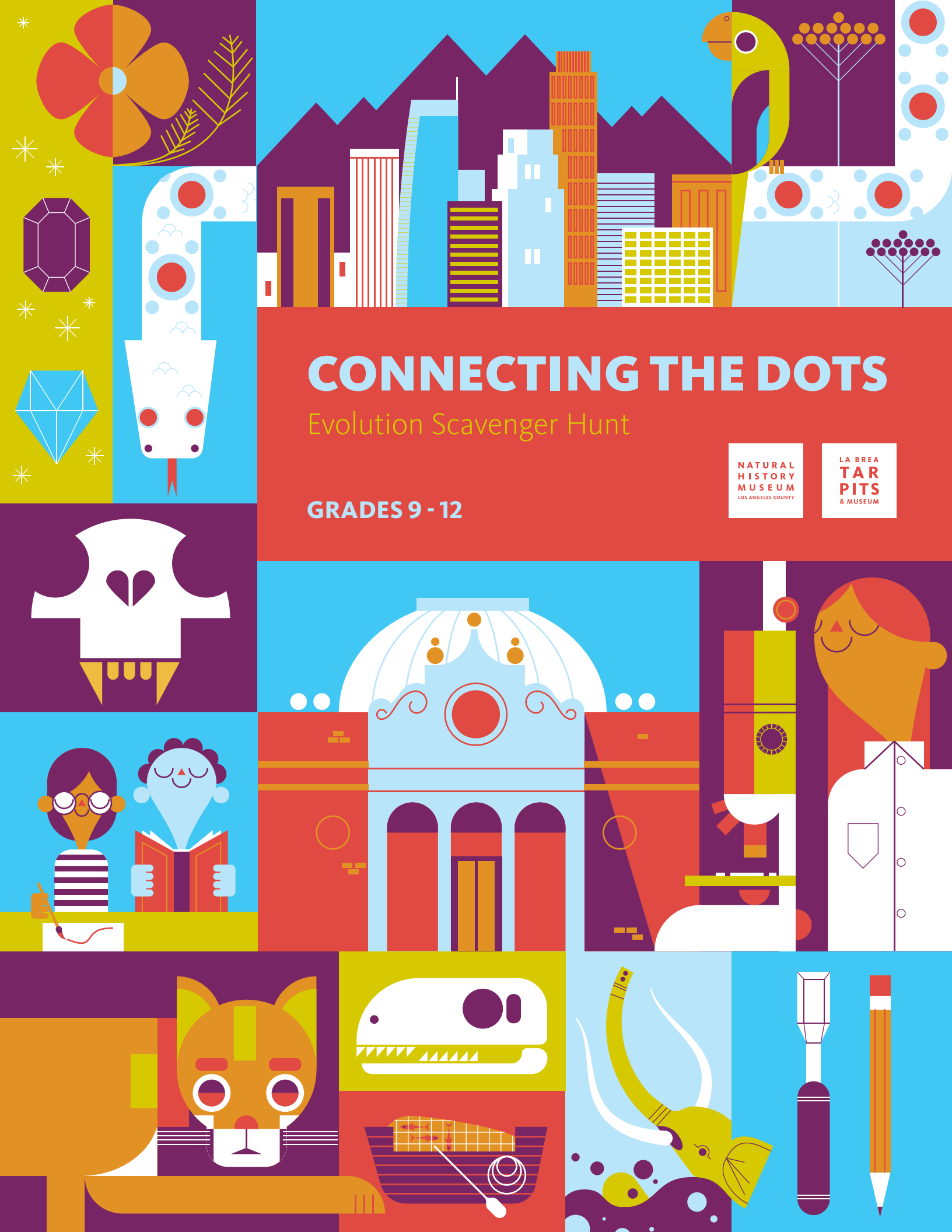

CONNECTING THE DOTS

Evolution Scavenger Hunt

NATURAL HISTORY MUSEUM LOS ANGELES COUNTY

LA BREA TAR PITS & MUSEUM

GRADES 9 - 12

NAME:

