

Genetic information is found in all living things

Critical teaching ideas - Science Continuum F to 10

Level: Moving towards level 10

Student everyday experiences

Students commonly view genetics as a complex part of science and consequently they form alternative conceptions of genetics. This is not just from school. Students commonly bring ideas of learning genetics from 'folklore' i.e., ways in which families describe what and how certain characteristics are inherited.

Examples of these conceptions include:

- that any observable variation between organisms of the same species is solely due to environmental factors (See Driver Squires Rushworth & Wood-Robinson, 1994).
- that not all living things contain genetic information.
- that a gene is not a real thing (See Lewis Leach & Wood-Robinson, 2000).
- that genes that carry the genetic material are only found in the blood or only found in the brain or only found in the reproductive system.

that a person will only carry genes for characteristics they display (e.g. tongue rolling) and not for characteristics that they do not display (e.g. red hair).

- that acquired changes (e.g. muscle development) can be passed onto offspring.
- that genetic inheritance involves an averaging of the genes from both parents (e.g. dark skin and white skin leads to brown skin). So each of a child's characteristics is somewhere in between those of the parents.

Widespread confusion exists among students between the concept of inherited changes in populations that take place over large periods of time e.g. generations and that of non inherited changes in individual organisms that take place over the period of the organism's lifetime. (See Wood-Robinson Lewis & Leach, 2000).

Genetic material, including genes and DNA, forms the basis of life.

Genetic information is passed from generation to generation through inherited units of chemical information (in most cases, genes). Organisms produce other similar organisms through reproduction, which allows the line of genetic material to be maintained and generations to be linked. Through reproduction, organisms in a species maintain a 'bank' of genetic information which links individual



members and successive generations.

Organisms possess genetic material that contains information for the development of characteristics. This material passes from one generation to the next through reproduction.

All plants and animals are made up of cells where the genetic material can be found in the form of genes and chromosomes (usually in the nucleus). (See Lewis Leach & Wood-Robinson, 1999)

Changes that take place in an organism over its lifetime e.g. darkening of human skin due to exposure to sunlight, normally has no effect on the organism's genetic makeup and because of this will not be passed on to the organism's offspring. (See Wood-Robinson, 1994)

Changes to an organism that are a result of or result in genetic mutation alter the genetic makeup of an organism and can be passed on to the next generation.

Mutations are changes in an organism's genetic information that potentially affect the current functioning of that genetic information.

Critical teaching ideas

- Genetic material provides the information that allows living things to function.
- Genetic information can be passed on from generation to generation.
- Changes in genetic information e.g. from mutation can give rise to variation in characteristics and can be passed on through the generations.
- Students need to realise that genetic material is found in all living things and it carries information that directs the organism's functioning.

By studying reproduction students should develop an understanding that genetic information is passed from one generation to another via organised chemical structures.

Students need to study examples of changes in genetic information that can arise due to mutation. They also should study the impact of acquired changes on organisms and develop an understanding that these changes are not inherited because they are not created by genetic changes.

For organisms to survive it is important that the information needed for survival is passed on through the generations. The genetic information also needs to have some inbuilt capacity within populations of organisms if organisms are to respond to changes in their environment. Mutations also contribute to this capacity.

Teaching activities

Collect evidence/data for analysis

Students could be given a group of organisms e.g. tiger snakes in South Australia and asked to track the variations that have occurred in that species. For example, for the Tiger Snakes in Australia, one species has developed into 6 individual species:

1. *Notechis scutatus* (Common Tiger Snake).
2. *Notechis ater ater* (Krefft's Tiger Snake).

3. *Notechis ater niger* (Peninsula Tiger Snake).
4. *Notechis ater occidentalis* (Western Tiger Snake).
5. *Notechis ater serventyi* (Chappell Island Tiger Snake).
6. *Notechis ater humphreysi* (Tasmanian and King Island)

Clarify and consolidate ideas for/by communication to and with others.

The students could then comment on how this variation has enhanced the chances of survival in different environments and contributed to changes in a pool of genetic information.

(This has been documented in many places including Bushman Films: <http://www.barefootbushman.com>)

Students could create their own 'David Attenborough' type documentary. They could pick some living thing to investigate; local examples might be frogs, dogs, cats, reptiles or birds. They could also choose to create a documentary about plants including those that have been genetically modified for food. For ideas on how to carry out this type of activity the students could watch videos e.g. David Attenborough documentaries all of which are listed at the following URL:

http://www.bbc.co.uk/nature/programmes/who/david_attenborough.shtml



Promote reflection on and clarification of existing ideas.

Another activity might be for the students to develop high tech genetic identity cards, for this students may need to research the possible ethical and human rights considerations of collecting this personal information. They would also need to consider whether certain drugs would be able to alter genetic information and how this information would be recorded on the identity cards.

Students might also produce identity kits which would include family information, photographs and family background. This could lead to discussion on who would have access to these and why they would need that access.

Collect evidence/data for analysis.

Students should use variety of visual images to collect and describe data about the changes that can occur within and between organisms. They would also need to research using books, journals and the internet, then they would need to analyse what they had found to produce their findings

Promote reflection on and clarification of existing ideas.

Students might also discuss the causes and sources of mutations as well as other sources of variation (e.g. recombination). They will also need to discuss and analyse the ethical aspects of genetics and how these impact on humans.

Open discussion by a shared experience

Ethical issues and dilemmas associated with genetics can elicit student need to know and provide excellent routes into student engagement. A useful resource to explore the role of the sickle cell gene in natural selection is:

- [A Mutation Story](#)