FROST SCIENCE

DNA DISCOVERIES

DNA DISCOVERIES

Overview

Students will discover how paleontologists study and classify dinosaurs and how evolutionary biologists study the relationships between organisms. Students will use fossil and genetic evidence to investigate evolutionary relationships between living and extinct organisms

Objectives

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

- Compare the structure and function of physical characteristics of organisms and classify organisms into groups according to these characteristics.
- Support hypotheses about evolutionary relationships using both fossil and DNA evidence.

Key Ideas

- Modern taxonomy is the classification of organisms according to their evolutionary relationships, which can be evidenced through physical structures, behaviors and genetic sequencing.
- The classification of extinct animals, including dinosaurs, is performed using information from the fossil record and is limited by the absence of genetic material.
- Fossils are the preserved remains of prehistoric organisms and can be used as evidence to make inferences about former life on Earth.

Background Information

Fossil Evidence

To learn more about organisms that lived a long time ago, paleontologists study fossils. Fossils are the preserved remains of prehistoric organisms and can form in several ways. From simple impressions, to casts filled with hardened minerals, these ancient specimens can help scientists make inferences about former life on Earth, including dinosaurs. After unearthing dinosaur fossils at excavation sites, paleontologists can study them in laboratories to gain a better understanding of dinosaur appearances, behaviors, and evolutionary relationships.

Modern Taxonomy

Scientists classify, or group, organisms to indicate their evolutionary relationships. This classification system, called taxonomy, relies on a hierarchy of increasingly specific levels. From general to specific, these levels indicate the organism's domain, kingdom, phylum, class, order, family, genus and species. In the past, scientists have inferred evolutionary relationships between organisms by observing similarities and differences in their physical structure and behavior. For example, the domains Eukarya and Bacteria can be differentiated through several structural characteristics including the presence or absence of a nucleus.

Today, genetic analysis allows scientists to group organisms based on similarities in their DNA, RNA, and proteins. These evolutionary hypotheses, determined by genetic analysis, can be visually mapped using phylogenetic trees. Like real trees, phylogenetic trees have a trunk and branches, where the trunk represent a common ancestor and branches represent descendants.

Dinosaurs

Dinosaurs are classified as a distinct group of animals based on various skeletal characteristics. Along with birds and crocodilians, dinosaurs belong to the archosaur lineage.

- Archosaurs are reptiles that can be identified by **an opening on both sides of the skull in front of the eyes.**
- Dinosaurs, specifically, are differentiated from other archosaurs through several skeletal modifications, including a **unique hip bone that consists of three fused bones with a hole in the center.**

Unlike modern organisms, classification of extinct non-avian dinosaurs is dependent on the fossil record and limited by the absence of DNA. However, the generic material of living avian dinosaurs (birds) can be used to test paleontologists' theories about prehistoric dinosaurs.

GenBank and BLAST

The Basic Local Alignment Search Tool (BLAST) is a National Center for Biotechnology Information Biometrics program that can be used to compare genetic sequences. This online resource is available to the public and is used by scientists to study evolutionary relationships among different organisms. Specifically, BLAST allows for users to input and compare nucleotide sequences with their database to identify similar nucleotide sequences. For investigators seeking to use the genetic data of a specific organism instead of comparing genetic sequences, genetic sequences of individual organisms can be accessed via GenBank, the National Institute of Health genetic sequence database. GenBank contains up-to-date genetic sequences that can be used by the public without restrictions.

Materials (per group)

- Fossil photos – 1 set
- Appendages photos – 1 set
- Laminated skull photos – 1 set
- Laptop/computer access (optional) - 1
- Dry erase markers – 1 (per student)
- DNA Discoveries datasheet – 1
- Index cards – 1 (per student)
- Archosauria phylogenetic tree printout – 1
- Scissors – 1

Each group will receive a different set of data that corresponds to one of the following organisms:

- Red panda set – 1 set
- Short-beaked echidna set – 1 set
- Malayan tapir set– 1 set
- West Indian manatee set – 1 set

Set-up Procedure

- OPTIONAL: On a projector screen, TV or smart board, pull up links to online resources.
  - GenBank
  - BLAST
- Divide students into groups of 4 groups.

Standards

7th Grade:

SC.7.L.15.1 Recognize that fossil evidence is consistent with the scientific theory of evolution that living things evolved from earlier species.

SC.7.L.16.1 Understand and explain that every organism requires a set of instructions that specifies its traits, that this hereditary information (DNA) contains genes located in the chromosomes of each cell, and that heredity is the passage of these instructions from one generation to another.

SC.7.N.1.1 Define a problem from the seventh grade curriculum, use appropriate reference materials to support scientific understanding, plan and carry out scientific investigation of various types, such as systematic observations or experiments, identify variables, collect and organize data, interpret data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions.

Activity Procedure

Introduction:
Reveal students' prior knowledge about how paleontologists identify and classify dinosaur fossils.

What the Facilitator Does	Anticipated Behaviors/Responses from Students
1. Begin the lesson by prompting students to answer the following question: What percentage of genes do you think we share with bananas? a. Pass out index cards to each student and ask students to write down a percentage on their index card. b. Tell students that if they have heard of this before, the resource may have referred to a very specific gene and not the entire genome.	1. Students will follow instructions and write their thoughts down.
2. Have students crumple their index card and throw it to another area of the room. Then, ask them to pick up a crumpled index card that does not belong to them and raise their hand to share the answer.	2. Students will crumple up their index card and toss it to another area of the room before picking up one that does not belong to them. They will not throw index cards at one another. Students who would like to share will raise their hand and share the answer that is on the index card.
3. After some answers are provided, explain that bananas and humans have genes, or proteins, called orthologues (or-THOUGH-logs) in common. Of these, about 40% of them are similar in bananas and humans. This is about 1% of our entire genome, so we share about 1% of our entire genome with a banana.	3. Students will be attentive and ask questions if needed.

<table>
<tr><td>4. Now, switch gears and ask students to keep DNA in mind as they go through this lesson. Share that scientists use DNA to understand wildlife and paleontologists sometimes use DNA to understand fossils. Tell students to channel their inner paleontologist by imagining they are at an excavation site and have just discovered a fossil.

Question(s):

Q1: How do we identify what type of organism we have found?

a. Ask students to talk with their group to decide how they would identify their findings.

b. During this time, walk around the classroom and encourage students to work together to think about identification and classification.</td><td rowspan="2">4. - 5. Students will discuss the question with their group and describe ways that they might try to identify a fossil. Students will listen to their peers, be respectful and be attentive.