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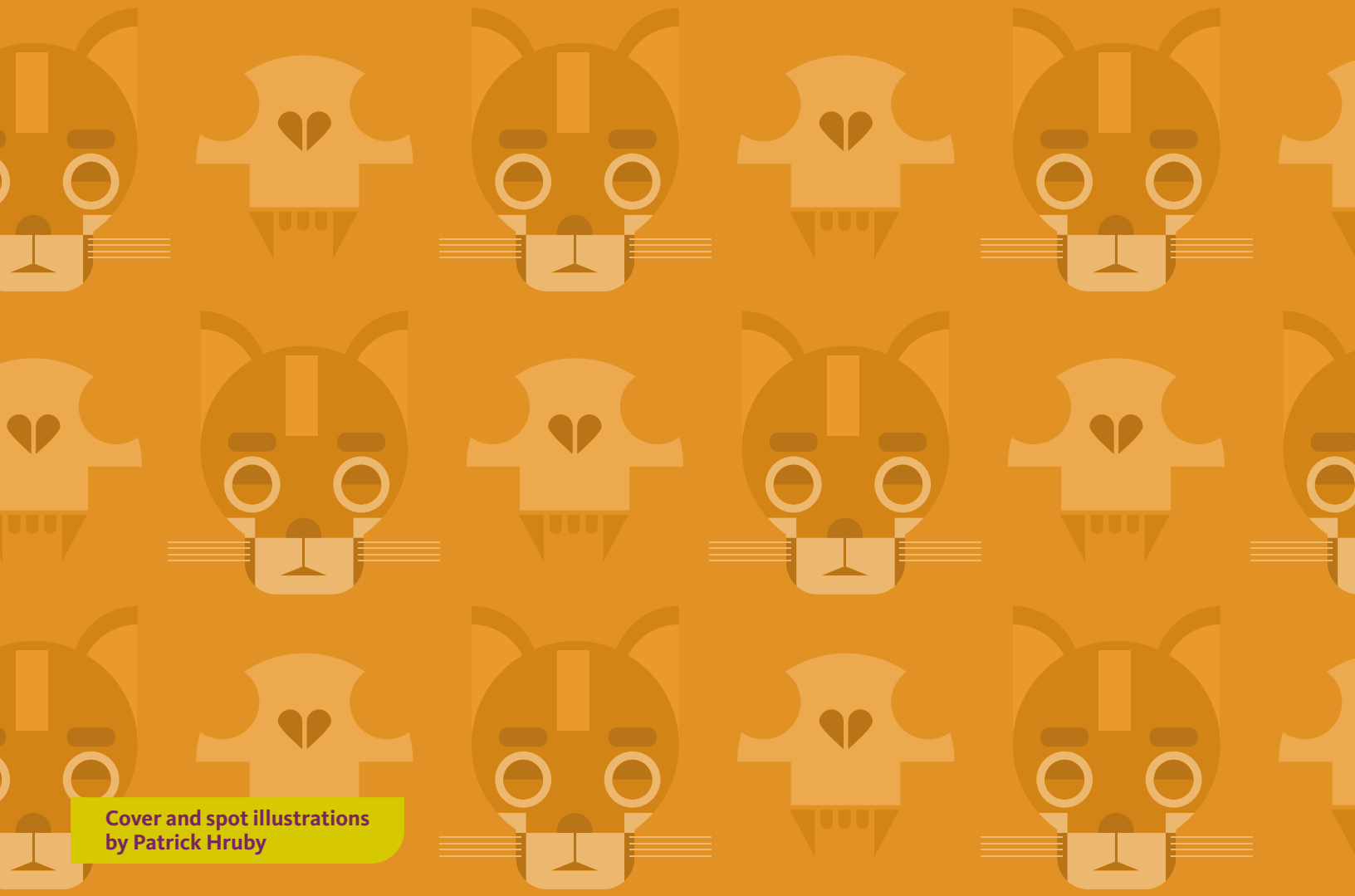


