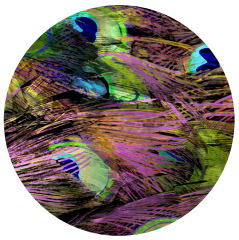

Ch-Ch-Ch-Ch-Changes

The Foundations of Evolution

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Grade Level	9th – 10th Grade	**Time Frame**	212 minutes
Subject	Science	**Duration**	4-5 periods
Course	Biology		

Essential Question

How does environmental change impact evolutionary shift(s) in an organism's genetic makeup?

Summary

In this lesson, students will examine the facts associated with evolution, make inferences about an organism based on fossilized remains, explore how evolution is influenced by the environment, and construct a timeline of an organism's evolution as a result of environmental factors or human impact over time. This lesson offers multimodality, which means it offers face-to-face, online, and hybrid versions. The attachments also include a downloadable Common Cartridge file, which can be imported into a learning management system (LMS) such as Canvas or eKadence. The cartridge also includes interactive student activities and teacher's notes.

Snapshot

Engage

Students watch a video and respond to guiding questions about how mutations of an organism lead to evolution.

Explore

Students make inferences about an organism's lifestyle based on its fossil remains and discuss their inferences with their peers.

Explain

Students analyze how evolutionary selection occurs.

Extend

Students construct an evolutionary timeline and examine environmental factors that cause evolutionary shifts.

Evaluate

Students reflect on previous knowledge and misconceptions about evolution and compare them to what they learned in the lesson.

Standards

ACT College and Career Readiness Standards - Science (6-12)

EMI301: Identify implications in a model
EMI401: Determine which simple hypothesis, prediction, or conclusion is, or is not, consistent with a data presentation, model, or piece of information in text
EMI601: Determine which complex hypothesis, prediction, or conclusion is, or is not, consistent with a data presentation, model, or piece of information in text

Oklahoma Academic Standards (Biology)

B.LS4.5 : Evaluate the evidence supporting claims that changes in environmental conditions may result in (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.
B.LS4.5.1: Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species.
B.LS4.5.2: Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species' adaptation over time is lost.

Attachments

- Addie's Story S-I-T Activity—Ch-Ch-Ch-Ch-Changes - Spanish.docx
- Addie's Story S-I-T Activity—Ch-Ch-Ch-Ch-Changes - Spanish.pdf
- Addie's Story S-I-T Activity—Ch-Ch-Ch-Ch-Changes.docx
- Addie's Story S-I-T Activity—Ch-Ch-Ch-Ch-Changes.pdf
- Addie's Story Video Questions (Answer Key)—Ch-Ch-Ch-Ch-Changes.docx
- Addie's Story Video Questions (Answer Key)—Ch-Ch-Ch-Ch-Changes.pdf
- Addie's Story Video Questions—Ch-Ch-Ch-Ch-Changes - Spanish.docx
- Addie's Story Video Questions—Ch-Ch-Ch-Ch-Changes - Spanish.pdf
- Addie's Story Video Questions—Ch-Ch-Ch-Ch-Changes.docx
- Addie's Story Video Questions—Ch-Ch-Ch-Ch-Changes.pdf
- Common Cartridge—Ch-Ch-Ch-Changes.zip
- Extend Rubric—Ch-Ch-Ch-Ch-Changes - Spanish.docx
- Extend Rubric—Ch-Ch-Ch-Ch-Changes - Spanish.pdf
- Extend Rubric—Ch-Ch-Ch-Ch-Changes.docx
- Extend Rubric—Ch-Ch-Ch-Ch-Changes.pdf
- Lesson Slides—Ch-Ch-Ch-Ch-Changes.pptx

Materials

- Lesson Slides (attached)
- Addie's Story Video Questions handout (attached; one per student)
- Addie's Story Video Questions Answer Key document (attached; for teacher use)
- Addie's Story S-I-T Activity handout (attached; one per student)
- Extend Rubric (attached; one per student)
- Sticky notes (one per student)

Preparation

Preparation instructions are outlined below for the face-to-face, online, and hybrid versions for this lesson.

Face-to-Face Lesson

Prior to the Explain phase of the lesson, create a Word Cloud on Mentimeter. Copy the invite code and QR code for the Word Cloud and insert the codes into the highlighted sections on **slide 13** of the **Lesson Slides**.

Online Lesson

Prepare your LMS for the lesson using the attached **Common Cartridge**.

Prior to the Explain phase of the lesson, create an EdPuzzle and embed the *Evolution 101* video. Include any additional questions throughout the video that you want students to answer. Assign the EdPuzzle to students and ensure that they are accessing the student version, not the editable version with questions.

