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Parrots, Penguins, and Parts

Homologous Structures

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Published by *K20 Center*

Grade Level	6th – 8th Grade	**Time Frame**	3-4 class period(s)
Subject	Science	**Duration**	180 minutes

Essential Question

How do scientists determine relationships between today's organisms and their ancestors using their physical appearance and characteristics?

Summary

In this lesson, students will learn to compare anatomical similarities and differences between organisms and explain the relationship between organisms based on homologous structures. They begin by reading a recent research article on either parrots or penguins. Then, students learn about the ancient roots of modern-day birds by playing a game about evolutionary traits, created by The Cornell Lab. The class explores homologous structures as a source of evidence for evolution; then, in groups, students examine the bone structures of several mammals and develop a claim, reasoning, and evidence about evolutionary relationships.

Snapshot

Engage

Students use the How I Know It strategy to evaluate what they know about parrots or penguins. Then, they read articles containing recent research on parrots or penguins.

Explore

Students watch or play the science game "Flap to the Future," drawing on what they see to create a Cognitive Comic depicting an organism's evolutionary change.

Explain

Students view a diagram and discuss their observations on similar mammalian bone structures, then watch a clip to develop an understanding of homologous structures.

Extend

Students view x-rays of animal hands and match them to various animals. Then, students develop a Claim, Evidence, Reasoning (CER) statement about the relationship between those animals based on their bone structures.

Evaluate

Students share what they used to think about homologous structures versus what they now know, post-lesson.

Standards

Next Generation Science Standards (Grades 6, 7, 8)

MS-LS4-2: Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.

Oklahoma Academic Standards (8th Grade)

8.LS3.1.4: Though rare, mutations may result in changes to the structure and function of proteins.

Attachments

- CER—Parrots, Penguins, and Parts - Spanish.docx
- CER—Parrots, Penguins, and Parts - Spanish.pdf
- CER—Parrots, Penguins, and Parts.docx
- CER—Parrots, Penguins, and Parts.pdf
- Cognitive Comics—Parrots, Penguins, and Parts - Spanish.docx
- Cognitive Comics—Parrots, Penguins, and Parts - Spanish.pdf
- Cognitive Comics—Parrots, Penguins, and Parts.docx
- Cognitive Comics—Parrots, Penguins, and Parts.pdf
- Hand It to the Animals—Parrots, Penguins, and Parts - Spanish.docx
- Hand It to the Animals—Parrots, Penguins, and Parts - Spanish.pdf
- Hand It to the Animals—Parrots, Penguins, and Parts.docx
- Hand It to the Animals—Parrots, Penguins, and Parts.pdf
- How I Know It—Parrots, Penguins, and Parts - Spanish.docx
- How I Know It—Parrots, Penguins, and Parts - Spanish.pdf
- How I Know It—Parrots, Penguins, and Parts.docx
- How I Know It—Parrots, Penguins, and Parts.pdf
- I Used to Think... But Now I Know—Parrots, Penguins, and Parts - Spanish.docx
- I Used to Think... But Now I Know—Parrots, Penguins, and Parts - Spanish.pdf
- I Used to Think... But Now I Know—Parrots, Penguins, and Parts.docx
- I Used to Think... But Now I Know—Parrots, Penguins, and Parts.pdf
- Lesson Slides—Parrots, Penguins, and Parts.pptx

Materials

- CER handout (attached; one per group of 3 students)
- Cognitive Comics handout (attached; one per student)
- Hand It to the Animals handout (attached; one per student)
- Hand It to the Animals digital handout (linked)
- How I Know It handout (attached; one per student)
- I Used to Think... But Now I Know handout (attached; one per student)
- Lesson Slides (attached)
- Markers (at least one per student)
- "Flap to the Future" online game (linked below; optional)
- Internet-enabled devices for students (Chromebooks, etc.) (optional)

Engage

Begin on **slide 4** of the attached Lesson Slides. Hand each student a copy of the attached **I Used to Think... But Now I Know** handout. Invite students to follow the I Used to Think... But Now I Know strategy to answer the Essential Question on the slide: "*How do scientists determine relationships between today's organisms and their ancestors using their physical appearance and characteristics?*" Ask students to write down their answers to this question in the "I Used to Think..." column of the handout. Then, ask students to put this aside for now; they will continue using it later in the lesson.

