What Makes a Primate a Primate: The Homology Between Species

Lesson plan for grades 9-12
Length of lesson: 2 hours 10 minutes
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SOURCES AND RESOURCES:
- State of Texas Science TEKS
  http://ritter.tea.state.tx.us/rules/tac/chapter112/ch112c.html
- ESI Hot Science Cool Talks lecture # 90, Dr. Anthony Di Fiore, Primate Social Behavior
  http://www.esi.utexas.edu/hot-science-cool-talks/378-primate-social-behavior
- Spider Monkey Intro Video (by National Geographic)
  http://video.nationalgeographic.com/video/monkey_spider?source=searchvideo
- What makes a Primate a Primate
  http://tolweb.org/treehouses/?treehouse_id=3029
- Virtual Hat
  http://austindavid.com/flotsam/hat.php
- Primate Development and Taxonomy
  http://www.iupui.edu/~mstd/a103/primate%20lecture%202.html
- Fascinating Animals (taxonomy guide)
  http://facinatingamazinganimals.wordpress.com/2012/03/11/animal-trees/

POTENTIAL CONCEPTS TEKS ADDRESSED THROUGH THIS LESSON:

§112.34. Biology, Grade 9: subsection 2H

§112.34. Biology, Grade 9: subsection 3B, 3E

§112.34. Biology, Grade 9: subsection 7A

§112.34. Biology, Grade 9: subsection 8B

PERFORMANCE OBJECTIVES:

Students will be able to:
- Communicate valid conclusions about primate homology and ancestry through the support of data and research in the form of visual and graphically organized presentations
- Communicate and apply scientific information extracted from various credible sources
- Evaluate models according to their limitations in representing biological organisms or objects
- Analyze and evaluate how evidence of common ancestry among groups is seen through homologies and anatomical/developmental studies.

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- Categorize organisms using a hierarchical classification system based on similarities and differences shared among groups.

MATERIALS (per group of four):

- Desktop or Laptop computers (1 per student preferred, but also possible to have 1 per pair of students)
- Primate Projects Instructions Handout (1 per group)
- Primate Analysis Journal Entries Handout (see preparation section for number of copies)
- Poser Boards (enough for every group)
- Construction paper
- Scissors
- Glue sticks, liquid glue, or tape
- Printer

CONCEPTS:

- **Hierarchy**: "a system or organization in which people or groups are ranked one above the other according to status or authority."
- **Homology**: "similarity in sequence of a protein or nucleic acid between organisms of the same or different species."

BACKGROUND:

What Dr. Anthony Di Fiore's Lecture was about:

"Humans have long been fascinated with their evolutionary cousins in the primate world, monkeys. Dr. Anthony Di Fiore studies several species of monkeys in Amazonian Ecuador, and how the ecology of the area shapes their behavior and the societies in which they live. There are several different ways of studying primates, and these differ depending on species and ecological habitat. Methods include traditional observational studies as well as the modern use of technological equipment and techniques in molecular genetics. Through these methods, we have discovered remarkable things about the social behavior of our primate cousins, and how they may be both strikingly similar to, and vastly different from, humans."

This lesson focuses on understanding what makes a primate a primate. Students will explore and research the unique characteristics of various primates as well as compare and contrast the characteristics of various primates in order to understand the concept of inter-species homology.

PREPARATION:

- Computers should be fully charged and updated prior to distributing them to students. Computers may also have to be safe-search locked or have web viewing restrictions to help focus student research times and project work to a point of maximum efficiency

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- Virtual Hat is an online random number assigner that can be utilized to help divvy up the listed primates to the appropriate student groups. It is idea that the groups consist of 2-4 students and that a majority (if not all) of the listed primates be assigned to the student groups. This will help create a more comprehensive analysis of primates and will help students understand inter-primate homology better. The virtual hat is an option and can be easily replaced by numbers in a hat or a Popsicle stick drawing.
- Students many need printer access in order to print out the necessary text and images for their poster-board visuals.
- Depending on how many groups of students (we will call that number "n") were created in the class for the poster-board project, there should be 1 less than that ("n-1") printed copies of the Primate Analysis Journal Worksheet (see materials section) printed off for every group.

ENGAGE: *20 minutes*

Teacher: Starts by playing "Spider Monkey intro video" (see resources section)

Teacher Says: Spider monkeys have stolen the hearts of many people around the world. Their adorable appearance and human like behaviors make them popular amongst the common population while their complex social behavior and evolutionary background make them extremely interesting to the scientific community. When looking at the video what were a few things everyone noticed? Feel free to mention things that aren't specific to spider monkeys.

