignor Raymus, the chair of CAMMUL (the pressure group ‘Campaign Against Man-Made Unnatural Life’) has written to the SynBot Institute to raise public concerns about “work that

is described as ‘genetic engineering’, where you try to change the natural structure of living things, and create new un-natural plants that may lead to all sorts of unforeseen problems” - a “type of ‘research’ ... based on the widely discredited ‘theory of evolution’ which is now recognised to be a scientific theory which is confused, mistaken and contradicted by evidence available to anyone who chooses to look around them and think about the natural world.” Ignor Raymus then sets out some arguments against evolution. These are based on common objections that are raised, and which may appeal to ‘common sense’:

- something like a green plant, with all its complex structure, could not possibly come about by chance
- there is so much variety in living things that they cannot possibly be derived from common ancestors
- left to their own devices, living things are not going to breed to ‘improve’ the species
- no one has ever managed to breed sheep from dogs, no matter how much they have selected the parents
- parents always leave offspring of the same type
- if man had evolved from monkeys, then why are there still monkeys?
- why do the genes for some diseases seem to get passed on so effectively?

Responding to these objections with sound arguments requires a good understanding of the theory of evolution by natural selection!

Resources

In ASCEND the students were not required to produce any particular form of output in this activity, although there are materials and hints suggesting two complementary approaches. Teachers using these materials in other contexts may wish to make the activity more prescriptive. The important learning principles are that students are being asked to actively process and organise information to encourage meaningful learning; and that by working in small groups, focused dialogue - with sharing and exchanging of ideas - is encouraged.

The groups are provided with a set of cards labelled with possibly relevant concepts (‘species’, ‘variation’, ‘mutation’ etc.), and are provided with an example of a simple concept map type schematic:-

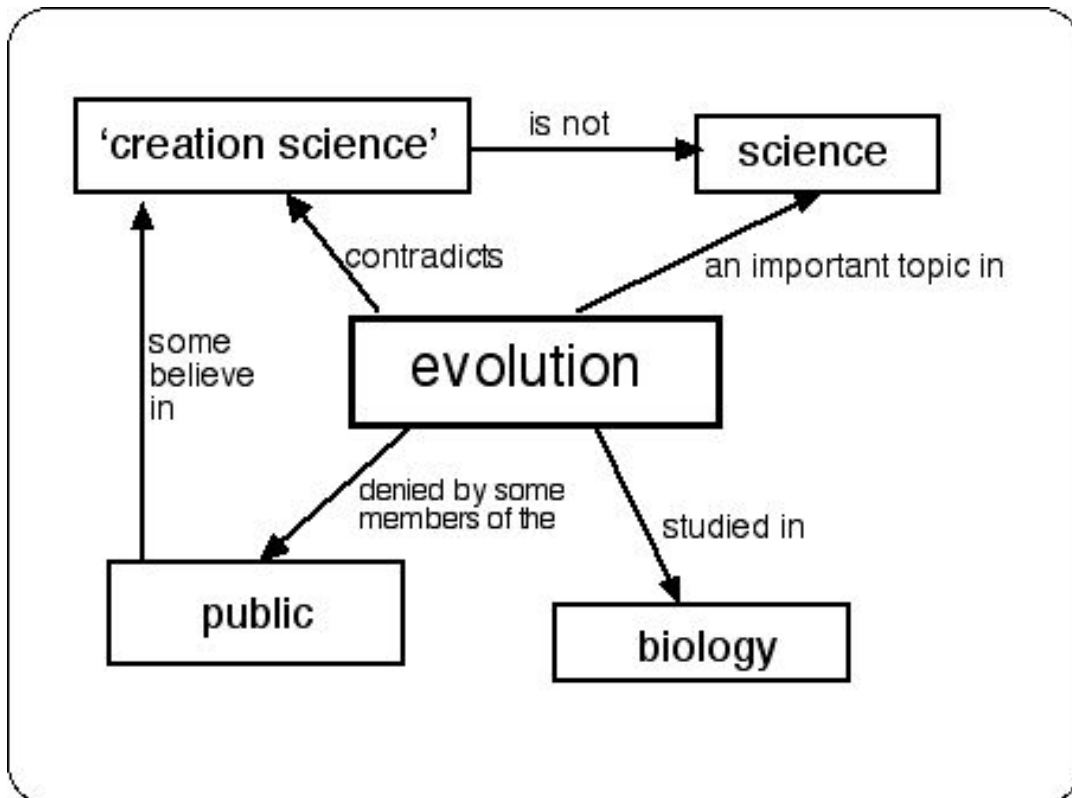


Figure 8.1: example of a simple concept map

Building a concept map to model how key ideas link is one way of showing how scientific ideas build into extended networks. Figure 8.1 is provided as a model (the caption in the student materials is 'mapping out related concepts'). However, this would not in itself make an argument for accepting evolutionary theory as reliable knowledge.