Cover and spot illustrations
by Patrick Hruby

CONNECTING THE DOTS

Evolution Scavenger Hunt

GRADES 9–12

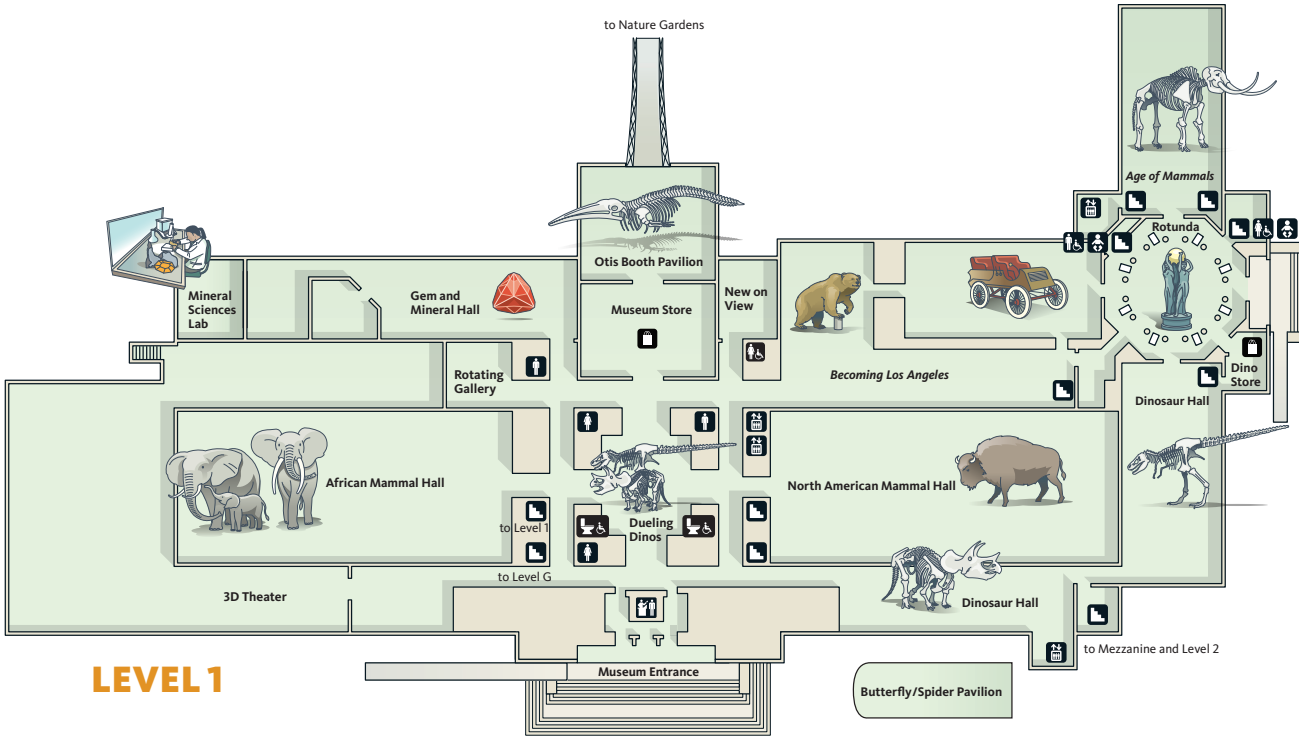
INTRODUCTION

We're looking for clues about our ancestors! We'll be going on a trip around the Natural History Museum to learn more about some animals in the museum and our evolutionary history. Ready to get started? If we look at the organisms alive on our planet today, we would find that many of them share a recent common ancestor. As we explore the museum, we'll identify some of these ancestors and traits they share with their living relatives – and look to explain connections that support the theory of evolution!

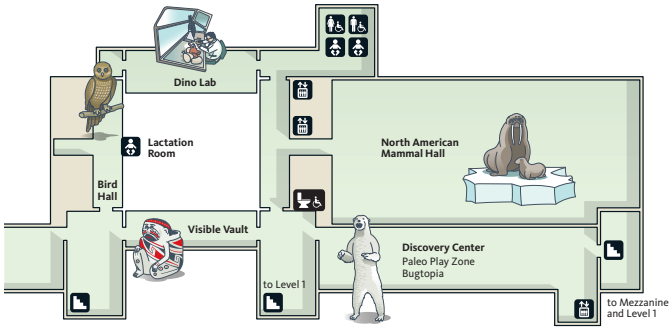
MATERIALS

- Writing utensil
- Mobile phone (if permitted)