Possible Student Responses:
- "The spider monkeys have a really long tail that the video claimed, acts as a 5th limb."
- "Perhaps their most common habitat is the rainforest because I saw lots of green foliage that was characteristic of some South American jungle."
- "There were other animals present in the video as well. Some cat like predator was in the video as well as some animals that looked like different kinds of monkeys."
- "Spider monkeys remind me a lot of human children because they like the play and they have similar physical features."

Teacher Says: Those are all interesting observations. Indeed, the spider monkey was the focus of that short video clip but there were also other animals in that video that weren't talked about too much. Of them, perhaps the most similar to the spider monkey was the monkey like creatures that were shown in the trees. Since we don't know exactly what to call them, perhaps its best to recognize them as a potential primate for now. But what are some of the common characteristics of primates?

Teacher: Shows clip from Dr. Di Fiore's lecture (minute reference 11:18-13:57)

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Teacher Says: Let's now go through and list some of the important characteristics of primates since today's focus will be on better understanding these creatures and how they relate to one another, and perhaps, how they might even relate to us humans.

*The following are potential responses that could be achieved through a class room discussion. In periods where there are a lack of responses or ideas, teacher should ask students to *think-pair-share* (get with a partner and talk about ideas for a set amount of time before returning back to the original class room discussion).

1. Shortened snout
2. Several types of teeth: incisors, canines, premolars, molars
3. Forward facing eye orbitals
4. Stereoscopic vision (visual fields of eyes overlap to create depth perception/binocular disparity)
5. Have Clavicles (collarbones)
6. Two separate bones in the forearm and lower leg
7. Nails instead of claws
8. Increased thumb mobility (have opposable thumbs)
9. Grasping feet
10. Trend toward more vertical posture
11. Tend toward different use of forelimbs and hindlimbs
12. Trend toward longer lives with longer periods of infancy, childhood and adulthood
13. Trend toward enlarged brains with increased areas for vision and reduced areas for olfaction

Teacher Says: Now that we've discussed and listed some of the more dominant characteristics of primates, we hopefully have a checklist for, and idea of what a primate would look like. For the next portion of class, you and your group will be doing some in-depth research on a randomly assigned primate.

EXPLORE: *50 minutes*

Teacher: Will randomly draw names from a hat or from the "Virtual Hat" (see resources section) to assign each group with their corresponding primate for the research project (see preparation for further instructions).

List of Primates:
1. Hamadryas Baboon
2. Blond Capuchin
3. Lion Tamarin

4. Macaque
5. Black Crested Gibbon
6. Red Slender Loris
7. Eastern Gorilla
8. Sumatran Orangutan
9. Bonobo

Teacher Says: Now that each group has their assigned primate, you will all now have 50 minutes to do thorough research on your particular primate as well as complete a poster-board visual to display all of the information you've collected. To achieve credit for the project, each group must follow the details and requirements described in the "Primate Projects Instructions" handout (see materials).

