"To Pick" or "Not To Pick"

Lesson Plan for Grades: 8th grade middle school science or 9th grade biology
Length of Lesson: 75 minutes
With transition times, a possible warm up, and cleaning time, this would extend to 90 minutes (two 45 minutes sessions).

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Subject area/course:

- Biology, specifically natural selection

Materials:

- 1 plate or plastic tray
- 1 cup (or medium amount) of assorted beans and/or macaroni
- 4 plastic cups
- 1 plastic knife
- 1 plastic fork
- 1 plastic spoon
- Stopwatch
- 1 calculator
- 1 worksheet
- 1 pack of markers or colored pencils

TEKS/SEs:

§112.34. Biology

Process

(3) Scientific processes. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:

(A) analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, so as to encourage critical thinking by the student;

(C) draw inferences based on data related to promotional materials for products and services;

Content

(7) Science concepts. The student knows evolutionary theory is a scientific explanation for the unity and diversity of life. The student is expected to:

(C) analyze and evaluate how natural selection produces change in populations, not individuals;

(D) analyze and evaluate how the elements of natural selection, including inherited variation, the potential of a population to produce more offspring than can survive, and a finite supply of environmental resources, result in differential reproductive success;

Lesson objective(s):

- Students will be able to model their data collected through lab in graph form
- Students will be able to define natural selection and its characteristics
- Students will be able to apply the concept of natural selection to curate ideal environments for specific traits

Differentiation strategies to meet diverse learner needs:

- Teacher will give instructions in multiple formats: handouts, larger print on the board, verbally, and through model examples.

- Teacher will allow students autonomy in job assignments while still ensuring all student participation.
- The elaborate section allows students who grasp the concept to move forward and students who are struggling to continue to collaborate with their partners to discuss the idea further.

ENGAGEMENT (10 minutes)

- The teacher will display four pictures of animals in camouflage. Students will be asked to compare the images and discuss the benefits of this specific trait.

EXPLORATION (35 minutes)

- Students will use different utensils to pick up pieces of food to mimic the limitation of different traits in an environment.
- Students will collect and record data and calculate the 'surviving population' based on the 'food collected'.
- Students will graph their findings and present it to the class.

EXPLANATION (10 minutes)

- Teacher will lead the discussion by having students share their answers to the discussion questions. The discussion will end with students formulating their own definitions to natural selection. This will allow students to connect the lab to the content.
    - Discussion Questions
        - *What is happening to each type of organism?*
        - *Which food gathering trait was best adapted to the environment? How can you tell? What happened to this trait over the generations?*
        - Were the data among the group similar? Were the final outcomes similar? Does this make sense? Why or why not?
        - What is natural selection? Did natural selection occur? Explain why you think it did or did not occur.

ELABORATION (20 minutes)

- Students will take what they learned about natural selection traits and do the reverse. While before the variable was the trait and the constant was the environment, students will take their knowledge of the concept and manipulate an environment to create optimal conditions for a trait.
- Student will present their finding to the class.

EVALUATION (throughout entire lesson)

- Teacher will conduct formative assessments during the lesson by walking around and leading discussions with each group.
- Each group will present twice and turn in a packet with their data, calculations, answers to the discussion questions.

SOURCES AND RESOURCES

- Dr. Michael J. Ryan's *Hot Science – Cool Talks #116,* "A Taste for the Beautiful", http://www.esi.utexas.edu/talk/beautiful/

ENGAGEMENT [Teacher][10 min]

Purpose: Students will be introduced to camouflage and will discuss the benefits of this trait to segue into natural selection. Ask thought provoking questions regarding the images to help promote thoughts about environmental adaptations and natural selection.

Would the gray tree frog be able to survive in the same environment as the chameleon or vice versa? Why or why not?

Materials:

- Pictures below
- Warm up handout [below]

Safety Information:
None

Procedure:
Teacher will show the students four pictures [see warm up handout below].

The teacher will ask the students what these four pictures have in common.
The teacher will have students do a think pair share (2-3 minutes to discuss with partner at table) about the purpose of this trait (3-5 minutes to share out with class).

