

How EGG-ceptional Are We? (AP Biology)

Evolution: Embryonic Development

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Grade Level	10th – 12th Grade	**Time Frame**	150 minutes
Subject	Science	**Duration**	2-3 class periods
Course	Biology		

Essential Question

How do we decide what to believe about evolutionary claims?

Summary

Students will investigate the similarity of reproduction, embryonic development, and DNA sequences to illustrate the indirect evidence for evolution. "How EGG-ceptional Are We?" has been scaffolded to AP Biology.

Snapshot

Engage

Students listen to the storybook *An Egg Is Quiet* then discuss observations from the book.

Explore

Students attempt to sort embryo images into similar groups.

Explain

Students use a second card sort and claims to draw conclusions.

Extend

Students analyze data and charts to draw conclusions about similarities between organisms.

Evaluate

Students answer a Free Response Question.

Standards

Next Generation Science Standards (Grades 9, 10, 11, 12)

HS-LS4-1: Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
HS-LS4-2: Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.
HS-LS4-4: Construct an explanation based on evidence for how natural selection leads to adaptation of populations.

Attachments

- AP-DNA-Comparison-Handout-How-EGG-ceptional-Are-We - Spanish.docx
- AP-DNA-Comparison-Handout-How-EGG-ceptional-Are-We - Spanish.pdf
- AP-DNA-Comparison-Handout-How-EGG-ceptional-Are-We.docx
- AP-DNA-Comparison-Handout-How-EGG-ceptional-Are-We.pdf
- BLAST-Lab-Handout-How-EGG-ceptional-Are-We.pdf
- Embryo-Claim-Cards-How-EGG-ceptional-Are-We.pptx
- Lesson-Slides-AP-How-EGG-ceptional-Are-We.pptx
- Lesson-Slides-How-EGG-ceptional-Are-We.pptx
- Student-FRQ-How-EGG-ceptional-Are-We.pdf
- Student-Version-Embryo-Cards-Explore - Spanish.docx
- Student-Version-Embryo-Cards-Explore - Spanish.pdf
- Student-Version-Embryo-Cards-Explore.docx
- Student-Version-Embryo-Cards-Explore.pdf
- Teacher-FRQ-How-EGG-ceptional-Are-We.pdf
- Teacher-Version-Embryo-Cards-Explore.docx

Materials

- *An Egg Is Quiet* by Dianna Aston
- Lesson Slides (attached)
- Student Version Embryo Card Sort (attached; enough for groups of two or three; cut out)
- Teacher Version Embryo Card Sort (attached)
- AP DNA Comparison Handout (attached; one per student)
- Embryo Claim Cards (attached; one copy per group of four)
- BLAST Lab Handout (attached; one per student)
- Student FRQ (attached; one per student)
- Teacher FRQ (attached)
- Colored pens or markers
- Sticky notes

Engage

Use **slide 3** from the attached **Lesson Slides** to introduce the essential questions and **slide 4** to introduce the objectives to students.

Go to **slide 5.** If you have a copy of *An Egg Is Quiet* by Dianna Aston, read it to students. If you do not have access to the book, show students the following "An Egg Is Quiet" read-aloud video on YouTube. Instruct students to use the I Notice/I Wonder strategy to write down observations, important details, and questions they think about as they hear the story.

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

Teacher's Note: Read a Picture Book? To High Schoolers?

Yes, that is the Engage, and yes, high schoolers can be engaged by a picture book. Humans rely on sight observations more than any of us would like to admit, and a picture book capitalizes on that. It'll be nostalgic for them, and can be a break from the seriousness of getting older.

Afterwards, allow students to look back through the book if they need to revisit it. In pairs, have students share what they've written and revisit the book (or copies of pages of the book) to either reinforce the observations they made or to revise them. Also use this time for students to discuss the questions they wrote and see if rereading the book answers the questions or if further investigation is needed.

Teacher's Note: Observations

Considering the context of the lesson, it would be ideal for students to get to the point of observing multiple species, with a great amount of diversity, all reproduce through egg/embryonic development. Also, all eggs, even though they are all different in shape, size, and species, function in the same way: protection and nutrition.

Explore

Go to **slide 6** and pass out the 'Set A' Card Sort embryo cards (letters at the bottom) from the attached **Student Version Embryo Cards** to groups of two or three students. Prompt students to group together the embryos that are similar. There are no duplicates, so each is a unique animal, but possible categories could be mammals, reptiles, amphibians, etc. Some students will think these are similar animals, but in different developmental stages. Try to leave it open-ended as 'group what you think is similar together' if possible. When students are done, have them do a modified Gallery Walk, where students write why their group decided the card groupings on sticky notes as category headings. The groups then rotate and read the other groups' ideas. When a full rotation through has happened, give time for students to decide if they want to change their original groupings or not.

