MONARCHS: METAMORPHOSIS, MIGRATION, MIMICRY AND MORE
MIDDLE SCHOOL

Life Science TEKS

Sixth Grade:	6.12E, 6.12F
Seventh Grade:	7.10A, 7.10B, 7.10C, 7.11A, 7.11B, 7.11C, 7.12A, 7.13A, 7.13B, 7.14A
Eighth Grade:	8.11A, 8.11B, 8.11C

Life Science Vocabulary

abiotic, adult, biotic, carnivore, cell membrane, cell wall, chlorophyll, chloroplasts, chromosomes, chrysalis, community, complete metamorphosis, consumers, cytoplasm, dominant, ecosystem, egg, endoplasmic reticulum, food chain, food web, genotype, Golgi, herbivore, incomplete metamorphosis, inherited traits, insects, larva, learned behaviors, migration, mimicry, mitochondria, molt, natural selection, niche, nucleus, nymph, omnivores, organisms, phenotype, population, producer, pupa, recessive ribosome, vacuole

Pre-Show Activity

Pre-Show Lesson: Butterfly Spots (Inherited Traits)

Materials: 8 brown, red, yellow and orange colored dots (or M&Ms) or for each student, copies of students pages 1-3 for each student

Procedure:

The brown gene (B) is dominant to all other color genes.
The red gene (R) is recessive to brown and co-dominant to yellow.
The yellow gene (Y) is recessive to brown and co-dominant to red.
Co-dominant alleles result in an orange color.

1. Each student should get 8 dots of each color for a total of 32. Each colored dot represents a gene.

2. Use the colored dots to figure out which gene combinations express which butterfly spots and fill in the table in Appendix A-1. (See Answer Key in Appendix A-2.)

Part 2:

The brown spotted butterflies blend in well with their environment and are hidden from predators. The red and orange spotted butterflies blend in well, but also their color is a warning sign for predators who think that they are poisonous. Unfortunately, the yellow spotted butterflies are easily spotted by predators and none of them are going to survive long enough to reproduce.

1. Make a first generation of spotted butterflies. Pull out the genes (colored dots) in pairs without looking at them. This simulates the way male sperm randomly connect with the female egg. Record the twelve pairs in the 1st generation genotype column of the chart in Appendix A-3. Record their corresponding phenotypes in the second column. Also record the total amount of butterflies with each color of spot in the 2nd table.

2. The yellow spotted butterflies do not survive. Remove all genes which represent the yellow spotted butterflies and put them aside.

3. Put all the genes you have left back into the gene pool. Do not include the genes from the yellow spotted butterflies that you set aside. Draw a second generation of butterflies again without looking and record your data in the appropriate columns of the chart below. Set any genes from yellow spotted butterflies aside.

4. Continue this with the third and fourth generation of spotted butterflies. Record your data in the chart.

Post-Show Enrichment Activities

Activity One: Stump Your Neighbor

After the presentation, have students use what they learned to write questions with the answers included. After a sufficient amount of time, play the game "Stump Your Neighbor". The teacher will randomly call on a student and they will ask a question. Each table group will record their answer on a small dry erase board. After 10 seconds, call time, and each group will hold up their white board. The group that asked the question (as long as they got it right) and every other group that got it correct gets a point. Keep track of points to see which group wins!

If you do not have dry erase boards, you can cut white, plastic coated three-ring binders in half and make 2 "dry erase boards" out of one binder.

Activity Two: Peppered Moths

Introduce students to the story of the peppered moths. In the 1950s in Europe, there was a rise in the dark colored peppered moths due to pollution during the Industrial Revolution.

When newly industrialized parts of Britain became polluted in the nineteenth century, smoke blackened the bark of trees and killed lichens growing on them. Pale colored moths which had been well camouflaged before by the lichens and lighter bark, now became very conspicuous. They were no longer camouflaged by the trees and were eaten by birds. Rare dark moths, which had been conspicuous before, were now well camouflaged in the black background. Birds switched from eating mainly dark moths to eating the pale moths. When this happened, the most common moth color changed from pale to dark. Natural selection had caused a change in the British moth population. The moths had evolved.

After learning about the peppered moths, students, in small groups, will create an experiment to test the theory of Natural Selection. For example, students can hide brown objects and yellow objects in an area that is mostly brown or yellow. Other students in their group will act as predators and search for the prey. Students will repeat the test at least 3 times, record their data in a chart, graph it and draw conclusions.

Activity Three: Cells

Compare the cell of a butterfly to the cell of a milkweed plant. Students will make a model of a plant cell (milkweed plant) and an animal cell (butterfly). They can use Petri dishes as the cell membrane. Put out other materials that they can use (different shaped noodles, different colored pipe cleaners, colored construction paper, different colored and shaped buttons, various seeds, etc.) Students will use their science text books as a guide to help them create a model of each cell. They will draw and record their cells with cell parts labeled in their science notebooks.

Students can create a Venn diagram comparing a milk weed plant cell and a butterfly cell.

Students can write an analogy comparing one of the cells to some other system. They should tell which part of the system represents each part of the cell and why. See example in Appendix A-4.