TABLE OF CONTENTS



LEVEL 1



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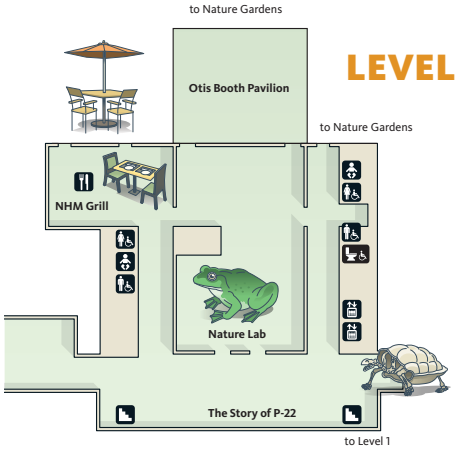

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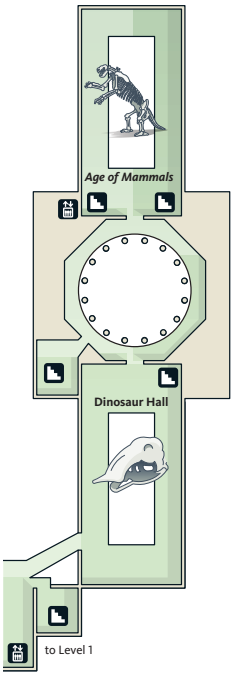


LEVEL 2 ROTUNDA

VOCABULARY

As you work on this scavenger hunt, jot down any new or interesting vocabulary words you find in this guide or on museum labels that you'd like to remember later. When you're back in the classroom, look up the definitions to each word and add them below:

WORD	DEFINITION
Evolution	The change in the characteristics of an organism or across species over several generations

LET'S BEGIN!

Charles Darwin was a British naturalist, geologist, and biologist who made invaluable contributions to the study of ***evolution***, or **the change in the characteristics of an organism or across species over several generations.** Darwin traveled extensively by ship in the 1830s, observing the natural world by taking scientific notes and illustrations throughout his journey. He was one of the first to publish his ideas about the evolution of life on Earth.

Some of his most well-known findings were on the Galapagos Islands, which are off the coast of Ecuador in South America. On these islands, he famously studied some feathery friends and their unique adaptations.

CLUE #1:

Take a close look at the map of the museum on the previous page. Which hall would be the best place to learn more about BIRDS?

Write the name of that exhibit below and head that way!

ACTIVITY 1

BIRDY ADAPTATIONS

Just as you might use different tools to perform different functions, different traits or characteristics of organisms work best under different circumstances, or ***selective pressures***. Examples of selective pressures include shortage of a particular food because of environmental change, female preference for larger or more colorful males, or the presence of a particular predator on the landscape. If there are a variety of traits in a group of organisms, the individuals with advantageous traits – **traits that perform well under these selective pressures** – will survive to pass on their genes to the next generation. These advantageous traits are called ***adaptations***, and can include traits for hunting, mating, and – very importantly – not getting eaten!

In this first stop, we'll look at some preserved birds on display in order to understand the structure and function of different species' beaks and how they evolved.

Find two birds in this room that look similar but have different beaks. Sketch each of these birds in the boxes below:

BIRD #1 _____

Draw the first bird here:

Where do you think this bird lives? Describe what its habitat might be like:

_____

_____

_____

What do you think this bird eats?

_____

_____

_____

BIRD #2 _____

Draw the second bird here:

Where do you think this bird lives? Describe what its habitat might be like:

_____

_____

_____

What do you think this bird eats?

_____

_____

_____

Why do you think these birds' beaks are different, even though the birds look similar?

Let's take a look at these two graphs showing the distribution of beak size for ground finches in two separate years: 1976 (the top graph) and 1978 (the bottom graph).