Possible response(s):

R1: Compare the organisms to other fossils found in the area.

R1: Look at the physical structures to see what looks familiar.</td></tr>
<tr><td>5. When ready, ask students to share their thoughts.

a. Tell students that during the rest of the activity they will learn about multiple ways paleontologists learn about the fossils they find.</td></tr>
<tr><td>6. Hand out the Fossil photos of invertebrates, a reptile, and a fish and a pair of scissors to each group. Ask students to cut the printouts along the lines into individual fossil photos. Then, without providing any additional information, tell students to sort the fossils into categories.

a. Hand out a DNA Discoveries datasheet to each group and tell students to answer question 1.</td><td>6. Students will cut out the individual fossil pictures. Then, as a group, students will make observations about each of the fossils on the DNA Discoveries datasheet. They will then sort the fossils in a way that makes sense to them and explain their reasoning. During this time, all students will be active participants in their groups.</td></tr>
<tr><td>7. Ask students the questions below.

Question(s):

Q1: How did you sort the fossils and why did you sort them in this way?

a. While they are answering, write the different ways they are sorting the fossils on a whiteboard or in a way for all students to see.

b. Ensure students understand that there are multiple solutions.</td><td>7. Students will share the different ways they sorted the fossils with the facilitator and their class.

Possible response(s):

R1: Number of bones, size, type of animal, etc.</td></tr>
</table>

8. Tell students that scientists group organisms based on similarities or differences in their physical structures, which can help them hypothesize if two organisms are closely related. Species with similar structures are likely to be descended from a common ancestor that also had this structure. a. Ask students to look back at the **Fossil photos** they just sorted. Tell students that all photos of are of animals. No photos include a plant. Tell students to re-sort the photos if needed.	8. Students will re-sort the photos if they had originally classified the sea lily as a plant.
9. Pass out the **Appendage photos** of a dolphin flipper, human hand, and fish fin to each group. Explain that students will be looking at one structure in several different organisms to hypothesize which organisms are most closely related based on their similarities. *Question(s):* **Q1:** Looking at the images provided, which organisms do you think are most closely related? a. Instruct students to record their observations, hypothesis, and reasoning on their **DNA Discoveries datasheet**.	9. Students will view the structure of a dolphin flipper, human hand and fish fin and record their observations. a. Students will use their observations to make a hypothesis regarding which specimens are most closely related. b. Students will justify their hypothesis.
10. Ask each group to share their hypothesis and reasoning.	10. Each group of students will share their hypotheses and reasoning. *Possible response(s):* **R1:** The similarities between the bone structures in the human hand and the dolphin flipper provide evidence that a dolphin is more closely related to a human than a fish, which had no bone structure in it's fin.

11. Explain that now, students are going to observe dinosaur bones to understand how dinosaurs are related to other organisms that live on Earth. a. Pass out the laminated **Skull photos** of a dinosaur, crocodile, bird and mammal and dry erase markers to each group. b. Ask students to use the dry erase markers to mark or circle the similarities and differences between each skull. They can use whatever marks they want as long as they know what marks indicate a similarity and what marks indicate a difference.	11. Students will work as a group to observe the laminated **Skull photos** and mark the differences and similarities between them with dry erase markers.
12. Explain that scientists classify dinosaurs as a distinct group of animals based on various skeletal characteristics. Along with birds and crocodilians, dinosaurs share an ancestor called Archosauria (ar-ko-sore-ee-ah). *Question(s):* **Q1:** Are there any similar characteristics in the four skulls provided? **Q2:** What do you think this tells us about dinosaurs? a. If students do not mention the opening on both sides of the skull in front of the eyes, have students look again to try to identify this similarity in both the bird and dinosaur skull. Explain that extinct crocodilians also have this feature but extant, or living, crocodilians (like in the skull pictured) lost this feature. However, living crocodilians, birds, and dinosaurs do share a mandibular fenestra, which is an opening in the lower jawbone.	12. Students should identify similar characteristics in three (dinosaur, crocodile, bird) out of the four skulls and determine what we can learn about dinosaurs from looking at these fossils. *Possible response(s):* **R1:** The archosaurs are distinguished by one opening on both sides of the skull, each positioned in front of the eyes. **R2:** Dinosaurs are related to crocodiles and birds. Dinosaurs, crocodiles and birds all share a common ancestor.
13. Pass out the **Archosauria phylogenetic tree printout**. *Question(s):* **Q1:** What does this image represent? a. Share that paleontologists hypothesize that living birds are part of the Dinosauria lineage, which means birds are avian dinosaurs. For extinct animals as old as non-avian dinosaurs, the only evidence they left behind are preserved remains of physical structures, fossils, like the ones we observed earlier.	13. Students should observe the **Archosauria phylogenetic tree printout** and discuss with their group what it could represent. They should listen to their peers' ideas and to the instructor when explaining the model. *Possible response(s):* **R1:** This is a model representation of an evolutionary hypothesis. The trunk represents an ancestral lineage, with each branch representing a descendant.

Body of the lesson: ***In this part of the lesson, students will compare physical similarities and differences of related animals to make hypotheses about which are most closely related. They will then compare given genetic information to check if their hypotheses are correct.***	
What the Facilitator Does	**Anticipated Behaviors/Responses from Students**
1. Guide students to begin thinking about or discussing DNA by asking them to recall the banana and human genomic similarities. a. Share that in addition to morphological similarities (which they observed), they can look at genetic material including DNA, RNA and proteins to further support or contradict evolutionary hypotheses. b. Through the next part of this lesson, students will look at different sets of animals to explore how scientists have used DNA to determine animal lineages.	1. Students should listen and engage in discussion when prompted.
2. Pass out one **Animal set** to each group. These include the Red panda, Short-Beaked echidna, Baird's tapir and West Indian manatee sets. Each set includes an image of the full body external morphology of each animal and their genetic data. *Question(s):* **Q1:** Which two organisms are most closely related to the main organism? The main organism is labeled on the photo. a. Tell students to record their hypothesis and observations in question 4. b. During this time, walk around the classroom and assist groups who need additional help while encouraging quiet students to participate in the discussion.	2. Students will make observations based on the morphology of each organism and will record these observations. a. They will then determine, with their groups, which organism is most closely related to the main organism. Students will record this hypothesis.
3. Ask each group to share their main organism and state their hypothesis about which of the two other organisms is most closely related to the main one.	3. Students will share the organisms found in their sets, their hypotheses, and the evidence they used to make their hypothesis. During this time, students will listen to their peers, ask questions when appropriate and engage in the discussion.

