Genetic Diversity and Us

LESSON

GRADE LEVEL K-8

CATEGORY Earth, Ecosystems and Ecology

TOPIC Diversity and Genetics

LENGTH
Part 1: one science period.
Part 2: one science period.

MATERIALS
- Part one: items for measuring diversity (magnifiers, rulers, binoculars) and
- Part two: Diversity worksheet (genetic wheel) plus coloured pencils and a comprehensive dictionary with root word meanings.

SETTING
Indoors

GROUP SIZE
One class (teams of three or four)

SUBJECT AREAS
Science and Math

SKILLS
Observing, counting, assessing, recording, researching, and reading

KEYWORDS
Genetics, genes, speciation, ecosystems, living and non-living, differences, similarities, and biodiversity

HCTF Education

Overview

Part 1 (k-8) Introduces the concept of differences or genetic diversity among individuals of the same species (animal or plant of choice).

Part 2 (3-8) Introduces the concept of genetic diversity among human individuals.

Objectives

Students will be able to:

- Understand the role genetic diversity plays in determining a species' appearance and behaviour.
- To understand that genetic material is passed down from parent to offspring.
- To explore the way genetic diversity helps wildlife species to survive and adapt to changes in its environment.

Background

Biodiversity starts with differences in the genetic material (DNA) of any individual from the common cold virus to human beings. Genetic diversity refers to how each individual is different in some way from every other individual of its species even when some of the differences are visibly detectible and some are not. Genetic diversity is a very important kind of biodiversity because genes carry the genetic code and are inherited from parents of that organism and in that way the differences among a species are replicated thereby making the population as a whole able to adapt to disease and other changing environmental conditions. Genetic differences also affect how organisms look and behave.

In animals, genetic diversity may appear as colour differences (e.g. eye colour, hair/fur colours), size differences (big feet/ small feet), sex differences (male or female) or behavioral differences. Genetic diversity may exist in less obvious forms inside an individual's body (e.g. blood type) and cells, affecting the way we grow, think and fight disease.

Genetic diversity exists in every living thing and has a role to play in the ongoing health of each species as well as the formation of new species. Species with high genetic diversity can adapt better and more easily to changing factors and conditions (including diseases) in their environment. As genetic variation widens in response to changing factors new features can evolve leading to a new species. This has been studied extensively in bird species of isolated islands. In some cases the adaptation is in the shape of the bird's bill enabling them to eat a wider variety or a more plentiful food source. It is genetic diversity

that allowed for a slight change in bill shape to appear in one or a number of a particular bird's offspring and if the change for that individual provides an distinct advantage (they are able to survive better than others without the change) then those birds with the different bill will be more successful in reproduction and the bill shape change will be passed down to their offspring in each successive generation. Over a long period of time, this process may result in a new species if the isolation continues or the changes make the offspring of a crossed pair (bird with new beak and old beak shape) unable to breed (sterile) or not able to make viable offspring of its own. This process is known as speciation. Examples of speciation happen more often in populations that are isolated or separated from the others of the same species as changes are more easily re-produced in smaller numbers; but this does mean that the new species population will likely be small and therefore vulnerable. There is strength in numbers when it comes to genetic diversity and species population health.

Genetic health is important for rare or endangered species and researchers often talk about the potential to be genetically extinct (those without enough genetic diversity to sustain the population into the future). The spotted owl is one species where scientists are concerned with figuring the number of needed breeding pairs to keep a species going rather than being concerned with the actual number of spotted owls. In order to keep a small population alive scientists involved in rare species breeding programs (planned crossings) plan for crossing animals with the greatest genetic diversity, especially if the species tends to have genetic traits that limit mixing such as keeping a mate for life rather than cross breeding. This can, of course, be expensive or impractical as genetic diversity can only be determined by expensive testing of genetic material (animal tissue or blood) and the species may be elusive or the collection of genetic material may harm the individual.

The Activity

PART 1 (K-8)

Warm up

Working in groups of three or four students each team will need:.

1. A plant or animal species to investigate such as cats, dogs, seeds from one species, flowering plant, squirrels, etc
2. a magnifier (for small objects)
3. a ruler to measure size
4. optional: net, binoculars (for bird studies)

Procedure

1. Each team collects six to eight specimens of the same type of plant or animal. Examine the differences. If you can't collect them, observe them closely and either photograph or sketch them. For younger students, start with observing differences in objects of the same kind (crayons, building blocks, pictures of one type of animal/plant such as owls, roses, bears).
2. Picking several examples from one kind of thing or a species have the students make observations and if appropriate record or draw answers to questions such as:
   - Size (measure if you can):
   - Shape:
   - Colour(s):
   - Location (especially for plants - in sun or shade):
   - Identifying Marks of that individual:

PART 2 (GRADE 3-8)

Warm up

Copy the genetic wheel for individual or teams of students.

Procedure

1. Students should start at the centre of the wheel and moving outwards, use one colour pencil crayon per person and colour in each characteristic as it applies to them or the member on the team. Move circle by circle from the centre to the outside until they reach a number at the outside edge of the circle.
2. Record the number in the same coloured pencil on the sheet.
3. Students should find others who have the same number or very close their number in the class, discuss why that doesn't mean the students are genetically similar by discussing the limitations of the wheel, the vast size of the human genome, and explore some of the other things that genetics controls in humans like blood type, bone structure, skin colour, foot size, etc.

Assessment

PART 1

1. As a class or individual list the differences between individuals of the same species.
2. Discuss why differences between individual animals or plants of the same species are important?
3. Scientists often give common and scientific names to species based on a description of the species dominant feature. Ask students to come up with a different name for each of the individual species you looked at.
4. Use a field guide to help you identify the scientific names of the specimens you studied. Scientific names are often derived from Greek or Latin. Use a dictionary to try to figure out the meaning of the scientific name to see if it helps describe the species. E.g. Velox means rapid or swift and vulpes means fox. So the latin vulpes velox is the scientific name of a Swift Fox. In plants the bigleaf maple;s scientific name is Acer macrophyllum, where Acer in Latin describes the lance like and sharp qualities of a maple's leaf points and the macrophyllum which literally means 'big' (macro) 'leaf' (phyllum – in Greek).

PART 2

1. Students should compare their number to others. How many of you had the same number? Find out where your numbers branched off.
2. Use this activity with your parents and/or siblings to generate "genetic math sentences." [e.g. #116 (dad) + #52 (mom) = #27 (you) + ?]
3. Describe or draw a family tree of common characteristics among the various generations and members of your family.

Extensions

1. Why are plants or animals of the same species different? Can the differences help the animal or plant survive, which differences would help?
2. If you are studying plants can the students use genetic diversity to explain why a plant in one area that is badly damaged by a pest or disease is not or only has very little damage in another area? Some examples could come from vegetable gardens (pea or tomatoes) or tree species and the pine beetle.
3. Scientists know that a good mix of genes in a species contributes to stronger and healthier living things. If new genes are not continually being introduced and mixed into a population, both individuals and the population as a whole may suffer, especially if the population is small. Investigate this concept by researching breeding programs for rare animals and (if appropriate) discuss why this may be necessary in some cases. Discuss the ethics of seed banks or animal breeding programs (some zoos, aquariums and conservancies).
4. Investigate what happens over a number of generations to human families where sisters and brothers intermarry or by researching the problems food producers have when they "over specialize"—raise too many individuals of the same variety over a long period of time. One example is to look at is poultry or fish farming industry.