Teacher: While the students are working, the should display a timer on the overhead or board or call out how much time is left and particular intervals to allow maximum work efficiency from the students as well as project completion. When the students have completed their projects, the teacher will ask students to pin-up their poster-board visuals around the room in a gallery like fashion for later in the lesson.
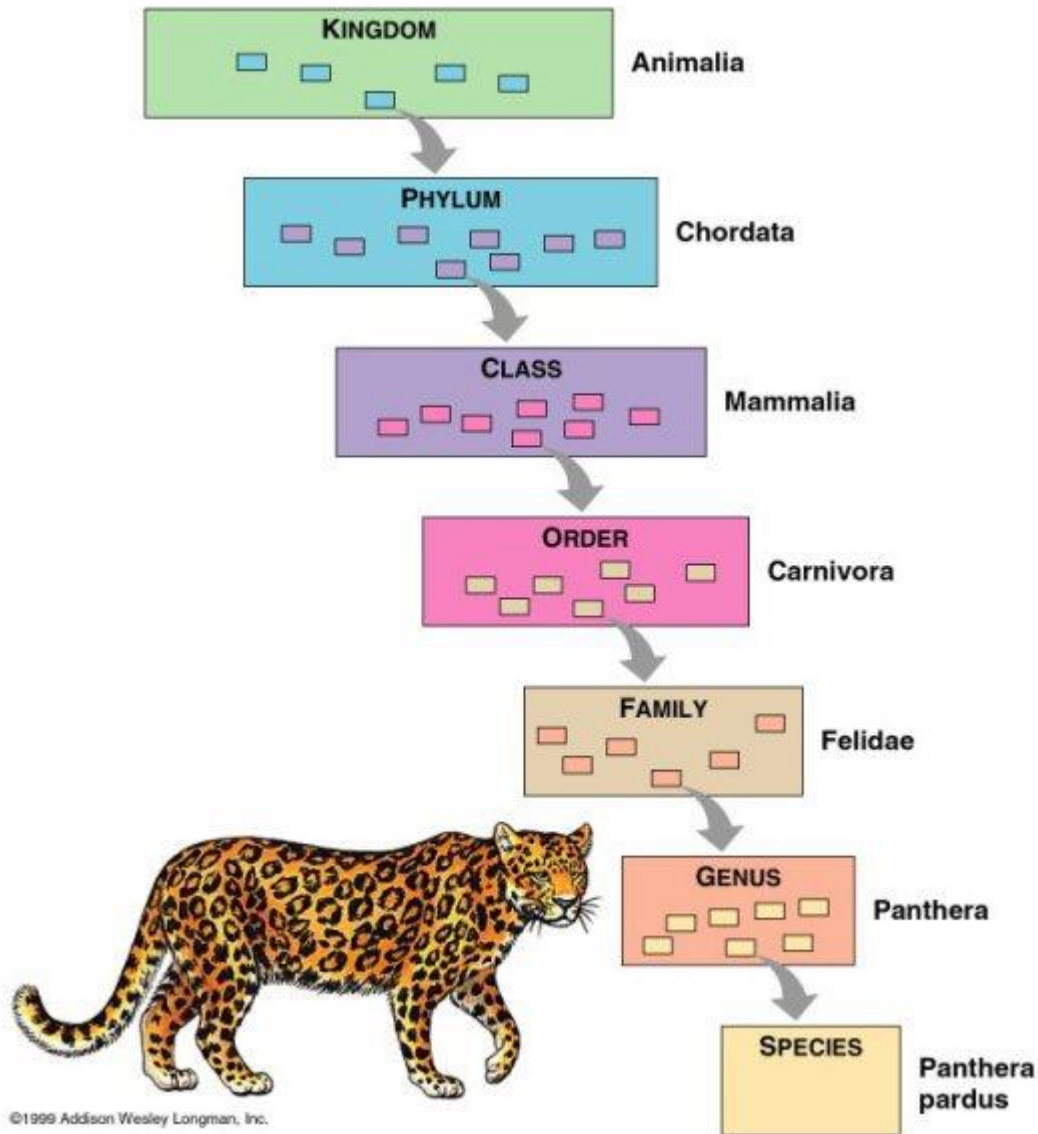
EXPLAIN: *20 minutes*

Teacher Says: These poster-board displays look fantastic. I know that everyone wants to see other groups' projects but before we can do that, we need to discuss some important ideas that could potentially link all of these posters together.

I would like everyone to think back to their middle school or even elementary days. Does anyone recall the word "Taxonomy?"…..Well taxonomy is a branch of science concerned primarily with the classification of organisms. Now, some of you might be thinking "what do you mean by classification?" and "why is this even important?" Well, imagine being a scientist doing field research. You're walking through the desert or the woods or the swamps and you suddenly come across this animal. Immediately, you sit down and begin to sketch the animal on your field journal so that you can remember what it looks like. After you are done, you continue walking only to come across yet another unique animal. Now imagine doing this thousands and thousands of times for every animal that you see (even though there are millions of species of organisms currently in existence). You would eventually get to a point where it's hard to differentiate between certain animals and you have an incredibly difficult time sharing your findings with all of the other field researchers. How can you possibly refer to a specific creature without pulling up your sketch pad and showing a crude picture of the animal? The answer to this dilemma is to name each different organism uniquely; however, even that becomes problematic as you can't possibly come up with thousands of different names off the top of your head, and memorizing all of those names would be a headache even for the brightest of scientists. The solution to this is something that almost everyone comes across on a day to day basis; a form of classification.

Just as the phonebook organizes numbers and names, taxonomy seeks to organize all of the unique animals into an understandable and related system. To do so the system must first start out with a basis of **hierarchy**.

Hierarchy is the concept of having ranks or levels of importance/value. Perhaps the most prevalent example of a hierarchy is leadership status of medieval kingdoms. At the bottom of the hierarchy are the peasants which are numerous and the least powerful in the kingdom. As you work your way up from the peasants you will notice that there are fewer and fewer individuals in each rank but they gain more and more power. For example, these peasants are controlled soldiers which are controlled by knights which are governed by dukes which are all under the rule of the royals (kings, queens, princes, princesses, etc…). The classification system for organisms must also have a similar sense of hierarchy, but rather than having importance or power change as one moves up and down the hierarchy, it is the specificity to the individual organism that changes.