4. Next, explain that students will test their observations using the data provided. This data compares the genetic material of these organisms. This will give them more evidence that may or may not support their hypotheses. a. Share that the data they will be using is commonly used for genetic research. The first source of data is GenBank, which is the NIH genetic sequence database, and the second is the NIH Basic Local Alignment Search Tool, or BLAST. b. Both databases can be used to view and compare the genetic information of organisms. It can be used to see how closely two organisms are related to one another.	4. – 5. Students will be attentive and ask questions as needed. Students will listen to the instructions and ask questions as needed. They will look over the genetic information with their groups and complete the table in question 4.
5. Ask students to look at the genetic data with their groups. Explain that there is a table with two different organism names (the two organisms that they were comparing to the main organism), a query cover percentage, and a percent identity. Tell students that this information is only for the two organisms they are comparing to the main organism. a. Explain that **query cover** refers to the overlap between the two sequences and **percent identity** shows how much of that overlap is identical. If species have high percent identity and low query cover, that means that even though not as much of their genetic information overlap, a high percentage of it is identical. The species with high percent identity and high query cover represent those that are most closely related. b. Tell students to record the **query cover** and **percent identity** in question 4.	

Conclusion:
At the end of the lesson, students will draw conclusions about which animal is most closely related to their main organism. They will share this information with the other groups and discuss how these results differed from their original hypotheses.

What the Facilitator Does	Anticipated Behaviors/Responses from Students
1. Conclude the lesson by asking students to think about the data they used to determine which species are most closely related. *Question(s):* **Q1:** Using the provided genetic information, which organism is most closely related to the main organism? a. Give students time to decide as a group which species is most closely related to their main species based on the evidence provided. b. Ask if this information does or does not support their previous hypotheses, which they made based on morphological data. Students should record their answer in question 4.	1. Students will discuss in their groups which species is most closely related to their main species. Once they have decided, record whether this information does or does not support their initial hypothesis. a. Each group will share this information with the class.
2. Prompt students to provide evidence as to why they believe the two species are closely related. Here, they should think back on the similarities in morphological characteristics and the similarities in genetic information. a. Tell students that scientists will never say their hypothesis is wrong or incorrect but will say that they reject their hypothesis or that the data does not support their hypothesis. b. Ask each group to share their data with the class.	2. Students will justify their decision based on the evidence provided throughout this lesson.

Clean-up Procedure

- Collect all the photographs and genetic data printouts from students. Make sure they are each in their respective sets.
- Sanitize the laminated printouts to remove any dry erase marker.
- Collect and sanitize dry erase markers and pencils.

Additional Resources

- GenBank - *https://www.ncbi.nlm.nih.gov/genbank/*
- BLAST - *https://blast.ncbi.nlm.nih.gov/Blast.cgi*
- Archosaur Phylogenetic Tree - *https://www.researchgate.net/figure/Digital-models-of-the-studied-fossil-theropod-and-extant-archosaur-taxa-in-a-simplified_fig1_283889260*
- Phylogenies - *https://evolution.berkeley.edu/evolution-101/the-history-of-life-looking-at-the-patterns/understanding-phylogenies/*
- Archosaurs - *https://ucmp.berkeley.edu/diapsids/archosauria.html*
- Dinosaurs - *https://ucmp.berkeley.edu/diapsids/dinomm.html*
- Taxonomy - *https://bio.libretexts.org/Courses/Prince_Georges_Community_College/PGCC_Microbiology/04%3A_Microscopy_Staining_and_Classification/4.03%3A_Classification_and_Identification*
- Levels of Classification - *https://bio.libretexts.org/Bookshelves/Microbiology/Microbiology_(Boundless)/08%3A_Microbial_Evolution_Phylogeny_and_Diversity/8.03%3A_Microbial_Phylogeny/8.3C%3A_The_Levels_of_Classification*
- Red Panda Case Study - *https://teach.genetics.utah.edu/content/evolution/ancestry/pdfs/panda-case-study.pdf*

DNA Discoveries Datasheet

Group Name:____

1. Fossil Sorting: Make observations about the structures of each organism. Record these in the **Observations** column. Then, create categories based on the similarities or differences you see and write them underneath the table where it says **Categories**. Finally, explain your reasoning behind choosing the categories where it says **Evidence**.

Specimen	Observations

Categories: What categories are you grouping these specimens into?

Evidence: Explain your reasoning based on evidence.

2. Hand Structures: As a group, closely look at the images provided. Make observations about each and record these in the **Observations** column. Based on their morphology, which animals do you think are most closely related? Write your hypothesis on the next page where it says **Record your hypothesis** and explain the reasoning for your hypothesis where it says **Evidence.**

Specimen	Observations

Record your hypothesis: Which specimens are most closely related?

Evidence: Explain the reasoning for your hypothesis based on evidence.

3. Skull Structures: Using a dry erase marker on the laminated images, show the similarities and differences between the animals.

4. Morphological and Genetic Investigation: Use the images provided to determine which animal is most closely related to the main organism. Make a hypothesis and record it where it says **Record your hypothesis** before making your observations and recording them in the **Morphological Observations** column.

Record your hypothesis: Which animal is most closely related to the main organism?

Remember
The higher the query cover, the more overlap, or alignment there is between the two sequences. Percent identity shows how much of that overlap is identical.

Animal	Morphological Observations	Query Cover (%)	Percent identity (%)

Which animal is most closely related to the main organism? Did genetic data support or not support your hypothesis? Why?

DNA Discoveries Datasheet: Instructor Answer Key

Group Name:____

1. Fossil Sorting: Make observations about the structures of each organism. Record these in the **Observations** column. Then, create categories based on the similarities or differences you see and write them underneath the table where it says **Categories**. Finally, explain your reasoning behind choosing the categories where it says **Evidence**.

Specimen	Observations
Sea lily	*No obvious skeleton, may have an endoskeleton. Stem-like stalk supporting thin, small arms.*
Ammonite	*Exoskeleton composed of a single, tightly spiraled shell.*
Horseshoe crab	*Exoskeleton composed of at least three separate plates or pieces.*
Fish	*Endoskeleton with vertebrae. Some cartilage is preserved. Seven cartilage fins.*
Reptile	*Endoskeleton with vertebrae. Four limbs. Long neck and tail.*

Categories: What categories are you grouping these specimens into?

Types of support

1. Stem-like stalk
2. Exoskeletons
3. Endoskeletons with vertebrae

Evidence: Explain your reasoning based on evidence.