Helps them blend in better
Helps them hide from predators

ENGAGEMENT [Teacher]: Warm up Handout

Display the following pictures on an overheard or projector for the warm up:

Figure 1. Furcifer oustaletic female, https://commons.wikimedia.org/wiki/File:Portrait_Furcifer_oustaleti_female.JPG

Figure 3. Daphnis nerii, https://en.wikipedia.org/wiki/Daphnis_nerii

Figure 2. Great Horned Owl, https://commons.wikimedia.org/wiki/File:Great_Horned_Owl_(Bubo_viginianus)_-_Peloncillo_Mountains_(2212986469).jpg

Figure 4. Gray tree frog, https://commons.wikimedia.org/wiki/File:Gray_Treefrog_Camouflage.jpg

EXPLORATION [Teacher][35 min]

Purpose: Students will explore natural selection by analyzing the effects of a food-gathering trait on the chance of survival through a model using utensils to parallel the limitations.

Materials:
Per group:

- 1 plate or plastic tray
- 1 cup (or medium amount) of assorted beans and/or macaroni
- 4 plastic cups
- 1 plastic knife
- 1 plastic fork
- 1 plastic spoon
- Stopwatch
- 1 calculator
- 1 worksheet
- 1 pack of markers or colored pencils
- Handouts
    - To pick or not to pick
    - Discussion questions

Safety Information:
Be careful with the utensils.

Procedure:
Part 1:
Teacher will segue into natural selection:

> *"Appearance, specifically camouflage, is one trait that improves survival rates. What are other traits that could affect an animal's survival?*
>
> *Size*
>
> *How fast they can run*
>
> *Today we're going to look at how different methods of food collection can affect a population."*

Teacher will assign groups of five.

***Bigger groups can be made with the addition of different utensils or 'limitations' such as chopsticks or using your hand but without your thumb.

Teacher will pass out the lab handout and materials while displaying instructions on the board as they begin to explain the activity.

> *"Today we will be doing a lab where we investigate how different limitations can affect how we gather food.*
>
> *You will be in groups of five and each member will have either a plastic fork, knife, spoon, or no utensil at all.*
>
> *Each group will have a plate of beans/macaroni and will have 30 seconds to collect as many pieces into their cup as possible using their utensil. You can only collect one food unit at a time.*
>
> *After the 30 seconds, you will count how many pieces you have and record the data on your data sheet.*
>
> *You will have 4 rounds, switching the utensils to your right each time. (Everyone should get to use each option.)*
>
> *After each round, follow the worksheet to calculate the surviving individuals."*

Teacher will explain that after they're done collecting their data, they will need to make a graph for each trait on how much food they acquired over time and answer the discussion questions as a group.
Teacher will announce the start of the Lab portion.

Part 2:
After the students are done collecting their data, have returned their materials, and gotten approved that their area is clean, they will receive poster sized sticky notes to create graphs of their data.

Part 3:
Students will hang their posters around the classroom and present their data to the class in the form of a "gallery walk". Giving the students time to walk around and see each groups poster, and answer discussion questions.

EXPLANATION [Teacher][10 min]

Purpose: Students will connect what they learned in the activity to natural selection.

Materials:

Per student:

Handout (filled in Explore Part 3)

Safety Information:

None

Procedure:

Teacher will lead a class discussion where the students share their answers to the discussion questions.

1. *What is happening to each type of organism?*
2. *Which food gathering trait was best adapted to the environment? How can you tell? What happened to this trait over the generations?*
3. Were the data among the group similar? Were the final outcomes similar? Does this make sense? Why or why not?
4. What is natural selection? Did natural selection occur? Explain why you think it did or did not occur.

Teacher will instruct the students to write the definition and guidelines of natural selection in the 'notes' section under the 'Discussion Questions'. Teacher can write on the handout key words from students as they discuss the questions or fill provide them to help the discussion progress, it also helps the students to what the teacher is writing.