Additionally, create a Word Cloud on Mentimeter and share the invite code in your classroom's LMS.

Prior to the Evaluate phase of the lesson, create a discussion board in Padlet and share the link and QR code with students.

Hybrid Lesson

Prior to the Explain phase of the lesson, create a Word Cloud on Mentimeter. Copy the invite code and QR code for the Word Cloud and insert the codes into the highlighted sections on **slide 13** of the **Lesson Slides**.

Prior to the Evaluate phase of the lesson, create a discussion board in Padlet and share the link and QR code with students.

75 minutes

Engage

Use the attached **Lesson Slides** to guide the lesson. Begin by displaying **slides 3–4** to read aloud the essential question and lesson objectives.

Go to **slide 5** and share the guidelines for the game *Telephone* with students.

Pull the first student aside, preferably in a space like the hallway where your conversation can be had at a normal level without being overheard. Tell the student the phrase, “The dodo bird was a flightless bird that laid one egg until humans arrived.” Have the student return to their spot in the classroom.

Once you and the student return to the classroom, have the first student whisper the same phrase to the student next to them. Remind them that they may only say the phrase once.

Have that student pass the same message on to the next student in line. Have them continue this process until the message reaches the last student in the chain.

Teacher's Note: Playing Telephone

As students whisper the message throughout the telephone chain, walk around and interrupt students as they try to pass the message. Intentionally target those who are trying to pass the message with questions like, "Hey Kim, what did you do this weekend?" or "John, how did the football game go this past Friday?"

Some students may catch on that you are trying to interrupt the message intentionally. Brush off their concerns and encourage each person to keep passing the message until every person receives the whispered phrase.

Have the last student announce the phrase they heard to the whole class.

Share with students what the original phrase was. Invite students to discuss how the phrase they heard differed from original. Encourage them to consider how this change was a result of the phrase being passed between students. Ask the following questions to the group:

- What does each person in the chain represent?
- What does the phrase represent?
- What does the teacher represent?
- What happened to the phrase by the time it reached the last person in the circle?
- What would be the term for that change?
- What do you think caused that change?

Sample Student Responses

Ideally, students should offer the following responses to the questions above:

- What does each person in the chain represent? *An organism*
- What does the phrase represent? *DNA*
- What does the teacher represent? *The environment*
- What happened to the phrase by the time it reached the last person in the circle? *It changed*
- What would be the term for that change? *A mutation*
- What do you think caused that change? *The environment*

Share with students that the dodo bird was a real bird that existed on Mauritius Island. The extinction of the dodo bird illustrates an evolutionary process. Share with students that the dodo bird became extinct for two reasons: (1) it was overhunted by humans, which resulted in a dramatic change in their environment, and (2) their reproduction process was very slow. Dodos were only able to produce one offspring, or one egg, at a time, which limited the number of birds on the island at any one time. They rapidly became extinct when Portuguese sailors hunted them for food and destroyed their habitats.

Optional Article Discussion

After the discussion, consider sharing the true origin of the fossil of the extinct dodo bird, *Raphus cucullatus,* using the Audubon Society's article, "Why the Dodo Deserves a New Reputation."

Introduce the concept that a shift in an organism's DNA and overall features is often a change that is enforced by their environment. This process is called *evolution*. The extinction of the dodo bird is an example of how the environment can significantly affect an organism or an entire species.

Address general misconceptions of the word *evolution*. This term is often misunderstood, and this lesson does not discuss the word's use in the context of how life begins. This lesson instead focuses on evolution in the context of change over time. Throughout this lesson, students will learn that evolution is a very slow process, and the evidence that scientists have studied for many decades confirms that, while change in living species is slow, it is occurring and can be traced.

Pass out one copy of the attached **Addie's Story Video Questions** handout to each student. Go to **slide 6** and introduce the PBS video, *Hunting the Nightmare Bacteria*. Then, begin the video and have students answer the questions on the handout as they follow along.

Teacher's Note: Stories in *Hunting the Nightmare Bacteria*

The video, *Hunting the Nightmare Bacteria,* is 54:46 minutes long. It is comprised of three separate stories. The narrator of the video explains the importance of these three events as follows:

"This is the story of three seemingly disconnected events beginning at the same time. What they each have in common is a type of infection that is becoming impossible to treat, a type of infection that has triggered deadly outbreaks even at one of our most prestigious hospitals. It is a crisis that is spreading alarmingly fast, threatening everyone, even the healthy." (Young, 2017, 1:57)

Consider watching only the first half of the video on the first day. Stop the video at the midpoint and review the relevant questions on the handout. The questions on the handout address all three stories in the video, which are summarized below with timestamps.