Fossil evidence shows the different skeletal structure of different organisms. Some organisms had stem-like stalks, some had exoskeletons, and some had endoskeletons with vertebrae. While the organisms could be sorted into other broader categories, like vertebrate and invertebrate, these categories are less specific and do not provide as much information. For example, this would have grouped the sea lily with the ammonite and horseshoe crab, which both have obvious exoskeletons.

2. Hand Structures: As a group, closely look at the images provided. Make observations about each and record these in the **Observations** column. Based on their morphology, which animals do you think are most closely related? Write your hypothesis on the next page where it says **Record your hypothesis** and explain the reasoning for your hypothesis where it says **Evidence.**

Specimen	Observations
Human hand	*Round bones. Five fingers, each with three joints.*
Dolphin flipper	*Flat bones. Five fingers. Two fingers have one bone with no joints, one finger has two joints, and two fingers have six joints.*
Fish fin	*No bones. Flat, cartilage rays/spines.*

Record your hypothesis: Which specimens are most closely related?

The relationship between dolphins and humans is closer than the relationship between dolphins and fish or humans and fish.

Evidence: Explain the reasoning for your hypothesis based on evidence.

The dolphin flipper and the human hand both have bones instead of cartilage. The bones in these appendages also each have five fingers.

3. Skull Structures: Using a dry erase marker on the laminated images, show the similarities and differences between the animals.

4. Morphological and Genetic Investigation: Use the images provided to determine which animal is most closely related to the main organism. Make a hypothesis and record it where it says **Record your hypothesis** before making your observations and recording them in the **Morphological Observations** column.

Record your hypothesis: Which animal is most closely related to the main organism?

This section will vary based on the animal set. For example, the red panda (Aliurus fulgens) is more closely related to the raccoon (Procyon lotor) than the giant panda (Ailurododa melanoleuca).

Remember
The higher the query cover, the more overlap, or alignment there is between the two sequences. Percent identity shows how much of that overlap is identical.

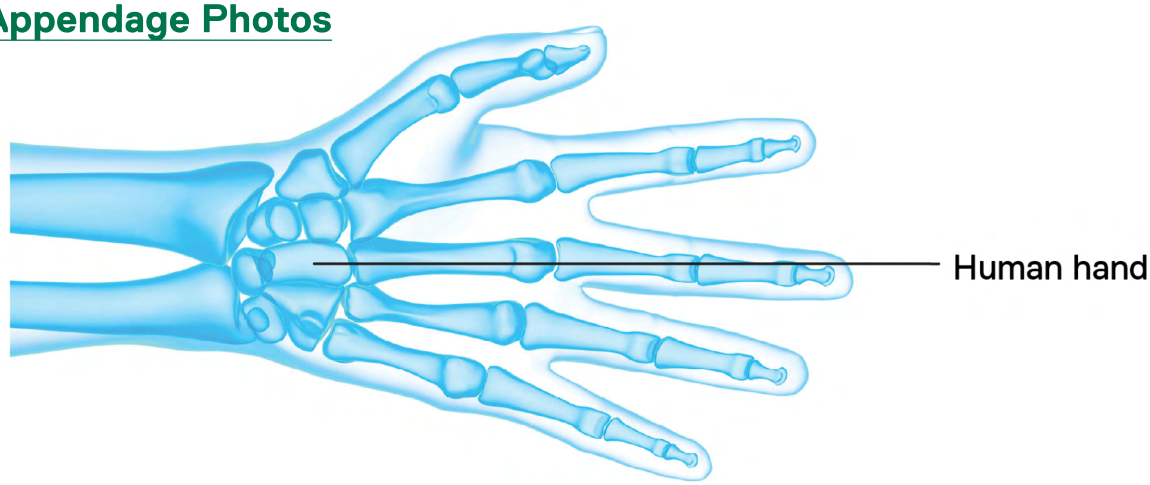
Animal	Morphological Observations	Query Cover (%)	Percent identity (%)
Red panda (Ailurus fulgens)	*Pointed ears. Five fingers. Medium wrist bone. Long tail.*		
Raccoon (Procyon lotor)	*Pointed ears. Five fingers. Small wrist bone. Short tail.*	*98*	*81*
Giant panda (Ailurododa melanoleuca)	*Rounded ears. Five fingers. Long wrist bone. Long tail.*	*96*	*81*

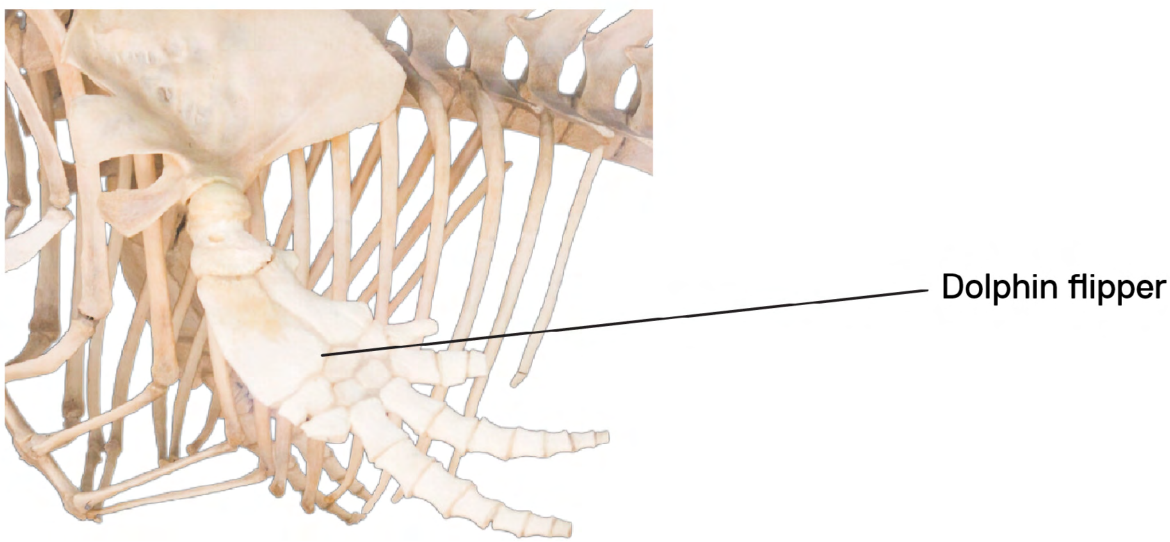
Which animal is most closely related to the main organism? Did genetic data support or not support your hypothesis? Why?

The red panda and the raccoon had a larger overlap in their DNA (query cover) than the red panda and the giant panda. Of these overlaps, both the raccoon and the giant panda had the same amount of identical DNA (percent identity). This means that the red panda shares more DNA with the raccoon than the giant panda, supporting my hypothesis.