Go to **slide 5**. Hand each student a copy of the attached **How I Know It** handout. Tell students they have a choice to complete the handout for either penguins or parrots. Invite students to follow the How I Know It strategy as follows: in the inside of the circle, ask them to write down everything they already know about the animal. On the outside of the circle, ask them to write down how they came to know each piece of information they've written down. They will draw a line between what they know (inside) and how they know it (outside).

Teacher's Note: Articles

The following activity invites students to read a research article on the animal they wrote about in the How I Know It activity. If your students do not have access to devices with Internet connectivity, you will need to print copies of the articles prior to this activity. If your students do have access to devices with Internet connectivity, you can share the links to the articles with students. If students completed the How I Know It about parrots, they should read the article "Scientists Discover prehistoric Giant 'Squawkzilla' Parrot, As Big As Small Child"; if they completed the How I Know It about penguins, they should read the article "A Human-Sized Penguin Once Waddled through New Zealand".

Go to **slide 6**. After students have completed the How I Know It handouts, have them group up with two other students who selected the same animal they did. Print and hand out one copy of the article per student or instruct each student to access the research article online. Ask each group to read the research articles using the Jigsaw reading strategy. This involves each student reading a portion of the article, and when the whole group is finished reading their section, they should share with the group the content of their part of the reading. Tell the students they may want to take a few notes on their section before sharing. They can add anything they learn to their How I Know It handouts, but should do so in a different color was used previously.

Teacher's Note: Recommended Reading Sections

The recommended sections for dividing readings up among students are, for the "Parrot" reading: 1) first 5 paragraphs; 2) paragraphs 6–10; and 3) paragraphs 11–15. For the "Penguin" reading, the recommended sections are: 1) first 3 paragraphs; 2) paragraphs 4–6; and 3) paragraphs 7–9. These recommendations also appear on slide 6.

Explore

After having students read the article about their chosen bird, invite them to learn more by watching gameplay videos of Flap to the Future, a browser-based web game created by The Cornell Lab. To begin this activity, hand out a copy of the attached **Cognitive Comics** handout to each student. Move to **slide 7**. Ask students to follow along with the videos in the lesson slides as they work on their handouts, completing the handouts via the Cognitive Comics strategy. Ask students to use this strategy to show how the organisms they play change throughout the game. Beginning with level 1, students should watch the level 1 gameplay video on the slide, drawing the organism they see and making notes in the appropriate panel. Then, move to **slide 8** and repeat with the level 2 gameplay video. Repeat again with **slide 9** and the level 3 gameplay video, and again with **slide 10** and the level 4 gameplay video.

Optional: Playing *Flap To The Future*

If your classroom has sufficient time and resources available, consider having students play Flap to the Future instead of watching gameplay. This game can be played in an Internet-connected browser window and guides students through four different levels that show four organisms at different stages in the same evolutionary cycle—from dinosaur to bird. To allow your students to play, you can share the above link to the game and have them access it on their Internet-enabled devices. Then, hand out the attached Cognitive Comics handout and have students complete it while playing. Allow 20-30 minutes for students to complete all four levels.

When students are finished drawing, move to **slide 11** and pose the guiding questions on the slide (also listed below) to students using the Think-Pair-Share strategy. Have students consider the first two questions on their own, then discuss their answers with an Elbow Partner.

1. Were there any differences between the organisms? What were they?
2. Were there any similarities between the organisms? What were they?
3. What did the game say about the relationship between the organisms?

Solicit a few answers from volunteer pairs in a brief class discussion.

Sample Student Response

Students should arrive at the conclusion that modern-day birds have adapted over time and share characteristics of dinosaurs.

