Science Unit: ***Plants and Animals Through the Stages of Ecological Life***

Lesson 5: ***Populations – The Survival of the Fittest (Part 2)***

School year:	2007/2008
Developed for:	Mount Pleasant Elementary School, Vancouver School District
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Grade level:	Presented to grades 6 - 7; appropriate for grades 4 – 7 with age appropriate modifications.
Duration of lesson:	1 hour and 20 minutes (revise as needed)

Objectives

1. Learn the ways in which a population can become diverse
2. Learn how mutation changes the diversity of a population
3. Learn the concept of natural selection

Background Information

All populations are composed of organisms that belong to the same species but are not necessarily the same. All organisms in a population are subjected to natural environmental pressures, which determine whether they will thrive and reproduce or whether they will perish. This is the concept of natural selection. Organisms best suited for their local and current environment they live will thrive and pass on those thriving abilities to the next generation, those who are ill adapted will not survive to reproduce and those bad qualities will die with them. Mutations play an important role in natural selection. When a mutation is silent, meaning it does not affect an organism's ability to survive in the current environment; the organism may carry that mutation and pass on to its offspring without any good or bad consequences. However, imagine that this mutation confers an advantage (be it better in hiding from predators, or better at finding food) those organisms will do better than the ones that don't have the mutation. As a consequence the most of the organisms of the next generation will be the offspring of the ones carrying the mutation. Mutations in general create diversity in a population. If we have a clonal population, for example the planted pine trees in BC, and a plague, like the pine beetle, comes along, then all trees will die, because they are all the same. Now if this same forest was not artificially planted, but was the product of a natural population of trees, it is likely that a few would have a mutation that might give them some protection against the pine beetle. The natural forest would be diverse in its genetic makeup and the planted forest would be identical in its genetic makeup. Another way in which populations can become diverse is through migration. When 2 populations become combined, the result is population that is more diverse and therefore more likely to survive environmental changes and plagues.

Vocabulary

Word:	Brief definition.
Population	A group of organisms of a species that interbreed and live in the same place at the same time
Diversity	A wide variety of characteristics present in a single population
Trait	Alternate forms of a given characteristic, ie furry versus furless
Mutation	A permanent and transmissible change in the genetic material of an organism

Natural selection	A natural process resulting in the evolution of organisms best adapted to the environment.
Clones	Organisms that reproduce by creating exact genetic copies of itself, creating a clonal population
Fitness	The ability of an organism to suit its environment and reproduce.
Generation	The average interval of time between the birth of parents and the birth of their offspring.

Materials

- Pictures of animal and plant populations
- Containers for the beans
- 1 pound of kidney beans
- 1 pound of white beans
- Tweezers
- Pins/ paper clips
- Spoons
- Clothes pin
- Timer

In the Classroom

Introductory Discussion

Review the population game

Ask students to describe the steps of the game and to explain which trait ratio is best for a population.

Answers: Step 1 - count your population, step 2 – weather of the season, step 3 – survivors, step 4 – reproduction, step 5 – new generation (step 5 = step 1) (for full explanation see part 1)

A population with a balanced number of traits is better for population survival, because it is more diverse

Divide the students into groups and give each group a container with a specific ratio. (we divided the students into 6 groups and gave 4 groups 8 kidney and 8 white beans, 1 group 16 kidney and 0 white beans and 1 group 0 kidney and 16 white beans.)

Draw a table on the board with 3 columns: Group number, Initial bean ratio, final bean ratio. Ask the group to contribute the ratio of their population.

Play the game for 8 or 10 generations. Randomly decide the weather.

(Don't worry about all groups containing the same initial ratio of beans coming up with different answers.)

Ask the students from each group to contribute with the final ratio. Fill it in the column.

Circle those populations with 0 organisms of one type of bean.

How could we make these populations obtain some organisms of the other type?

- wait for answers, and record it on the board

Draw a bacterial population. (a bunch of circles of the same colour)

Show how bacteria reproduce. (draw a second plate with twice as many circles of the same colour, except for only one circle being a different colour) – How could this happen?

Explain mutation. (talk about last class's question of antibiotics and super-bacteria)

Ask students to trade beans. Get one bean from your bowl and pass it on to the next group. What did the trading do to your population?

Explain migration. (when animals migrate they can change the ratio of other populations)

Science Activity: Modeling Natural Selection

Ask the students to put all beans in the correct bean container and to arrange themselves on the carpet into groups (as many groups as containers of beans available for the lesson). Each group will get a container filled with beans.

Draw 4 funny-looking animals on the board (the funnier the better!). Give a different 'mouth' to each of the first 3 animals: one will have a clothes pin mouth, one will have a tweezer mouth and the third has a pin or paper clip mouth. Leave the fourth.

Give the students the following scenario:

"We are a group of researchers that have been sent to a distant planet to research these animals. We discovered them but they still don't have a name. Let's first give it a name (ask the students to suggest names and vote. The species name will be composed of the first and second most popular suggestion). We were sent on a field assignment to learn more about these creatures and we learned that all of them eat beans, and we also saw that they have different mouths. One has a tweezer mouth, one has a clothes pin mouth and another one has a pin mouth. During the same field trip we found a fourth kind of (creature name), a spoon mouth one (draw a spoon mouth on the fourth funny-looking animal).
These are really rare. We believe those ones are mutants."

How do you think this mutation is going to affect the population?
Which mouth trait do you think is best to eat beans?

Distribute pins/ paper clips to 55% of the class, clothe pins to 30% of the class, tweezer to 10% of the class and spoons to 5% of the class. (The actual percentage isn't important, just make sure very few students start with spoons)

Mark 1 minute on the timer and tell them that they will have 1 minute to 'eat' as many beans as they can. Warn students against cheating.

At the end of 1 minute the creatures that failed to eat at least 20 beans will have died. Those students should play the offspring of the surviving animals (if a student had a pin give a clothe pin, if had a clothe pin give a tweezer, if had a tweezer give a spoon).

Play more rounds reducing the time gradually to 45 sec, 30 sec and 10 sec.

Ask: How many of you are pins? clothes pin? tweezers? spoons?
Ask them why they think most of them are spoons.

Closure Discussion

In the case of the creatures we just studied, was that a good or a bad mutation? Why?

(it was a good mutation for the spoon mouths but not for the other mouth types. Those died because they could not compete for food with the spoon mouths)

What did that mutation do to the population? (did it make it more or less diverse?)

Which trait survived best? Explain selection

The population became less diverse. What do you think will happen if somehow one of the creatures learns to eat something else? (it will survive and maybe even do better than the spoon mouth depending on how much of this other food is available)

Last class we talked about bacteria – what did we talk about? (reproduce clonally, how super-bacteria are created)

Using your knowledge of natural selection and mutation how do you think that can happen?

Use these diagrams to help them understand:

- draw a circle and put 2 dots of the same colour inside
- draw another circle and show that after sometime each bacterium reproduced, draw 4 dots
- draw another circle and ask: how many this time?
- If no one says that a mutation could occur ask them what could we do make this bacterial population more diverse
    - Make this mutation give the bacteria the ability to eat poison and not die!
- Next circle add 8 dots, where 7 are one colour and 1 is of another colour
- Keep the bacterial population growing until you have at least 10 of the second colour
- Add antibiotic – explain that it is a poison
- Which ones will die? Which ones survive?
- Why?

References

The Biology Corner. Natural Selection Activity. <http://www.biologycorner.com/worksheets.php> Accessed March 5th, 2008. [Modeling natural selection activity]

Extension of Lesson Plan

1. Older students may visit a molecular lab and experiment with bacterial colonies and antibiotic selection.