HASPI Medical Biology Lab 20
Evidences of Evolution
NGSS HS-LS4-1
Teacher Information

Description

a. Evidences of Evolution

Evolution is an important aspect of biology, and it is important to understand how and why this theory developed. In this activity students will visit 5 stations that provide evidence for the evolutionary theory, and discover how these evidences can be related to humans, health, and even how they may contribute to medical research. The stations include activities that cover 5 major evidences of evolution: The fossil record, DNA sequence comparison, anatomical homologies, amino acid sequence comparison, and embryology.

Next Generation Science/Common Core Standards

Students who demonstrate understanding can:

HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.

***Medical Application**: Understanding the evidences for evolution can enhance and support research involving human health and medicine.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating, and Communicating Information • Communicate scientific information (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** • A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence.	**LS4.A: Evidence of Common Ancestry and Diversity** • Genetic information provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence.	**Patterns** • Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** • Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future.

Connections to other DCIs in this grade-band: **HS.LS3.A, HS.LS3.B, HS.ESS1.C**

Articulation to DCIs across grade-levels: **MS.LS3.A, MS.LS3.B, MS.LS4.A, MS.ESS1.C**

Common Core State Standards Connections:

ELA/Literacy –

RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.

WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.

WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.

SL.11-12.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.

Mathematics –

MP.2 Reason abstractly and quantitatively.

Essential Question

By the end of this activity students will be able to:

- Identify specific evidences that support the evolutionary theory.
- Recognize how the fossil record and organism similarities point to a common ancestor.
- Explain how understanding evidences of evolution can impact human health and medicine.

Time

Estimated Time	***Actual Time** (please make note below)*
Lab 20: 55 - 75 minutes	

*Note: Share the actual time on the forum (**www.haspi.org**) or at HASPI curriculum conference*

Materials

HASPI is a grant-funded project and on occasion we are able to provide supplies to participating sites. If we are unable to provide supplies, the company, item number, and approximate cost have been included.

Supply	Provided (P) or Needed (N)	Quantity	Company/ Item #	Approximate Cost
Station Directions (5 pages)	P	1	HASPI	Cost of copies
Station 1 Articles (3 pages)	P	1		
Station 2 DNA Sequences (4 pages)	P	1		
Station 3 Digestive Tract (1 page)	P	20		
Station 4 AA Sequences (6 pages)	P	1		
Station 5 Embryo Sheets (5 pages)	P	1		
Scissors	N	As needed	-	-
Tape	N	As needed	-	-
Recycled/scratch or construction paper	N	40	-	-

Company Contact Information:
HASPI www.haspi.com Download free online

Common Student Misconceptions

The following is a list of possible misconceptions that students experience. Please feel free to add any additional misconceptions students experienced during this activity to be better prepared for the future use of this lab/activity.

- There is not an abundance of information on how fossils are formed. This should have been covered thoroughly in the middle school life science standards.
- Students may be confused as to why the comparison processes for DNA and amino acids are so similar. It is a great opportunity to reinforce the link between DNA and amino acids, and that mutations are the mechanism for change in both.

Additional Misconception Notes:

Guiding Questions

These questions are meant to support discussion of the concept/standard.

- Find and print out numerous images of a variety of living organisms and have students organize the images into groups. Allow them to group the organisms however they like. Discuss what characteristics the students used to form the groups and what other information would also be useful for grouping (DNA, protein structure, etc.). Relate this to how scientists, like Darwin, determined relationships through observation of similar and/or different traits.

The Task/Response System

Through multiple discussions and suggestions, HASPI has decided to use the task/response system for lab procedures and directions. The response column can be utilized to:

- Provide space for answers to questions provided in the task column.
- Provide space for data/observation records.
- Provide images to help relay a step.
- Support reinforcement of the standards/concepts immediately during the lab investigations.
- Any other way you see fit to use it!

Additional Information

Information	Page #	Location
Lab 20: Evidences of Evolution		
There are enough materials for 3 student groups at each station. Simply print out additional materials if you would like to accommodate more groups.	N/A	Background
The station sheets provide directions for each station along with the materials needed at each station.	N/A	Set up
Before the activity, cut out and tape together the DNA sequences (station 2) and the amino acid sequences (station 4).	N/A	Set up
Before the activity, cut out the embryo images and the labels for station 5. Place each set of embryos/labels in a plastic bag so they are not mixed with other sets.	N/A	Set up

Resources and References

- Baab, Karen L. 2012. *Homo floresiensis*: Making Sense of the Small-Bodied Hominin Fossils from Flores. Nature Education Knowledge 3(9): 4.
- Briggs, Helen. 2013. Neanderthal clues to cancer origins. BBC News, http://www.bbc.co.uk/news/science-environment-22780717.
- PBS. 2001. Evolution: A Journey Into Where We're From and Where We're Going. WGBH Educational Foundation, Clear Blue Sky Productions, Inc., www.pbs.org/wgbh/evolution/.
- University of Texas at Austin. 2007. Most Ancient Case Of Tuberculosis Found In 500,000-year-old Human; Points to Modern Health Issues. Science Daily. Retrieved December 15, 2013, from http://www.sciencedaily.com/releases/2007/1207091852.htm.
- Yamamoto, M., Cid, E., & Yamamoto, F. 2012. Figure 2: Amino acid sequence comparison of the GBGT1 genes between the Forssman-positive and negative species. Molecular genetic basis of the human Forssman glycolipid antigen negativitiy. Scientific Reports, 2:975.

Images (in order of appearance)

- http://www.macroevolution.net/images/natural-selection-225-212-10.jpg
- http://www.petersalebooks.com/wp-content/uploads/mass-extinction.jpg
- http://upload.wikimedia.org/wikipedia/commons/4/49/Ape_skeletons.png
- http://www.fromquarkstoquasars.com/wp-content/uploads/2013/11/evolution.jpeg
- http://www.freedomsphoenix.com/Uploads/Graphics/338/08/338-0808203248-human-evol.jpg
- http://evolution.berkeley.edu/evolibrary/images/interviews/visionaries_dna3.gif
- http://bio1151.nicerweb.com/Locked/media/ch22/22_17HomologousForelimbs-L.jpg
- http://dtc.pima.edu/blc/182/lesson1/1step3/1step3images/embryoes2116.jpg
- http://www.biomedcentral.com/sites/2999/series/EvolMed.png
- http://www.sciencedaily.com/releases/2007/1207091852.htm
- http://www.pentagonpost.com/wp-content/uploads/2013/10/Neanderthal-Cro-Magnon.jpg
- http://www.bbc.co.uk/news/science-environment-22780717
- http://www.jeron.je/anglia/learn/sec/science/prehist/01timeline.gif
- http://www.cnsweb.org/extra/digestvertebrates/WWWEdStevensCDAnatomy.html
- http://www.0095.info/de/index_thesende3_biologiede_biogenetischesgrundgesetz.html