

Coding the “Perfect” Animal		Grade 9 to 12 – Evolution	
Lesson Plan	Coding Tool	Pseudocode	
	Cross-curricular	Biology (SBI3U)	
Big Ideas Write and execute code in investigations and when modelling concepts. C3. Demonstrate an understanding of the theory of evolution, the evidence that supports it, and some of the mechanisms by which it occurs.	Specific Expectations C3.1 Explain the fundamental theory of evolution, using the evolutionary mechanism of natural selection to illustrate the process of biological change over time. C3.2 Explain the process of adaptation of individual organisms to their environment. C3.3 Define the concept of speciation, and explain the process by which new species are formed.		
Description In this lesson, students will learn about evolution, speciation, and animal adaptations that occur in different environments. Afterwards, they will be challenged to write a code using functions to represent the genome of an animal that can face and adapt any environmental condition.			
Materials <ul style="list-style-type: none">Printed HandoutPencil and EraserPowerPoint PresentationLaptop or device for research (optional)	Computational Thinking Skills <ul style="list-style-type: none">PseudocodeFunctions		

Introduction

Go through the slideshow to introduce or review the concepts of evolution and adaptation.

What is evolution?

Evolution is the process of change in genetic composition of a population over successful generations. Evolution is a strategy living organisms use to adapt in their environment.

For example, the giraffe has evolved a long neck to reach the leaves on tall trees. Some insects have evolved a resistance to pesticides.

Try to discuss with students about other examples that they can think of.

Why are there many kinds of animals in the world?

We have a wide range of diversity in animal species due to evolutionary radiation; one common ancestor has evolved into different species with various evolutionary traits to adapt in many kinds of environments.

Evolutionary Radiation

The diversification of mammals at the end of the Cretaceous period is a good example of evolutionary radiation. During the time, dinosaurs were dominating the land and were found at the top of the food chain. However, once they went extinct, mammals were no longer being hunted by them and were able to thrive. A common ancestor was able to evolve into many new species of mammals with unique traits to adapt in different environments... in other words, evolutionary radiation!

The cladogram on the right shows the different groups of mammals that have evolved from that common species. Each split in the diagram represents a common ancestor that has evolved into different species. In the cladogram, you will notice that many animals have different morphological traits, but are closely related to each other, such as camels and dolphins.

Charles Darwin and the Finches at the Galapagos Islands

In 1835, Charles Darwin, a naturalist, went on a voyage to the Galapagos Islands, an area with plenty of islands grouped together. While he was there, Darwin noticed that the birds located on each island were different from one another. Later, he believed that these birds came from the same ancestor, but has evolved differently due to being exposed to different conditions on their separate islands. Darwin hypothesized that the diet of the finches was the cause of their speciation. In fact, the finches who mainly ate seeds had larger beaks to crush their food. Finches who ate insects normally had a longer and thinner beak, possibly to help pick out

insects in the dirt or in trees. Finches with a parrot-like shape normally ate fruits. Darwin's finches show how evolution helps an animal to adapt according to its environment.

What are some environmental factors an animal must adapt to?

There are many conditions that can affect the way an animal evolves, such as:

Temperature	Presence of predators
Climate	Types of vegetation
Diet	Light level
Aquatic or terrestrial habitat	

Action

Each student will start off by answering the starting questions on the first page of the handout. They can write down a description for each environment, such as its temperature, availability of resources, potential predators, etc. This will help them create a plan of what traits their animal needs to survive. They should also use the list of environmental factors shown in the presentation as a guide.

Once finished, they will write down a code in the space provided in the handout to create the genome of their animal. This is the genetic code that will give their animal the characteristics needed to survive in any environment. If allowed, they can research different strategies animals have evolved to help adapt different conditions in their environment.

When a student has finished writing the code, test it by going through the five different environments to see if there is a certain condition that may harm the species. If there appears to be a flaw in the code, the student must go back and modify (or debug) their genome to improve the animal's adaptation by adding, removing, or changing functions. They will continue doing this until their code seems to work for all environments, or until the activity lasts too long.

Once every student has finalized their code and the activity is finished, give them time to answer the reflection questions on the last page of the handout (either individually, in groups or as a class):

1. Why does a "perfect" animal not exist?

Possible answers:

- Evolution's goal is to adapt to the current environment, not to be perfect.
- Some traits that are advantageous in some places might be harmful in other environments.

2. What are the disadvantages of having many traits to adapt in multiple environments?

Possible answers:

- The animal may require more energy to survive with all the traits, which can be difficult in areas with limited resources.
- Certain traits could oppose one another, or some traits might be harmful if the animal is in a certain environment.

3. What other factors are not being considered that could harm your animal?

Possible answers:

- Age
- Diseases
- Mutations
- Change in the environment over time

4. After doing this activity, how does evolution and coding have similarities?

Possible answers:

- Animals are coded by their genome, which “programs” them.
- An animal's genome changes with evolution to adapt their environment, like how one would debug their code to work the way they want it to.

Consolidation/Extension

As a group, students can share and discuss their answers for the reflection questions at the end of the handout and elaborate further on their answers with others.

Assessment

Students can be assessed for their participation while answering the reflection questions in the handout.

Additional Resources