

Title: “Bird Beak Adaptations”

Author: Miguel Morales

Lake Worth Community Middle School

miguel.morales@palmbeachschools.org

Abstract:

Students will be taught basic information on evolution and adaptations prior to the beginning of this lesson. The students will navigate through different stations experiencing simulations of adaptations, manipulations of 3D examples, and making connections to the standards to formulate hypotheses about certain adaptations and how they manifest in the morphology.

Subject, Grade, Level:

Middle School Science, 7th grade (can be adapted to 6th or 8th as well), on-level (can be adapted for higher levels as well).

Learning Objectives:

By the end of the lesson students will be able to:

1. Describe the impact of genetic variation and environmental change on the survival of a species and the role of adaptations in a species’ survival
2. Recognize natural selection as a primary mechanism leading to change over time in organisms
3. Describe how natural selection accounts for the appearance or disappearance of traits over time
4. Explain how a species’ inability to adapt may contribute to the extinction of that species

Science Standards:

NGSS:

- **MS-LS4-4.** Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals’ probability of surviving and reproducing in a specific environment.
 - **Connections to Nature of Science :**Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-LS4-1)
- **MS-LS4-6.** Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.

NGSSS (Florida Science Standards) (6th and 7th Grade standards)

- **SC.6.L.15.1** Analyze and describe how and why organisms are classified according to shared characteristics with emphasis on the Linnaean system combined with the

concept of Domains

- **SC.6.N.2.3** Recognize that scientists who make contributions to scientific knowledge come from all kinds of backgrounds and possess varied talents, interests, and goals (not assessed on the Statewide Science Assessment).
- **SC.7.L.15.2** Explore the scientific theory of evolution by recognizing and explaining ways in which genetic variation and environmental factors contribute to evolution by natural selection and diversity of organisms.
- **SC.7.L.15.3** Explore the scientific theory of evolution by relating how the inability of a species to adapt within a changing environment may contribute to the extinction of that species.

Timeframe: 2 - 3 class periods (one or two block periods)

Prep time: 15 minutes

- Set up materials/stations
- Check computers/ make copies of the lab sheet.
- Set up SMART board to meshlab (or similar program) with 3D CT scans

Pre-Lab Lecture: 20 - 25 minutes

- Go over evolution standards on PPT with videos and visuals (oVert images)
- Take notes (guided notes - depending on level/ proficiency in note-taking)
- Discussion/ Answer any questions
- Wrap up with exit quiz on lecture

Lab/ Activity: 20-30 minutes

- 4 Stations (5-8 minutes at each station)

Lesson Closure: 20 - 30 minutes

- Answer questions for each station with group
- Class discussion/ guided review

Materials:

- Seeds (sunflower works well or any other seed as long as they are the same type)
- Beak analogies: tweezers, pliers (parrot nose/slip joint/tongue and groove joint style), straw, spoon beak (two spoons rubber banded together like chopsticks), flat beak (two pieces of cardboard taped at one end)
- Medium sized box full of confetti with seeds inside
- Set of garden gloves (however many students per group or have them take turns)
- SMART board (a computer connected screen should work also)
- Morphosource CT scans (TBD) (Kiwi, chicken, parrot)
- 3D printed models of the morphosource CT scans
- Student computers/ worksheets/ lab sheets
- Notes

Procedure and general instructions (for instructor):

Part 1: Introduction: Goals, standards, and vocabulary for the lesson

- Students will get chromebooks (or Cornell notes sheet/guided notes) and discuss the warm up question with desk partner: “Come up with an example of an organism’s adaptation, how does that adaptation help that organism survive?”
- PPT presentation/ videos and notes (PPT can be self-made or found online on animal adaptations and evolution)
- Wrap up with discussion

Part 2: Station Activities: 4 Station Rotation

- Students will come into class and retrieve their chromebooks.
 - Review contents from previous class
 - Have students open google classes to access the lab assignments.
 - Students will begin at one of the 4 stations staying in their table groups
1. Station 1: Can You “Peck” It Up?: Students will use the lab sheet to follow the instructions.
 - On a lab table the seeds will be laid out randomly.
 - Students will choose one of the “beaks” to use for the experiment
 - One student will set the timer and the group will begin to pick up as many seeds only using their “bird beaks”
 - Once the timer goes off the students will count the seeds and input them into their data table
 - Depending on time constraints more than one trial may be done
 - Once the data has been recorded the students may answer the questions for that section until the next station rotation.
 2. Station 2: Can You “Dig” It? Students will use the lab sheet to follow the instructions.
 - On a lab table, a box filled with confetti (strips of paper or other soft material) will have seeds randomly laid within the confetti. The top of the box will be covered so the students have to use only their hands.
 - Students will put on garden gloves for the first part.
 - Using only their index and thumb they will forage through the box to find as many seeds as possible in the time allotted.
 - The student will input the data onto the data table.
 - The students will remove their gloves and redo the activity with their bare hands; again only using index and thumb.
 - The student will input the data onto the data table.
 - Each group member will go for 30 seconds with gloves and 30 seconds without.

3. Station 3: SMART Board CT Scan Analysis: Students will use the lab sheet to follow the instructions.
 - The Smart Board will have meshlab (or similar software) running with three examples of CT Scan skulls of birds with different shaped beaks.
 - Students will manipulate the virtual skulls paying close attention to the beak.
 - Students will measure the different parts of the skull and input the data on their lab sheets
4. Station 4: 3D print Analysis: Students will use the lab sheet to follow the instructions.
 - This station will have the 3D printed models laid out for students to manipulate.
 - Students will take qualitative notes on the 3D models. Texture, whether it's sturdy or flimsy, etc.
 - Students will also measure the 3D printed models to compare the method to the virtual model. Those data will also be input into a Data Table.