Story 1: Addie Rerecich's story introduces the video and pauses at minute mark 12:44. Doctor's could not explain how Addie's infection began. At minute mark 48:22, Addie's story concludes.

Story 2: David Ricci's story begins at minute mark 12:45. David's illness began with an injury that required the amputation of his leg. David was infected with NDM-1, a drug-resistant gene. David was not expected to survive the multiple surgeries he had during his missionary trip to India. When he returned home from India, doctors discovered that his infection was the first of its kind in the United States. At minute mark 46:33, David's story concludes.

Story 3: The third story begins at the 22:06 minute mark. This story is not the story of one particular individual, but rather the story of another drug-resistant organism known as KPC. This portion of the video explores the mysterious spread of KPC to multiple patients in a New York hospital. Medical professionals and researchers investigate the bacteria's growing resistance.

Teacher's Note: Video Pause and Explanation

At the 34:25 minute mark, the video displays a Petri dish. At this point, pause the video and draw students' attention to question 17 on the Addie's Story Video Questions handout. Have them read the passage found on their handouts, also reproduced below, and examine the Petri dish on screen.

"Notice, at the 34-minute mark of this film, the Petri dish shows a resistance test. Each white disc is a piece of paper infused with a different antibiotic. The clear area around the center disc demonstrates that the disc's antibiotic is effective against the bacteria being tested. The left disc's antibiotic is partially effective. The lack of a clear area around the other discs indicates that the bacteria are resistant to those antibiotic samples. The bacteria around those discs have grown enough to touch the discs."

Sample Student Responses

Sample student responses for the Addie's Story Video Questions handout can be found in the attached **Addie's Story Video Questions (Answer Key)** document.

After the conclusion of the video, pass out the attached **Addie's Story S-I-T Activity** handout. Go to **slide 7** and have students complete the handout using the S-I-T (Surprising, Interesting, Troubling) instructional strategy. Have students individually identify one surprising fact or idea, one interesting fact or idea, and one troubling fact or idea from the video. Allow approximately 10–15 minutes for students to add their initial responses.

Display **slide 8** and introduce the Chain Notes instructional strategy. Begin the two-minute timer on the slide and have students pass their papers clockwise. When each student gets a new paper, have them add to their group member's list. Repeat this process until each paper gets back to its original writer.

Display **slide 9** and have groups work together to draft a summary of the main ideas regarding evolution they gleaned from the video. Select one student from each group to share their group's summary with the whole class.

Teacher's Note: S-I-T and Chain Notes Activities

During the Chain Notes activity, walk around the room to ensure that each student has enough time to add to each paper. Allow 2 minutes for each peer response, sufficient time for students to review their peers' responses on their papers, and 2 minutes for each to discuss their group summary and select a spokesperson.

If students struggle to choose a spokesperson, choose a group spokesperson by asking a general question such as, "Who is the youngest person in the group?" Have the responding student choose a fellow student to speak for the group.

30 minutes

Explore

Move to **slide 10** and introduce the Photo or Picture Deconstruction instructional strategy to students. Give each student one sticky note and ask them to respond to the questions on the slide, reproduced below, using inferences they make about the photo.

- What do you think this organism might have eaten? Why?
- Where do you think this organism might have lived? Why?
- What animal do you think this organism is related to? Why?

Show **slide 11,** which contains the fossil photograph. Have students analyze the photo and record their observations and responses to the questions on a sticky note. Have students place their completed sticky notes on the projector screen, whiteboard, or other location near the picture. Share some of the responses from the sticky notes.

Navigate to the article "Fossilized Ancient Lizard Shows How Dinos Evolved to Live in the Oceans." Share additional scientific information about the organism from the article with students

Teacher's Note: Discussion

Clear up some potential misconceptions and emphasize any comments that are aligned to the standard. Recognize comments that are being stated multiple times. This could be an indicator that you may not need to spend much time later in the lesson explaining certain concepts.

Optional Activity

You can also use Nearpod to have students complete the activity digitally. Allow students approximately 5–10 minutes to make an initial post, then allow them 10 minutes to respond to a peer. Have them add their names or initials next to their posts and peer responses.

After the discussion, consider sharing the true origin of the fossil, the extinct *Vadasaurus herzogi* lizard, to allow students to compare their observations to those of researchers. Consider using the following resources to facilitate this comparison:

- "Meet Vadasaurus, a Foot-Long, Ancient Swimming Reptile"
- *Vadasaurus herzogi* database entry
- "Fossilized Ancient Lizard Shows How Dinos Evolved to Live in the Oceans"

15 minutes

Explain

Navigate to **slide 12** and introduce students to the Nova Labs video *Evolution 101*. You must open this video from a browser, as the video link cannot be posted in the slide deck.