Natural Selection simply means nature picks. To be more exact, the environment that a critter lives in determines which trait provides it the best chance of survival. Those with the most advantageous traits will increase in number and the others will decrease in number.

For natural selection to work, the following must occur.

1. *Individuals of a population must have a variety of traits (are you exactly like any other person in this room?)*
2. *The traits must be heritable - they can be passed on to their offspring. Remember genetics!*
3. *Individuals with different traits differ in:*
    a. *Survival ability*
    b. *Mating ability*
    c. *Number of babies produced and their survival*

When this is followed the frequency of the different traits varies between parents and offspring.

ELABORATION [Teacher][20 min]

Purpose: Students will use their knowledge from the exploration activity and discussion to apply their knowledge of natural selection and create an environment ideal to a particular trait.

Materials:
Per group:
Sticky note posters
Markers

Safety Information:

Procedure:
Teacher will prompt the students:

> *"Now that we know what natural selection is and what controls it, let's take it a step further."*
>
> Imagine that you could create an environment where one of the tools would work better than the previously chosen best tool. Describe your environment, explaining why your food gathering trait would be the optimal choice. Draw a line graph to represent what your data would look like.

Teacher will assign each group with a different trait from the ones tested.

Teacher will display the expectations on the board:

- Trait:
- New Environment:
  - Three characteristics of the new environment
- Three reasons on why your trait would be optimal
- Line graph representing possible data that could be collected from new environment
- Evidence for why it could look like what you predicted:
  - Three forms of evidence to support claim

Teacher will give students 10-15 minutes for students to work and will display a timer on the board.

Groups will present their ideas 10 minutes if time permits, if not a gallery walk style like in the explore would also work [5 mins].

Elaboration [Student Handouts]:

"To Pick" or "Not To Pick"

Today we are looking at a food-gathering trait, or how a critter gets its food. Five variants of the trait will be tested: knife, fork, spoon, index and middle finger (I+M), and index finger and thumb (I+T). Follow the instructions to see if natural selection takes place.

Procedure:

1. Decide the 'traits' for each group member. The five traits are the knife, fork, spoon, index and middle finger (I+M), and index finger and thumb (I+T).
2. Empty the cup of food units on the table or tray and spread them out carefully covering most of the available space.
3. At the signal, begin collecting food units for 30 seconds. Use only one hand. Collect one food unit at a time and place it in your collecting cup. Collect as many food units as you can in 30 seconds.
4. Count the food units that you collected and record the data in the appropriate box labeled "Food Units Acquired." Return the collected food units to the table or tray.
5. Pass your trait to the right.
6. Each pass is a new generation. The first collection of "Food Units" is for Generation 0, the collection from the first pass is Generation 1.
7. Repeat steps 2-5 until every member has had a turn with each 'trait' and/or until you complete 5 rounds.

Calculations

1. In the table labeled "Food Units Acquired," record the number of food units acquired in the appropriate box for each trait.
2. Add all the food units together (in the same generation) and record in the "total" box.
3. Multiply the number of individuals by the number of food units acquired for each trait. This gives you the number of offspring produced; record the number in the "Offspring" data table.

$$\#\ of\ individuals\ \times\ food\ units = \#\ \text{of offspring produced}$$

4. Add all the offspring in the row together and record in the "total" box.
   Calculate the number of surviving offspring by using the formula below. This gives you the number of surviving individuals for the next generation. Enter the data in the "Surviving individuals" table

$$\frac{\text{Number of offspring (per trait)} \times 100}{\text{total offspring}} = \text{Surviving individuals}$$

5. Repeat for each round.
6. It is ok to get decimals for Data Table 3. In the case that decimals happen round to the nearest tenths place.