Part 3: Data Analysis and Conclusions:

- After all stations are completed the students will compare and discuss the data from each station (3-5 minutes)
- Once all groups have analyzed their data the class will discuss the data as a whole. (guiding questions: Did all groups get similar results? What factors affected your ability to perform the task at the bird beak stations? What type of differences were there between the virtual model and 3D model? Which one was better for you?)
- Students will then be guided to put all their results together as a class. The resulting spreadsheet will be shared with the students.
- Students will be guided as to how to turn their data into a graph to visualize the data better.
- After the discussion and data analysis Students will finish answering the conclusion questions.
- At this time the teacher will circulate the room and answer any individual questions or help with any aspect of the lesson.
- Once the students finish the questions they will submit it through google classes.

Procedures and general instructions (for students):

Station 1 Background and Procedure:

Pretend you are a bird on Lab Station Island, your job as a living thing is to make sure you survive for long enough to breed. That means you need to eat! The better you are at it the greater your chances of survival. Follow the steps to play the game:

1. Choose a beak (Only one beak per person)
2. Group member #1 will set the 1-minute timer
3. When the time starts pick up as many seeds as you can. (You may only use your beak - no hands!)
4. When the time is done count your seeds and put them into your data table.
5. Deposit the seeds back on Lab Station Island (lab table)
6. Repeat steps 1-4 to perform multiple trials.

Station 2 Background and Procedure:

Pretend you are a bird on Box Island. Box Island differs from Lab Station Island in that the majority of the food is underground. There are only two types of birds on this island Glove birds and Finger birds. You will be playing the part of both of these birds. Your beak will be your fingers (thumb and index finger only). Follow the steps to play the game:

1. Only one group member will forage for food at a time. (Go in birthday order)
2. A group member who is not foraging will take the time: 30 seconds each round.
3. The first round will be with gloves on. You must dig through the box carefully so as not to alert any predators. Each seed that you find you will put aside to count at the end.
4. When the time is done record your data and return the seeds.
5. You will repeat step 3 and 4 but without gloves this time.

Station 3 Background and Procedures

You are a scientist interacting with cutting edge CT scanned data in order to take measurements.

1. The SMART Board will have the CT scanned images pulled up on meshlab on the screen already. (If not raise your hand)
2. Select the measurement tool from the menu.
3. Make the measurements with your group and input them onto the data table
4. Measurements:
5. Beak: from tip to skull
6. Skull length: from where the skull and beak meet to back of skull
7. Skull height: from bottom of skull to top of skull

Station 4 Background and Procedures:

You are a scientist interacting with cutting edge 3D models of different bird skulls.

1. Investigate the different skulls

2. Make some qualitative observations on your lab sheet.
3. Make the measurements with your group using the strips of measuring tape and input them onto the data table
4. Measurements:
 - a. Beak: from tip to skull
 - b. Skull length: from where the skull and beak meet to back of skull
 - c. Skull height: from bottom of skull to top of skull

Students Materials: See Lesson activity File below: "What's in a Beak?"

Station 1: Can you “peck” it up?

Follow the instructions on the lab table to complete this page.

Trial 1

Beak	Seeds collected
Tweezers	
Pliers	
Straw	
Spoon beak	
Flat beak	

Trial 2

Beak	Seeds collected
Tweezers	
Pliers	
Straw	
Spoon beak	
Flat beak	

Trial 3

Beak	Seeds collected
Tweezers	
Pliers	
Straw	
Spoon beak	
Flat beak	

Station 2: Can you “dig” it?

Follow the instructions on the lab table to complete this page.

	Gloves	No Gloves
Seeds collected: Group Member 1		
Seeds collected: Group Member 2		
Seeds collected: Group Member 3		
Seeds collected: Group Member 4		

Station 3: SMART Board CT Scan Analysis

Follow the instructions on the SMART Board to complete this page.

Specimen	Beak Length (mm)	Skull Length (mm)	Skull height (mm)
1 (Kiwi)			
2 (Chicken)			
3 (Parrot)			

Station 4: 3D Print Analysis

Follow the instructions on the SMART Board to complete this page.

Specimen	Beak Length (mm)	Skull Length (mm)	Skull height (mm)
1 (Kiwi)			
2 (Chicken)			
3 (Parrot)			

Qualitative Observations (Sturdiness, texture, how it feels, color, etc.):

Station 1 Questions

1. Which beak type was able to pick up the most seeds?
2. How does this activity connect to evolution and adaptation?
3. What might happen if the seeds were different? Would your beak still work the same?
4. What type of seed do you think would be best for the type of beak you had? Why?

Station 2 Questions

1. How was this different from the Lab Station Island?
2. Why was it easier to pick up the seeds without the gloves on?
3. What adaptations might be helpful if you were a bird who had to find food underground?

Station 3 Questions

1. What are some observations you made on the virtual 3D model?
2. Compare the measurements of the three different skulls. What might be affected by the different skull measurements? How does a longer or shorter beak help? Skull measurements?

Station 4 Questions

1. Compare the experience with interacting with the physical and virtual models.
2. Which did you like better? Why?