Teacher's Note: Expect Low Success

This is a very difficult task, which is the point. Let them struggle. A teacher key is included in the lesson slides and the attachments, but that's for when the task is over and it's time to debrief. These moments of disequilibrium are the gateway toward opening the mind to other thinking.

Taking the idea further, pass out the 'Set B' Card Sort embryo cards (numbers at the bottom) from the same document, so that both Set A and Set B are together, to each group. Give the prompt again to create groups. Students will probably understand that the idea is to pair the embryo with the developed animal, but try not to give it away.

Teacher's Note: The Reveal

The answers to what embryo is what animal is included not only as a teacher key but also in the Lesson Slides (**slides 7-15**). Show students when they've struggled enough. At some point reveal the answers, but try to let the struggle happen as long as possible without leaving students too frustrated.

Explain

Go to **slide 16**. Pass out slides 3-6 of the Embryo Claim Cards slide deck to each group of four. Students should use the Claim Cards strategy, so give each student a claim. Taking turns in their groups, they read their claim and either support the claim or refute it based on the evidence from their Card Sorts in Explore. Responses are then shared with the whole group. There are answers and explanations for each claim on **slides 17-20**.

Go to **slide 21** and pass out the **DNA Comparison worksheet** to students. Offer colored pens or markers and prompt students to look through or sequence the data with a partner. There are questions on the back that can provide inspiration for students, but allow students to explore the nucleotide sequences on their own.

Extend

Go to **slide 22** and introduce the BLAST software. Students conduct a lab using the BLAST software provided for free by the National Center for Biomedical Information. Use **slides 23-25** to guide students through the lab. The **BLAST lab handout** is included in the attachments. The software, in conjunction with the procedures, allows students to compare percent similarity of genes, and also percent similarity of protein structure associated with the gene.

Teacher's Note: BLAST? What's That?

The website is very academic and is obviously made for people who are 'in the field' (actually conduct research and know this stuff). Probability is high that students will ask a lot of questions of how to maneuver the website. It is highly recommended to explore the website and follow the instructions on your own before students do, so that you can troubleshoot when needed.

Is It Worth It?

This is one of the 13 labs recommended by College Board for AP Biology. This not only connects real-life research to something students are learning, but has a high probability of the information harvested in the lab being on the exam. Even though this can be time-consuming (depending on the level of your students), it is a lab that is definitely worth the time.

Additional Helpful Resources

- AP Biology Investigative Labs: Comprehensive Links
- AP Biology Lab Manual Resource Center

Be aware, there are pre-lab questions, online activities, the procedures, then analysis of each investigation. The pre-lab questions are full of great information and prepare the student for the lab. Either have them do it in class or as homework, but always before the lab starts. The online activities are great resources, but are optional depending on how much extra help your students need.

Evaluate

Go to **slide 26**. Pass out the attached **Student FRQ**. Have students individually answer the free-response question. Give them 22 minutes to answer the question. Technically, more time can be given if needed, but students should at least be informed of when 22 minutes have passed as that is the pacing guidelines set by College Board. A key is provided in the attached **Teacher FRQ**, along with scoring guidelines. Do not give students the key until after the question is given. It is highly recommended to not let it leave your classroom.

Teacher's Note: Timer

There is a timer on **slide 27** if you would like students to be able to see how much time they have remaining.

Resources

- AP Biology Lab Manual. (2016). The College Board. http://apcentral.collegeboard.com/apc/members/courses/teachers_corner/218954.html
- BLAST Software. (2016). National Library of Medicine (NLM). http://blast.ncbi.nlm.nih.gov/Blast.cgi
- K20 Center. (n.d.). Bell Ringers and Exit Tickets. Strategies. https://learn.k20center.ou.edu/strategy/125
- K20 Center. (n.d.). Card Sort. Strategies. https://learn.k20center.ou.edu/strategy/147
- K20 Center. (n.d.). Claim Cards. Strategies. https://learn.k20center.ou.edu/strategy/160
- K20 Center. (n.d.). Gallery Walk/Carousel. Strategies. https://learn.k20center.ou.edu/strategy/118
- K20 Center. (n.d.). I Notice, I Wonder. Strategies. https://learn.k20center.ou.edu/strategy/180
- Sunshine lemonade. (2016). An egg is quiet [Video of book read-aloud]. YouTube. https://www.youtube.com/watch?v=KgVaNbrCayU