The second suggested format, is a graphical representation of the argument in a form more like a flow chart (Figure 8.2), which is modelled for the students in one of the hand-outs (with the caption 'structuring an argument').

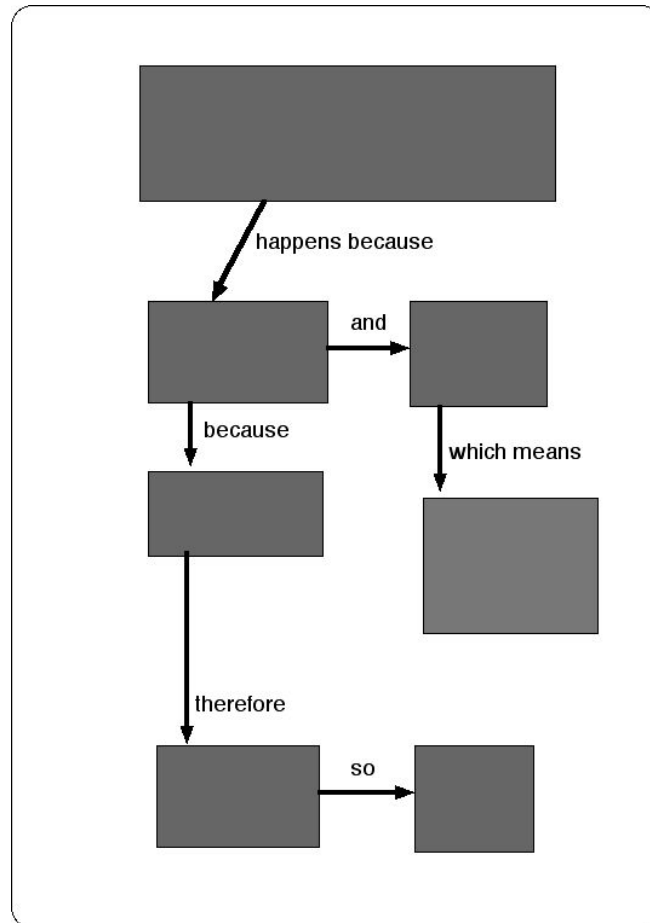


Figure 8.2: Schematic for representing an argument

The groups are provided with a set of ‘evocards’, each offering some information/evidence about how scientists understand evolutionary ideas. A few of the examples provided are:

- In most living things parents produce many offspring, but only a few survive to adulthood.
- The fossil record shows that there were many types of living things (e.g. the dinosaurs) that are now extinct. If a species fits its environment well, and the environment remains much the same, that species may hardly change in many, many millions of years – e.g. crocodilians.
- All living things alive today share similar genetic codes.
- Etc.

These ideas are suitable for being organised into a similar schematic to that shown in Figure 8.2. There are sufficient cards to provide an excess of examples and ideas, so that there is considerable flexibility in terms of possible creditable outcomes. As with most of the ASCEND teaching resources, it is possible for

teachers to adopt the materials in their original form, or to modify the original by changing, adding or omitting items to best meet the needs of different groups.

The following resources are included on the CD:

Resource	Description	Filename
A Serious Challenge to Science	Memo from the Director, <i>SynBot Institute for Plant Sciences</i> , setting out challenge	Act 8 memo
For Nature – Against Unnatural Science	Letter from the pressure group ‘Cammul’ to be addressed by the team.	Act 8 letter
Mapping out related concepts	Model of a single concept map, as an example of how ideas may be linked graphically	Act 8 map
Concept cards	Set of concept terms that can be used to construct a concept map (Best printed as one A4 page, and cut into cards)	Act 8 concepts
Structuring an argument	Model of how an argument may be structured graphically	Act 8 argument
Evocards	A set of pages with ideas/evidence that can be considered when developing an argument for life on Earth to have evolved by natural selection. (The document is set up with one card per page, but should be printed with several (e.g. 6) cards per A4 page.)	Act 8 ideas

Groups will also need poster paper, glue etc., if asked to produce a permanent record of their ideas. Concept cards and ‘evocards’ should be provided as pre-cut sets (ideally with each set in a labelled enveloped): otherwise groups will also need scissors.