Explain

Move to **slide 12**. Use the Picture Deconstruction strategy to discuss with students the picture on this slide (there is no need to divide this picture into quadrants as the strategy suggests, however). Be sure to **not** define or mention homologous structures or homology and **do not** describe the picture. Instead, ask students to describe what they see without interpreting it. After students have had time to describe what they see, ask them to interpret the image by posing the question, "What do you think this represents?"

Move to **slide 13**. Show students this Bozeman Science video clip (also linked on slide 13) about homologous structures. The video should automatically start at the appropriate point (1:35); be sure to pause at 2:08.

Embedded video
https://youtube.com/watch?v=Q9Aa_VsHK3I

Ask students to identify evidence in the picture on slide 13 that suggests that these organisms are related. Solicit a few answers from the class.

Extend

Move to **slide 14**. Show students this slide to illustrate that some animals share similar body structures. Images of a human nose, a pig's snout, and an elephant's trunk are all "noses." Point out that they have different functions and appearances, but they all have similar structures and locations. Tell students that these are called homologous structures.

Move to **slide 15**. Invite students to look at x-rays of 10 different zoo animals with the **Hand It to the Animals** handout.

Teacher's Note: Hand It To The Animals Activity

To view the x-ray images, students will need online access to the Hand It to the Animals handout. Consider making both printed copies and digital copies of this document available. Students can generate their own copy of the document by clicking this link (also shown on slide 15) and can view the x-rays on this version. The attached version of the same document can be printed and used to take notes.

Invite students to note on their printed handouts, describing for each linked x-ray what they see, stating the function of the limb, and guessing which animal it is from the list of possible answers provided on the handout.

Teacher Note's: Hints

To scaffold instruction, you might choose to pose the following hints to students during the activity: 1) X-ray size isn't necessarily related to the animal's size; 2) A heavier animal means thicker bones, as bones support weight; 3) Macaques and humans are primates—however, macaque hands have more padding, since they move by swinging on branches; 4) Bird bones don't show up well in x-rays, because they are very thin; 5) Panda x-rays look like they have five fingers plus a thumb—the false thumb is a wrist bone extension used to strip leaves from bamboo; 6) Sun bears are small in size, and the x-ray shows a deformed front paw.

Student Answer Key

1. Macaque monkey; 2. Hyena; 3. Baboon; 4. Human; 5. Sea lion; 6. Sun bear; 7. Owl; 8. Zebra; 9. Panda; 10. Lion

Move to **slide 16**. Place students into groups of three or fewer. Give each group a copy of the attached **CER Handout**. Invite each group to complete the handout with the Claim. Evidence, Reasoning (CER) strategy using the following prompt: "What is the relationship between the animals? Base your claim on what you see in the x-rays." Allow students time to answer this prompt with their groups. Then, ask for volunteers to share their CER with the class for discussion.

Evaluate

Move to **slide 17**. Have students get out the I Used to Think... But Now I Know handouts they started at the beginning of the lesson. Invite students to utilize the I Used to Think... But Now I Know strategy again, comparing their thoughts before and after the lesson about the similarities, differences, and relationships between organisms. They should add new notes to the "But Now I Know" column now that they've completed the lesson. Students can refer to their How I Know It handout from the beginning of the lesson if they need help getting started.

Additional Opportunities

The Museum of Osteology in Oklahoma City, OK, and Sia: The Comanche Nation Ethno-Ornithological Initiative in Cyril, OK, are additional resources in the state of Oklahoma that you can consider exploring with your students.

Resources

- Bozeman Science. (2013, Jul. 10). LS4A - Evidence of common ancestry and diversity [Video]. YouTube. Https://youtu.be/Q9Aa_VsHK3I?t=95
- K20 Center. (n.d.). Claim, Evidence, Reasoning (CER). Strategies. https://learn.k20center.ou.edu/strategy/d9908066f654727934df7bf4f506fc09
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