Fossil Photos

Appendage Photos





Skull Photos

Dinosaur

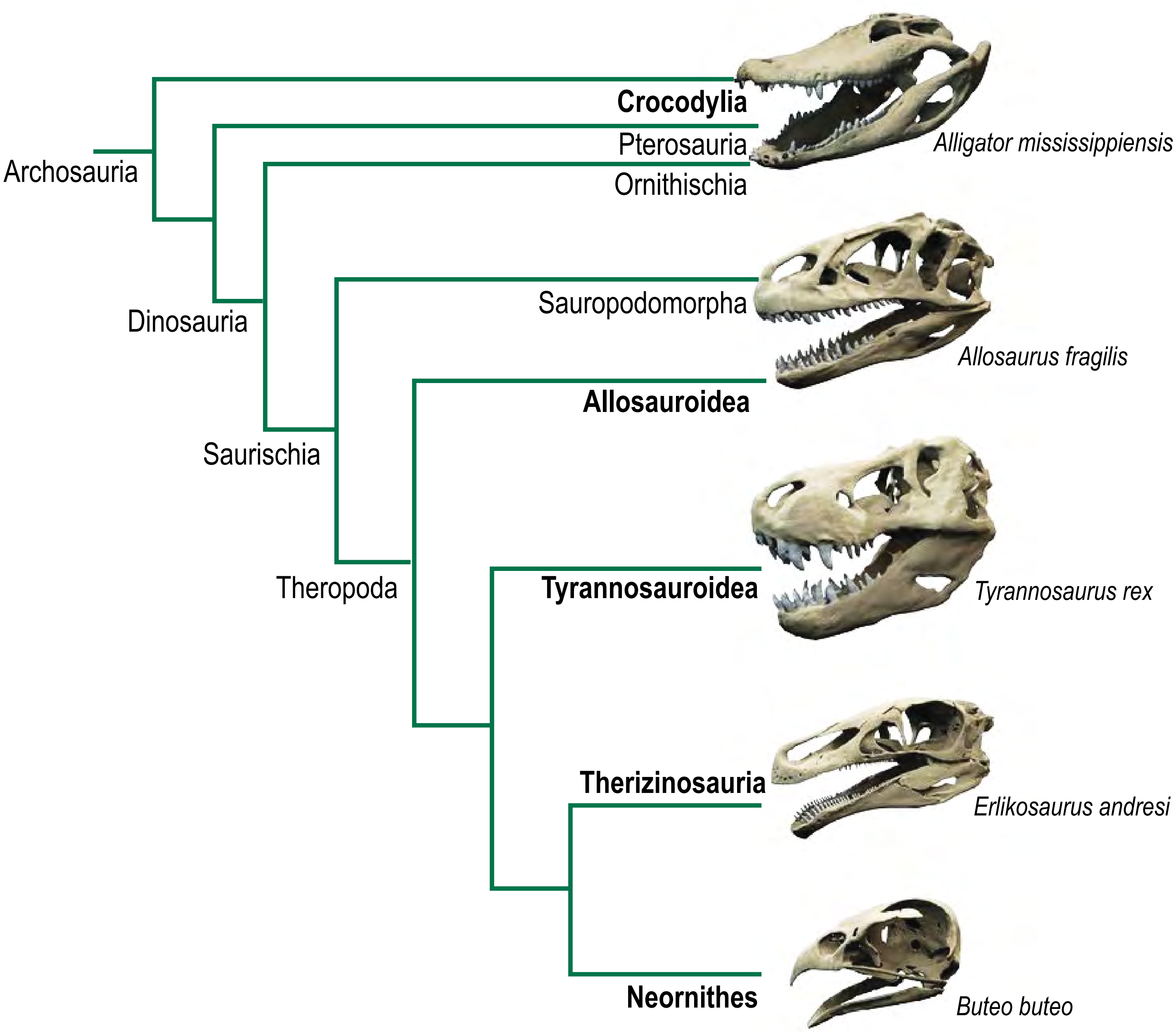
Bird

Crocodile

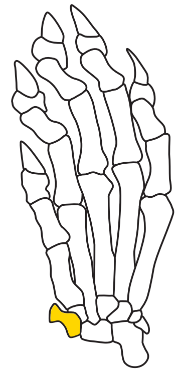
Mammal

Skull photographs sourced from Canva.com

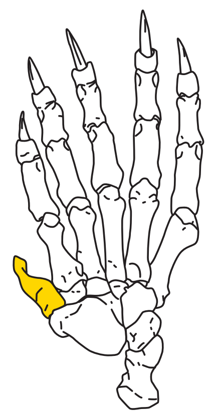
Archosauria Phylogenetic Tree



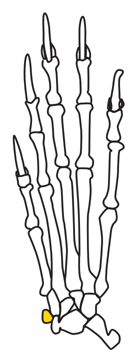
Red panda



Red panda

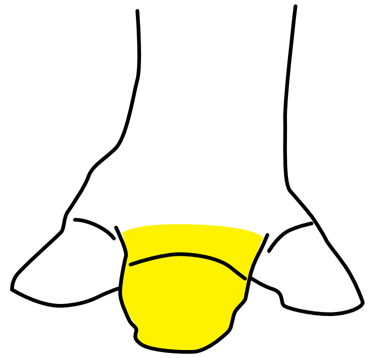


Giant panda

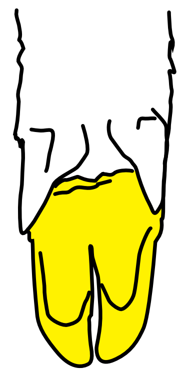


Racoon

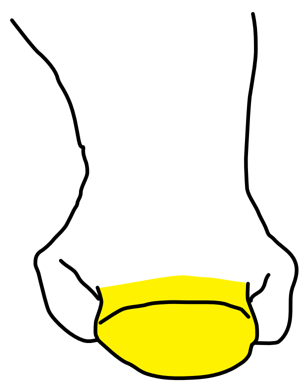
Baird's tapir



Baird's tapir