Play the video and have students watch. Stop the video at minute mark 4:23, where the substance of the video ends.

Go to **slide 13** and explain the concept of Collaborative Word Clouds to students. Have students navigate to Mentimeter using the join code on the slide. Ask students to choose one or two words that communicate the overall concept or theme of evolution based on what they learned from the *Evolution 101* video.

As students add to the word cloud, elaborate on key points made by the group. Ask students to make observations about which words are used most frequently.

60 minutes

Extend

Go to **slide 14**. Explain to students what a timeline is and what it can illustrate about an organism or species. Have students develop a timeline of an organism of their choice (plant, animal, fungi, bacteria, protist) using a program such as Adobe or another program of their choosing.

Display **slide 15** and introduce the following requirements for the timeline:

- Student timelines should demonstrate:
  - How the organism evolved over at least three different time periods.
  - The environment conditions and factors that may have caused the evolutionary shift during each time period.

Review these requirements and the **Extend Rubric** to ensure that students understand the expectations.

Optional Variations

If you want variety among kingdoms, you can assign each student a specific kingdom. Have students share their findings with the entire class.

2 minutes

Evaluate

Go to **slide 16** and give each student an index card. Introduce students to the I Used to Think... But Now I Know instructional strategy. Have students respond to the prompt on the slide on their index cards. Encourage them to compare what they used to think about evolution with what they know now about evolution.

Teacher's Note: Activity Goals

This activity enables students to examine any misconceptions they have about evolution and helps them understand the role the environment plays as an organism adapts in order to survive.

Resources

- Adobe. (n.d.). Free online custom timeline maker. https://www.adobe.com/express/create/timeline
- Bever, G. S., & Norell, M. A. (2017). *A new rhynchocephalian (Reptilia: Lepidosauria) from the Late Jurassic of Solnhofen (Germany) and the origin of the marine Pleurosauridae* [Image]. Wikimedia Commons. https://commons.wikimedia.org/wiki/Category:Vadasaurus#/media/File:Vadasaurus_herzogi_holotype_(fossil).jpg
- Hudson Institute of Mineralogy. (n.d.). *Vadasaurus herzogi*. Mindat. https://www.mindat.org/taxon-9398973.html
- Huizen, J. (2015, October 26). *Why the dodo deserves a new reputation.* Audubon. https://www.audubon.org/news/why-dodo-deserves-new-reputation
- John Hopkins University. (2017, December 7). *Meet Vadasaurus, a foot-long, ancient swimming reptile.* https://hub.jhu.edu/2017/12/07/vadasaurus-reptile-fossil/
- K20 Center. (2021, September 21). *K20 Center 2 minute timer* [Video]. YouTube. https://www.youtube.com/watch?v=HcEEAnwOt2c
- K20 Center (n.d). Collaborative word clouds. Strategies. https://learn.k20center.ou.edu/strategy/103
- K20 Center. (n.d.). Chain notes. Strategies. https://learn.k20center.ou.edu/strategy 52
- K20 Center. (n.d.). Edpuzzle. Tech tools. https://learn.k20center.ou.edu/tech-tool/622
- K20 Center. (n.d). I used to think...but now I know. Strategies. https://learn.k20center.ou.edu/strategy/137
- K20 Center. (n.d.). Mentimeter. Tech tools. https://learn.k20center.ou.edu/tech-tool/645
- K20 Center. (n.d). Nearpod. Tech tools. https://learn.k20center.ou.edu/tech-tool/4803
- K20 Center. (n.d.). Padlet. Tech tools. https://learn.k20center.ou.edu/tech-tool/1077
- K20 Center. (n.d.). Photo or picture deconstruction. Strategies.
- https://learn.k20center.ou.edu/strategy/140
- K20 Center. (n.d.). S-I-T. Strategies. https://learn.K20center.ou.edu/strategy/926
- Micu, A. (2017, November 8). *Fossilized ancient lizard shows how dinos evolved to live in the oceans*. ZME Science. https://www.zmescience.com/science/ancient-lizard-dino-evolve-ocean-0432/%C2%A0
- Nova Labs. (2020). *Evolution 101* [Video and interactive game]. PBS Online. https://www.pbs.org/wgbh/nova/labs//lab/evolution/research#/chooser
- Young, R. (Producer). (2017). Hunting the nightmare bacteria (Season 2013, Episode 14) [TV series episode]. In *Frontline*. Public Broadcasting Services (PBS).