There are 7 levels of hierarchy in taxonomy. The largest level which is also the most encompassing is called "Kingdom." This refers to the most simple and largest form of categorizing that can be used to organize all the living organisms on Earth (for example, Kingdom: Animalia). One can go down the hierarchy to get more and more specific categories such as Phylum, Class, Order, Family, Genus, and Species. "Species" is the most specific level of classification. That is why you often read or hear that there are "_____ amount of different species" in a given region. However, we still need to address the issue of naming all of these organisms.

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Taxonomy has a devised system of naming organisms which is called Binomial Nomenclature. This naming system is actually quite simple once you understand the hierarchy involved in classifying the organisms. Since each different level has different names for different subsets of organisms, the scientific binomial nomenclature for an organism is the Genus name (first letter capitalized) following by the species name (in lower case). The beauty behind this naming system is that it is unique enough to separately name all the different creatures that exist on earth, but utilizes the genus name (higher up in the hierarchy than species) so that an individual or scientist can know what other species this organism is related to.

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Let's focus now on Primates, as that is what we have been talking about for the majority of this lesson. "Primates" is actually an Order in the taxonomy classification system we talked about. That means that there are many species of specific organisms that go under this larger subcategory. All of you have worked hard or researching and learning about you particular species of primate and now you will understand why.

ELABORATE: *30 minutes*

Teacher Says: Your next job is to get back into your original groups and stand next to another group's poster (posters from Explore section should already be pinned up around the room). You will have approximately 3-4 minutes at each station (poster) before I call time. Then you and your group will move clockwise to the next poster. If your group lands on your own poster, spend the time to reanalyze your findings and make comparisons between your primate and the primates of the other groups. As you are walking through the gallery of posters, one person in each group will be designated as the scribe. The scribe's job is to complete the "Primate Analysis Journal" for each of the posters that the group looks at (see materials section and preparation section). This means that the other team members should be helping the scribe find the necessary information to complete each journal entry in the allotted time.

*Teacher should have timer on the overhead and provide 1 minute warnings prior to rotation

EVALUATE: *10 minutes*

Teacher: Everyone should be seated after they have looked at the last group poster and have filled out all of their Primate Analysis Journal entries for the different primates.

Teacher Says: I hope that everyone noticed lots of similarities and a few differences between the primates that the groups studied. These similarities in physical traits and characteristics is called **homology**. There are many specific physical features that scientists use to help organize various species into their correct taxonomy categories and even identify new species. One example of this is the hands of primates. Though one might think that all primate hands are the same, in fact, they all have key differences that can help any scientist differentiate between two similar looking species of primates. Another feature used for homology is the arrangement of teeth in the scull of the animal. Primates, due to their varying diets, have different organizations and shapes to their teeth which help scientists determine the remains of species as well as the potential ancestry of species.

For the next 5 minutes work with a partner to write down as many examples of homology between a human and a spider monkey and do the same for a dolphin and a monkey.

Primate Project Instructions   Primate: _____

Name: _____   Date: _____/_____/_____

Name: _____

Name: _____

Name: _____

<u>Instructions</u>: Now that you and your team members have been assigned a primate to research, your goal is to learn as much as you can about these primates in terms of their characteristics, history, anatomy, etc… in order to better understand how all the different species of primates relate to one another. Follow the Rubric below in order to receive credit and maximum points for your team's research and poster-board display.

Section:	Description	Score
Primate Background	In this section, research and describe the habitat of your primate, what it's diet is like, the places around the world where you can find the, approximately how many are left in the world, if they live in families or groups or independently, provide the binomial nomenclature for you species (scientific name)	25 pts
Primate Images	Find and attach detailed and aesthetically pleasing images of your primate so that others may know what it looks like. Beneath each image, provide a brief description of the image as well as a citation referring to where you obtained the image (URL address will suffice).	20 pts
Traits	Describe the anatomy and physical characteristics of you primate. Describe the potential or known functions of these physical characteristics. Provide images to support your findings and assumptions (i.e. – images of hands, tails, fur, skeleton, etc…)	25 pts
Relatives	Describe and identify close relatives or ancestors of your primate. Provide some similarities and differences between some of these relatives and your primate.	20pts
References	Make a list of citations and references that you used while researching your primate. Include web addresses, website names, authors, etc…	10 pts

Primate Analysis Journal Entry   Primate: _____

Names of students who did research on that primate:

Name: _____

Name: _____

Name: _____

Name: _____

Describe the habitat or environment of this primate:

_____
_____

What is the scientific name of this primate: _____

Describe some of the physical traits and characteristics of this primate:

_____
_____
_____
_____
_____

How is this primate similar to your group's researched primate?

_____
_____
_____
_____
_____

How is it different?

_____
_____
_____
_____
_____