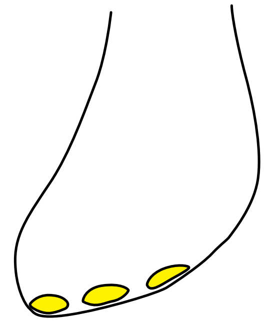


Wild boar

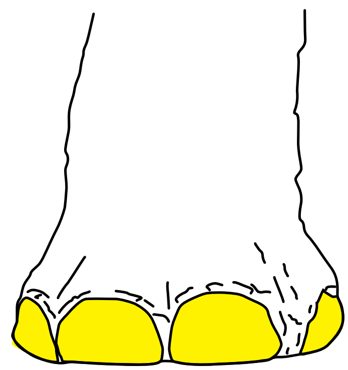


Black rhino

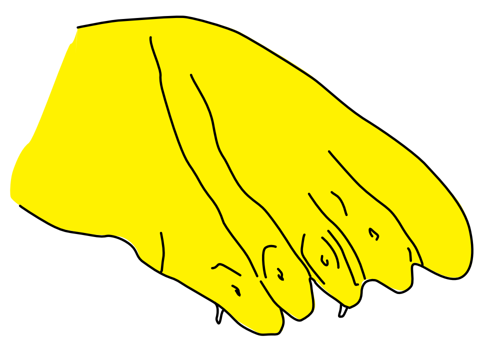
West Indian manatee



West Indian manatee

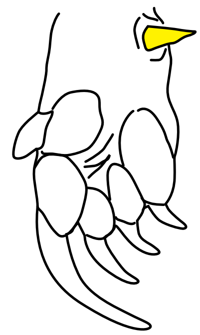


Asian elephant

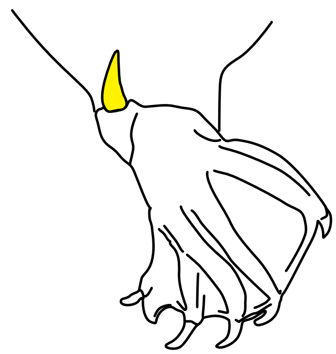


Atlantic walrus

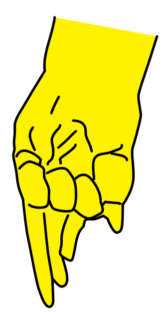
Short-beaked echidna



Short-beaked echidna



Platypus

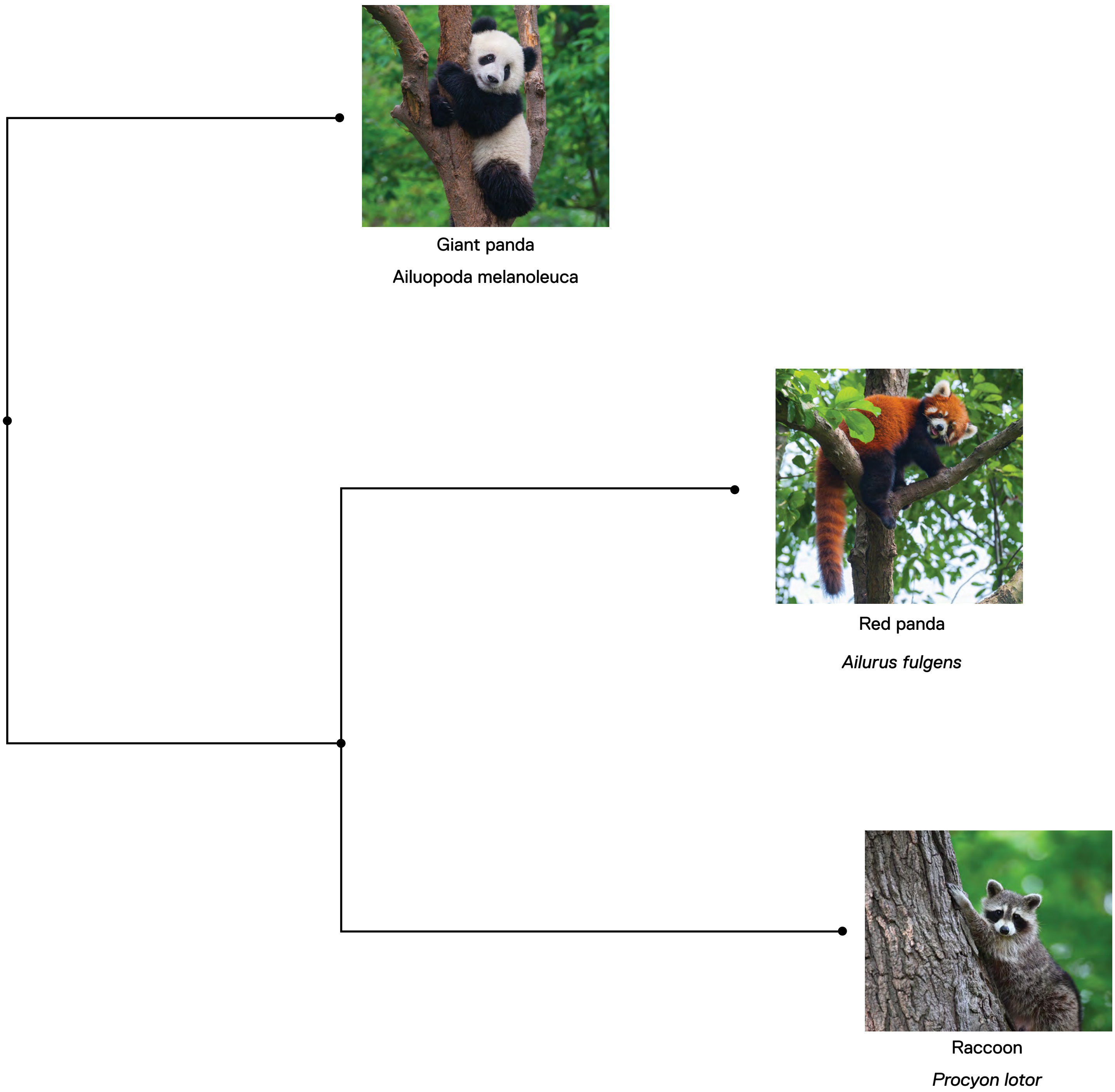


European hedgehog

Animal photographs sourced from Canva.com; Appendage illustrations from Frost Science