EXAMPLE:

Food Units Acquired

Data Table 1

Generation	Knife	Fork	Spoon	Hand (I+M)	Hand (I+T)	Total
0	**8**	**11**	**15**	**17**	**25**	**76**

Offspring

Data Table 2

Generation	Knife	Fork	Spoon	Hand (I+M)	Hand (I+T)	Total
0	**160**	**220**	**300**	**340**	**500**	**1520**

Knife: 20 x 8 = 160	Fork: 20 x 11 = 220	Spoon: 20 x 15 = 300	Hand (I+M): 20 x 17 = 340	Hand (I+T): 20 x 25 = 500

Surviving Individuals in the Population

Data Table 3

Generation	Knife	Fork	Spoon	Hand (I+M)	Hand (I+T)	Total
0	**20**	**20**	**20**	**20**	**20**	**100**
1	**10.5**	**14.5**	**19.7**	**22.4**	**32.9**	**100**

Knife: (160/1520) * 100 = 10.5	Fork: (220/1520) * 100 = 14.5	Spoon: (300/1520) * 100 =19.7	Hand (I+M): (340/1520) * 100 = 22.4	Hand (I+T): (500/1520) * 100= 32.9

Graphing:

Before you start graphing come up with a KEY for your graph, it must include the following:

- ☐ Names of traits
- ☐ A color for each different trait
- ☐ Labels for the trait and corresponding color

Example:

= Knife

= Spoon

FOOD UNITS ACQUIRED

In the table labeled "Food Units Acquired", record number of food units acquired in the appropriate box for each trait. Add all the food units together – in the same generation – and record in the "total" box.

Data Table 1

Generation	Knife	Fork	Spoon	Hand (I+M)	Hand (I+T)	Total
0						
1						
2						
3						
4						

After you collect the data, make a graph of Food Units Acquired table on the provided sticky note poster.

Offspring

Multiply the number of individuals (Data Table 3) by the number of food units acquired (Data Table 1). This gives you the number of offspring produced (data table 2) **(data table 3 x data table 1 = data table 2).** Add all the offspring in the row together and record in the "total" box.

Note: ***For Generation 0, the number of individuals for each trait is 20 (and already provided to you).*** *For Generation 0, it assumes that each trait is equally distributed in the population. You will need to calculate the number of individuals for Generations 1 – 4.*

Data Table 2

Generation	Knife	Fork	Spoon	Hand (I+M)	Hand (I+T)	Total
0						
1						
2						
3						
4						

Surviving Individuals in the Population

After Generation 0: Calculate the number of surviving offspring by using the following formula:

$$\frac{\text{Number of offspring (per trait)}}{\text{total offspring}} \times 100 = \text{Surviving individuals}$$

Data Table 3

Generation	Knife	Fork	Spoon	Hand (I+M)	Hand (I+T)	Total
0	20	20	20	20	20	100
1						
2						
3						
4						
5						

Need to Plan your graph(s)? Do it here!

Discussion Questions

Using your data tables and your group partners, answer the following questions in complete sentences.

In your own words, describe your graph. What is happening to each type of organism?

_____

_____

_____

Which food gathering trait was best adapted to this environment? How can you tell? What happened to this trait over the generations?

_____

_____

_____

Would you expect your data tables to be just like the data tables of other groups? Why or Why not? Would you expect the final outcomes to be similar? Why or why not?

_____

_____

_____

What is natural selection? Did natural selection occur? Explain why you think it did or did not occur.

_____

_____

_____

Notes:

RUBRIC FOR ASSEMENTS [Teacher Handout]

Packet: Completion grade because the graph and questions are both discussed in class

Explore & Elaborate Poster

1	2	3	4
If only one student talks during the presentation. If poster does not include any of the components under 4. If students cannot explain their data appropriately.	If half the group talks during the presentation. If poster has some components (2-3). If students can begin to explain the general trends of the data but with no context.	If most of the group talks during the presentation. If poster includes most of the components (4-5). If students can explain findings only in terms of the activity: explains the trendlines in terms of the beans/macaroni.	If all students talk during the presentation. If poster includes all the components: • Graph with 4 different lines • Labeled axes • Appropriate scale • 4 lines of best fit • Legend with colors • Brief summary explaining the trends of each data set If students tie in findings to content: explain the trendlines in terms of survival rates and trait benefits.