NATURE Sunday Academy.

Mechanisms of Evolution and Diversity

Project Description:

The lesson will introduce ways in which evolution can occur: Drift and Natural Selection. The lesson will also build on these ideas by linking to real life scenarios and observation of diversity.

Project Objectives:

Students will be able to:

1.Recognize examples of evolution via random genetic drift and natural selection

2.Explain how drift differs from natural selection

3.Use drift to explain why it is incorrect to state that evolution leads to perfection

4.Use understanding of natural selection to postulate hypotheses regarding diversity in traits

5.explain how population size influences the relative ability of drift to affect allele frequencies

6.graph data and formulate hypotheses to explain observations

11:00-11:30 Cultural connection

11:30-11:45 Introductions

-Introduction power point, definitions, terms etc.

-Genotype, Phenotype, Evolution, Drift, Natural Selection, Reproduction/Fission/cloning, Species, Allele

-Example with Buntings. Variation is observed, and biologists want to be able to explain the patterns of diversity that we observe.

11:45-12:00 – Begin Lesson 1. – Evolution by Natural Selection (likely will not finish this section fully before lunch) – still need to add in group discussion questions to take place during lesson.

Natural Selection – differing preference of students for M&M color.

Activity Instructions:

- You will be working with the haploid, asexually reproducing M&M organism. M&M's come in two phenotypic varieties – orange and blue. You will be modeling how a population changes over time.
- Responsibilities during the activity: Record your data in the provided data sheet and graph your data on the board (make it big!). The graph should have "Generation" on the X axis and "% Orange M&M's" on the Y axis (see data sheet for example). When the activity is complete, turn in your datasheet to the instructor.

1. Assess your source population
    - The cup on the table is your source population (Gen 0). It has 10 orange and 10 blue M&M's.
    - Record the proportion of orange M&M's on your data sheet and plot the data on the white board (Gen 0).
2. STOP! Wait for class discussion before proceeding
    - Predict what will happen
3. Create a new generation by fission!
    - Select 10 of your m&m's at random that will survive and reproduce (Carrying capacity – there is only enough chocolate in the environment to provide enough food for 10 m&m's to reproduce).
    - From the 10 chosen at random, double the number of blue and orange M&M's in your population. Ex. 4 orange and 6 blue -> 8 orange and 12 blue.
    - Place these M&M's in your "Focal" cup and record the percent on your graph (Gen 1).
    - Pass the "Focal" cup to the next person
4. Repeat step 3 again and record your observations on your data sheet and graph (Gen 2).

   Predict what will happen in subsequent generations.

12:00-12:30 Lunch

12:30-1:15 Finish Lesson 1 and discussion

<u>New Handout:</u>

Now a chocovoire arrives in the locations, and they think orange is tastier than blue.

- Remove 4 m's from population (predation) – you should now have 16 m's
- Select 10 of the remaining m&m's to reproduce

5. Create a new generation by fission!
    - From the 10 chosen at random, double the number of blue and orange M&M's in your population. Ex. 4 orange and 6 blue -> 8 orange and 12 blue (back to 20 in the population).

- Place these M&M's in your "Focal" cup and record the percentage of orange m's on your data sheet and graph (Gen 3)
- Pass the "Focal" cup to the next person
- Repeat step x-x two more times and record your observations on your data sheet and graph (Gen 4 and Gen 5)

6. Repeat steps 5 until you have completed the process through Gen 5.
7. Hand in your datasheet to the instructor.

1:15-1:40 – Video about Peter and Rosemary Grant's research on Galapagos.

http://media.hhmi.org/biointeractive/films/OriginSpecies-Finches.html

Video thought questions

1.Why where there only big, hard seeds available to the Medium Ground Finches on Daphne Major during the 1977 drought?

2.What would you predict would happen in a year of heavy rain, why?

3.How did the Grants' determine whether beak size was heritable?