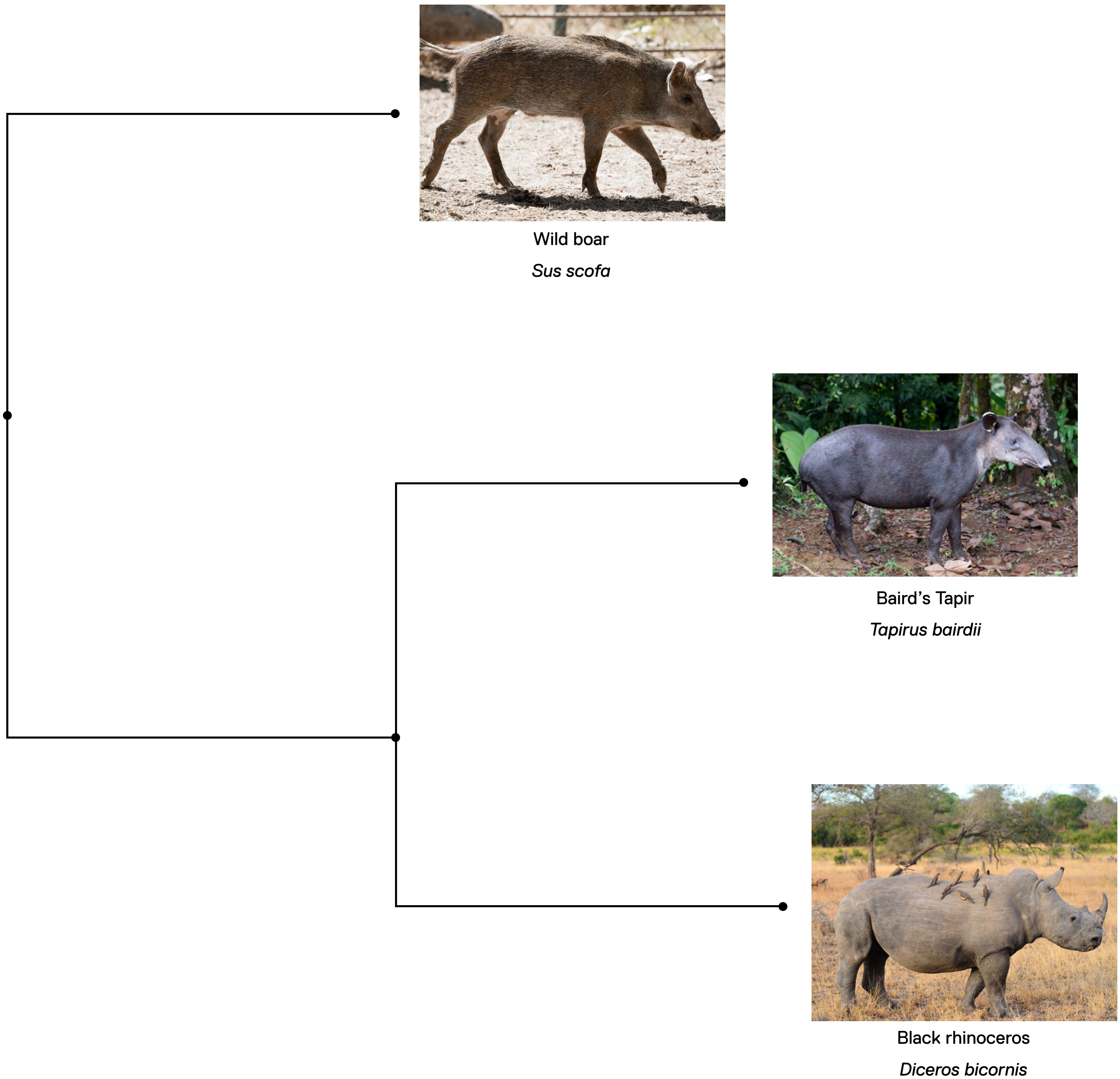
Red Panda Genetic Data

Red panda (*Ailurus fulgens*)		
Animal	Query Cover (%)	Percent Identity (%)
Raccoon (*Procyon lotor*)	98%	81%
Giant panda (*Ailuropoda melanoleuca*)	95%	81%