Activity Four: Monarch Migration Game

Assign one student to be each of the following and put a picture around their neck of their assigned role:

Bird - bird picture
Freezing temperatures - snow picture
Captured by a child - child with butterfly net picture
Hit by a car - car picture

The rest of the class will be monarch butterflies. Take the students out to the playground. Tell students that one area is the United States, and another area is Mexico. Define these areas. In between the United States and Mexico set out 6 colorful buckets. In each bucket, you will need to have some colored chips or base 10 block units. The buckets will represent the flowers and the chips or blocks will represent the nectar. You may want to attach a picture of a flower on each bucket.

All monarchs will start in the United States area. Their goal is to migrate to Mexico before it gets too cold. In order to get to Mexico, they will need to eat along the way. They must collect nectar from at least three flowers before they can arrive safely in Mexico and rest on the trees. Along the way, there will be obstacles. They may experience freezing weather which would cause them to die. They may be eaten by a bird, caught by a child or hit by a car. If one of these 4 students wearing these pictures touches them, they will die. If they are touched, they will need to stop where they are and sit down. All students must walk during the simulation!

After students finish a round, discuss what happened. How many monarchs made it? What were the problems? How could we help the monarch population? If students suggest planting more flowers or not capturing them in nets, try these things and compare your results. You can add more buckets to represent more flowers or remove the picture of the child with the net. Have students switch roles and try the game again. Discuss with students how this game is similar and different from the actual migration of the monarchs. (Depending on where a monarch is traveling from, it can take over 2 months to make the journey) What other hazard might the monarchs face on their journey? What are some ways humans have impaired their survival? If the journey is so dangerous, why do they do it? (Scientists believe that the ancestors of monarchs were tropical butterflies that could not survive long periods of very cold weather. When monarchs moved into areas that had cold winters, they never evolved the ability to tolerate these winters, and needed to migrate to warmer locations. Many people think that monarchs evolved in the tropics, and just move north each spring to take advantage of the milkweed we have in the summertime.)

Students can collect population data for each round and graph the results. You may want to say that one monarch represents a group of 1,000.

Appendix

A-1

Student page 1

Name ___________________________________ Date _________________

Data: (Students should have 9 genotypes when finished with the chart.)

List all Possible Gene Combinations- (Genotypes)	Butterfly Spot Color (Phenotype)

Data Analysis:

A. Can two red spotted butterflies mate and have a brown spotted offspring? Explain.

B. Can two orange spotted butterflies mate and have a red offspring? Explain. (Hint: You may need to extend your chart.)

C. Can two brown spotted butterflies mate and have an orange offspring? Explain.

D. According to this data, what is the probability of having an orange spotted butterfly?

E. According to this data, what is the probability of having a brown spotted butterfly?

A-2

Answer Key:

List all Possible Gene Combinations- (Genotypes)	Butterfly Spot Color (Phenotype)
BB	Brown
BY	Brown
BR	Brown
RB	Brown
RY	Orange
RR	Red
YB	Brown
YY	Yellow
YR	Orange

Data Analysis:

A. Can two red spotted butterflies mate and have a brown spotted offspring? Explain.

No, they will only produce red spotted butterflies.

B. Can two orange spotted butterflies mate and have a red offspring? Explain.

Yes because orange spotted butterflies are either RY or YR which means they could produce RR (red) or RY (orange) or YY (yellow)

C. Can two brown spotted butterflies mate and have an orange offspring? Explain.

Yes because one could be BR and one could be BY and if they each give the recessive give- B and Y, it would produce an orange spotted butterfly.

D. According to this data, what is the probability of having an orange spotted butterfly?

2 out of 9

E. According to this data, what is the probability of having a brown spotted butterfly?

5 out of 9

A-3

Student page 2-3

Name ________________________________ Date _________________

	First Generation (Genotype)	First Generation (Phenotype)	Second Generation (Genotype)	Second Generation (Phenotype)	Third Generation (Genotype)	Third Generation (Phenotype)	Fourth Generation (Genotype)	Fourth Generation (Phenotype)
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								

Colors of Spots	Amount in 1st Generation	Amount in 2nd Generation	Amount in 3rd Generation	Amount in 4th Generation	Amount in 5th Generation
Brown					0
Red					
Orange					
Yellow	0	0	0	0	

A. Have all the yellow spotted genes disappeared? Explain.

B. How has the population size changed? How does this compare to what happens in the wild? Explain.

5. Environmental changes are happening. The area where the spotted butterflies live is getting warmer. What used to be a brown, dry area is turning green and colorful. These colors camouflage the red, orange and yellow spotted butterflies, but not the brown spotted butterflies. In generation 5, the yellow spotted butterflies will survive, but all brown spotted butterflies will not survive long enough to reproduce. Complete the last column in the charts for the fifth generation.

A. How is the population size changing?

B. Have any genes disappeared? Explain.

C. How does what happened to the recessive yellow gene compare to what happened to the dominant brown spotted gene?

Conclusions:

A. Explain how this model represents what happens in the real world.

B. Explain the limitations of this model. How does what happens in the real world differ from this model?

B. What if each of you has started with only one brown gene among your spotted butterflies, how would the population have been different?

C. How would the population have changed if the orange spotted butterfly had been best camouflaged, so that a few brown spotted butterflies were eaten each generation?

Modified from The GENETICS Project; University of Washington

A-4

An animal cell is like a school…

Butterfly Cell Part	School Part	How are they Similar
Cell Membrane	Outside wall of school building	The cell membrane holds the cell together, the outside wall of the school hold the school together.
Vacuoles	Cafeteria	The vacuoles hold food in the cell and the cafeteria holds the food in the school.
Etc.		