1:40-2:20 Lesson 2 Genetic Drift

- Discussion of Huntington's disease (HD) in the Dutch population that migrated to South Africa

- Discussion 1: Did everyone get 50:50? Who got more orange? More blue? Anybody have just one color? If we extend this out several generations, what do you think will happen?
- Discussion 2a: Look at your graph, what happened to the frequency of orange over time? Is this evolution?

- Discussion 2b: Look around the room – how does your data differ from those collected by other groups? Why might this be?

- Discussion 2c: Was there selection? Focus on one graph that goes to (or near) fixation

- Discussion 4: Return to Dutch example, tie in results from M&Ms activity, show full graph with incidence of HD in native South Africans. At this point, the term "founder effect" is introduced.

Activity Instructions:

- You will be working with the haploid, asexually reproducing M&M organism. M&M's come in two phenotypic varieties – orange and blue. You will be modeling how a population changes over time.
- Responsibilities during the activity: Record your data in the provided data sheet and graph your data on the board (make it big!). The graph should have "Generation" on the X axis and "% Orange M&M's" on the Y axis (see data sheet for example). When the activity is complete, turn in your datasheet to the instructor.

8. Assess your source population
    - The cup on the table is your source population (Gen 0). It has 10 orange and 10 blue M&M's.
    - Record the proportion of orange M&M's on your data sheet and plot the data on the white board.
9. Create a new "splinter" population
    - Without looking, draw four M&M's from the source population.
    - Dump the remaining M&M's in your "Reserve" cup. Place your splinter population in the "Focal" cup.
    - Based on the M&M's in your "Focal" cup, fill in the data sheet and graph (Gen 1)
10. STOP! Wait for class discussion before proceeding
11. Create a new generation by fission!
    - Double the number of blue and orange M&M's in your splinter population. Ex. 3 orange and 1 blue -> 6 orange and 2 blue.
    - Place these M&M's in your "Focal" cup.
    - Pass the "Focal" cup to the next person
12. Reduce the population size to four

- Without looking, draw four M&M's from your cup
- Dump the remaining M&M's in your "Reserve" cup. Place your reduced population in the "Focal" cup.
- Fill in the data sheet and graph with your new data (Gen 2)

13. Repeat steps 4 and 5 until you have completed the process through Gen 5
14. Hand in your datasheet to the instructor.

2:20 – 2:45 – Study skin – diversity of bills.

Study Skin worksheet

Introduction:

Did you ever wonder why there are so many types of bird beaks (scientists call them bills)? The most important function of a bird bill is feeding, and it is shaped according to what a bird eats. You can use the type of bill as one of the characteristics to identify birds. Here are some common bill shapes and the food they are especially adapted to eat:

SHAPE	TYPE	ADAPTATION
	Cracker	Seed eaters like sparrows and cardinals have short, thick conical bills for cracking seed.
	Shredder	Birds of prey like hawks and owls have sharp, curved bills for tearing meat.
	Chisel	Woodpeckers have bills that are long and chisel-like for boring into wood to eat insects.
	Probe	Hummingbird bills are long and slender for probing flowers for nectar.

	Strainer	Some ducks have long, flat bills that strain small plants and animals from the water.
	Spear	Birds like herons and kingfishers have spear-like bills adapted for fishing.
	Tweezer	Insect eaters like warblers have thin, pointed bills.
	Swiss Army Knife	Crows have a multi-purpose bill that allows them to eat fruit, seeds, insects, fish, and other animals.

1. Examine the beak of each bird and determine the type of each beak based on its shape and function. Some beak types may be used more than once.
2. Place your choices on the chart in the column marked **Beak for**: (Some of the same beaks may be found on different birds).

Name of Bird	Beak for eating?
Mallard duck	
Rose breasted grosbeak	

American kestral	
Eastern Kingbird (flycatcher)	
Common nighthawk	
House wren	
Virgina rail	
Ruby-throated Hummingbird	

2:45-3:00 Wrap Up Discussion

Materials

M&Ms

Paper cups