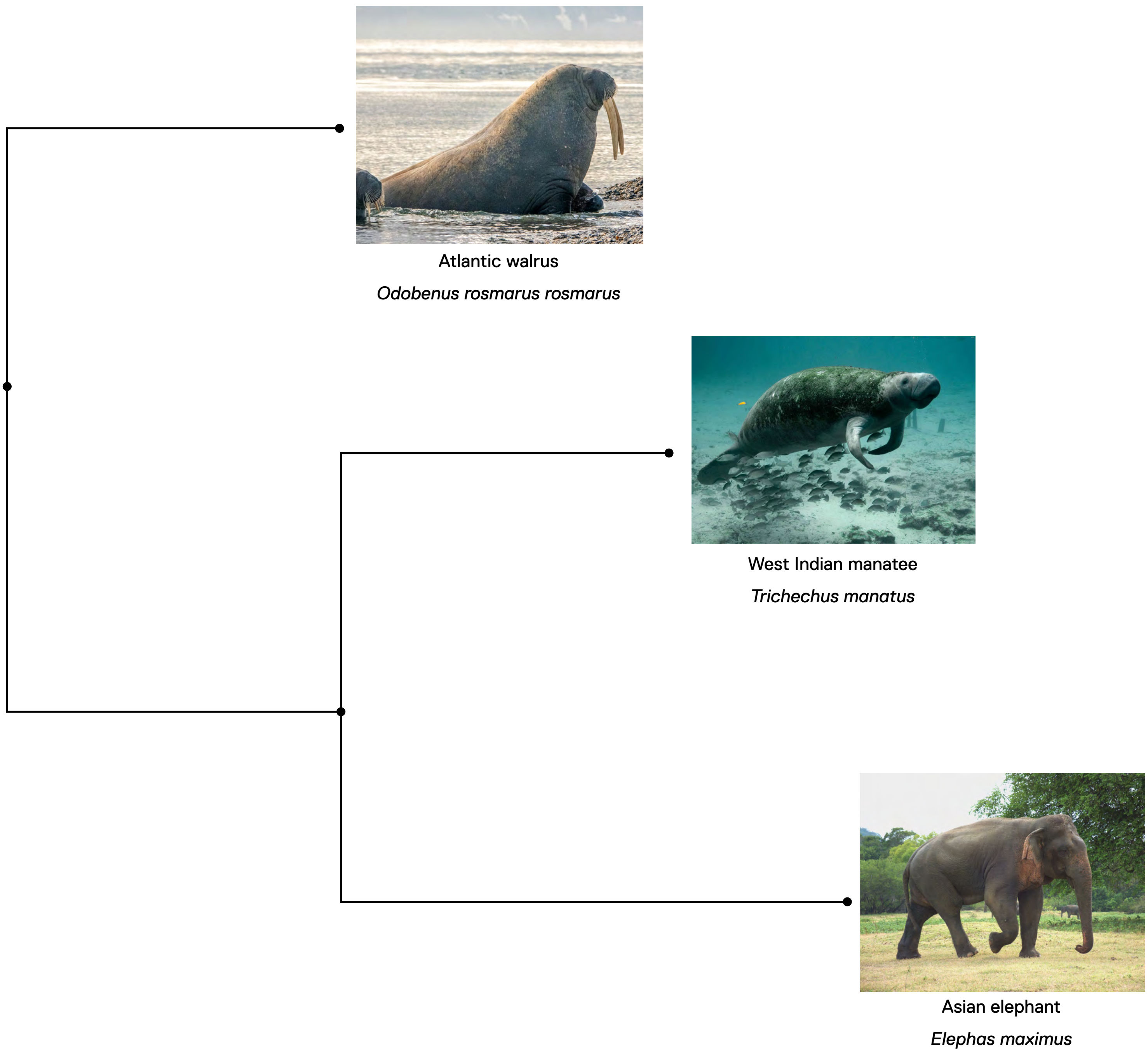
Baird's Tapir Genetic Data

Baird's tapir (*Tapirus bairdii*)		
Animal	Query Cover (%)	Percent Identity (%)
Wild boar (*Sus scrofa*)	96%	85%
Black rhinoceros (*Diceros bicornis*)	95%	81%



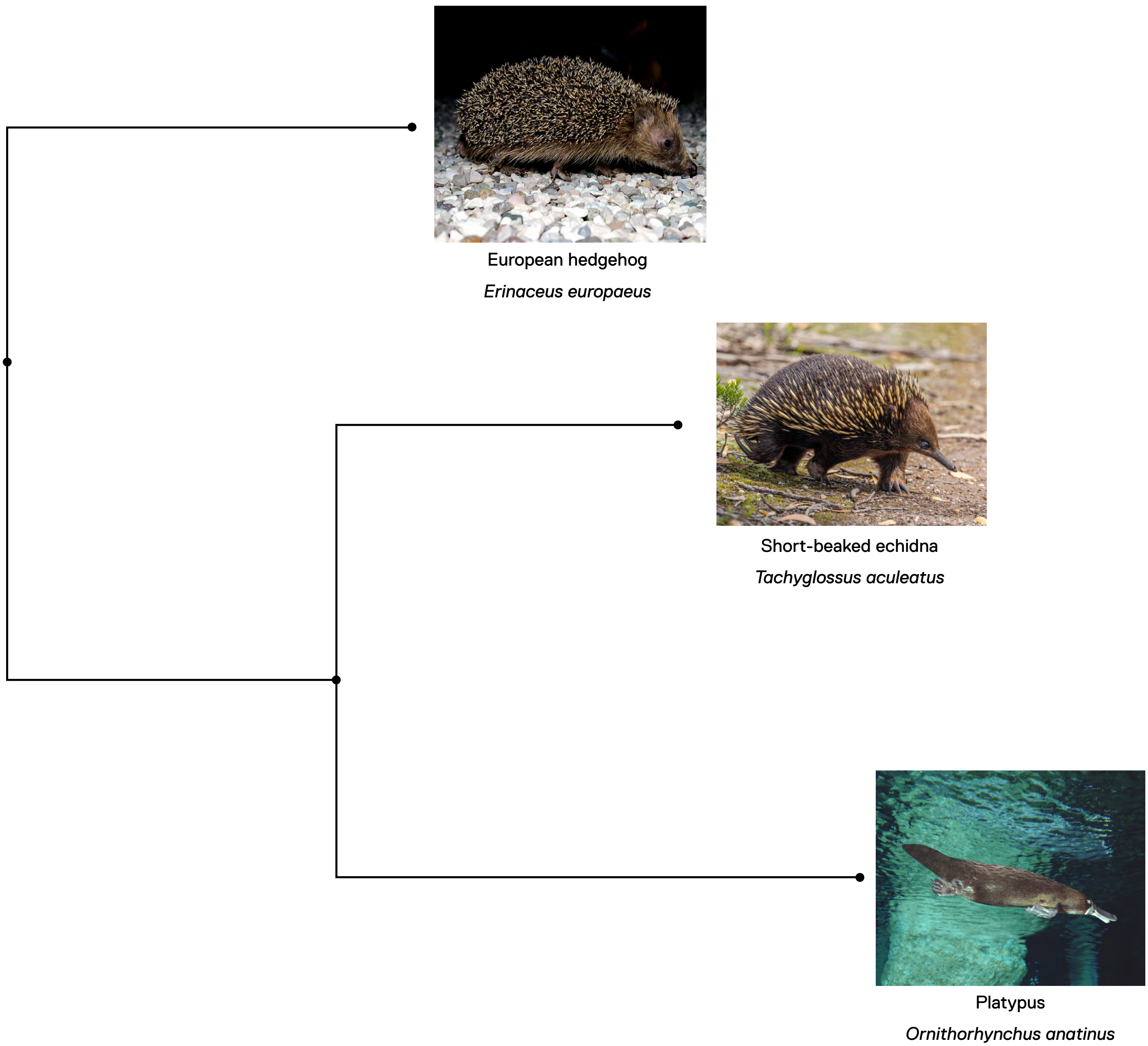
West Indian Manatee Genetic Data

West Indian manatee (*Trichechus manatus*)		
Animal	Query Cover (%)	Percent Identity (%)
Asian elephant (*Elephas maximus*)	97%	79%
Atlantic walrus (*Odobenus rosmarus rosmarus*)	79%	77%



Short-Beaked Echidna Genetic Data

Short-beaked echidna (*Tachyglossus aculeatus*)		
Animal	Query Cover (%)	Percent Identity (%)
Platypus (*Ornithorhynchus anatinus*)	95%	83%
European hedgehog (*Erinaceus europaeus*)	42%	75%



NOTES

DNA DISCOVERIES

Curriculum developed by: Mikaela Arena, Analisa Duran and Jamie Maingot

PHILLIP & PATRICIA FROST MUSEUM OF SCIENCE

1101 Biscayne Blvd., Miami, FL 33132 I 305-434-9600 @FROSTSCIENCE

The Phillip and Patricia Frost Museum of Science is supported by the Miami-Dade County Department of Cultural Affairs and the Cultural Affairs Council, the Miami-Dade County Mayor and Board of County Commissioners of Miami-Dade County. This project is supported by the Building Better Communities Bond Program and the City of Miami. Sponsored in part by the State of Florida, Department of State, Division of Arts and Culture, the Florida Council on Arts and Culture, and the National Endowment for the Arts. The museum is accredited by the American Alliance of Museums, is an affiliate of the Smithsonian Institution and a member of the Association of Science and Technology Centers.