Using the information presented in the graphs and the word bank, fill in the blanks to determine what happened to ground finch beaks in those two years:

Grants' Finch Study Data

Figure 1

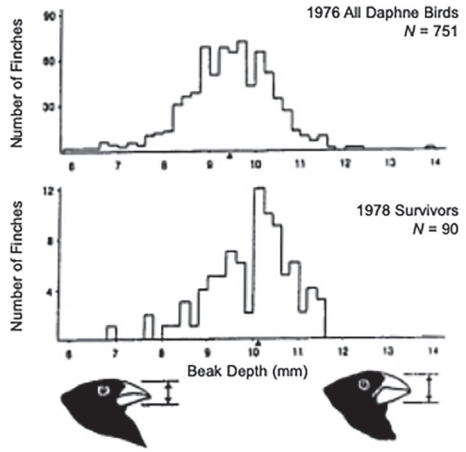


Figure 1: Histogram of distribution of beak depth of medium ground finches (*Geospiza fortis*) on Daphne Major, before and after the drought of 1977 (Grant 1986). Reprinted by permission of Princeton University Press.

WORD BANK

fewer
more
bigger
smaller
beak
drought
number
survive
right

The y–axis, or vertical (up-and-down) axis, shows the _____ of finches. The x–axis, or horizontal (side-to-side) axis, shows the _____ depth (or size) in millimeters. According to the description, there was a _____ in 1977. In 1978, there were _____ finches than in 1976. From this, we can infer (or make an educated guess) that many finches did not _____ the drought.

Take a closer look at the distribution, or the spread, of data in the lower graph. In 1978, there were fewer finches overall. However, the bars on this graph have shifted to the _____. This means that of the surviving finches, more of them had _____ beaks.

Hypothesize: Why did the finch populations in 1978 have bigger beaks?
Hint: Think about the connections between drought, access to food, and their beak shape.

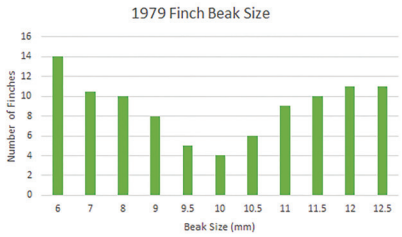
_____

_____

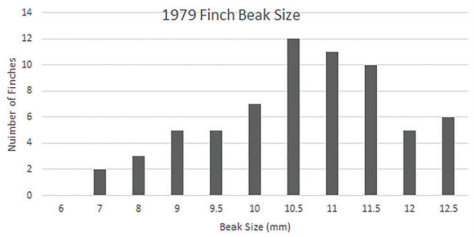
_____

Predict: If the finches who survived the drought in 1977 reproduced and passed on their genes to their offspring, what would the graph of beak depth for 1979 look like? Circle the best option:

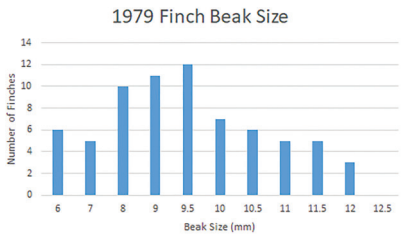
A



B



C



CLUE #2:

Take a close look at the map of the museum on the first page. Which hall would be the best place to learn about animals on THIS CONTINENT? Write the name of that exhibit below and head that way!

Hint: There are two different halls with this same name – you want to go to the one on Level 2!

_____

ACTIVITY
2

CAT COUSINS

We've now arrived in North America! Here, we'll look at how related animals with the same (or very similar) characteristics could have evolved on different continents – we'll think about why that might happen and how this helps support the theory of evolution.

Find the Canadian lynx diorama in this exhibit. Draw a scientific illustration, or detailed sketch, of the animal and its habitat. Then, read the description on the display and write a few complete sentences about the animal:

Draw the Canadian lynx below:

Where does it live? What is its habitat like? What do you think it eats?

CLUE #3:

Take a close look at the map of the museum on the first page. In which hall do you think you might see a GIRAFFE? Write the name of that exhibit below and head that way!

ACTIVITY
3

COMPARE & CONTRAST

At our last stop, we took a closer look at the Canadian lynx. At this stop, we'll look at a relative of the Canadian lynx and see if we can explain how and why these animals have similar characteristics – even though they live on different continents!

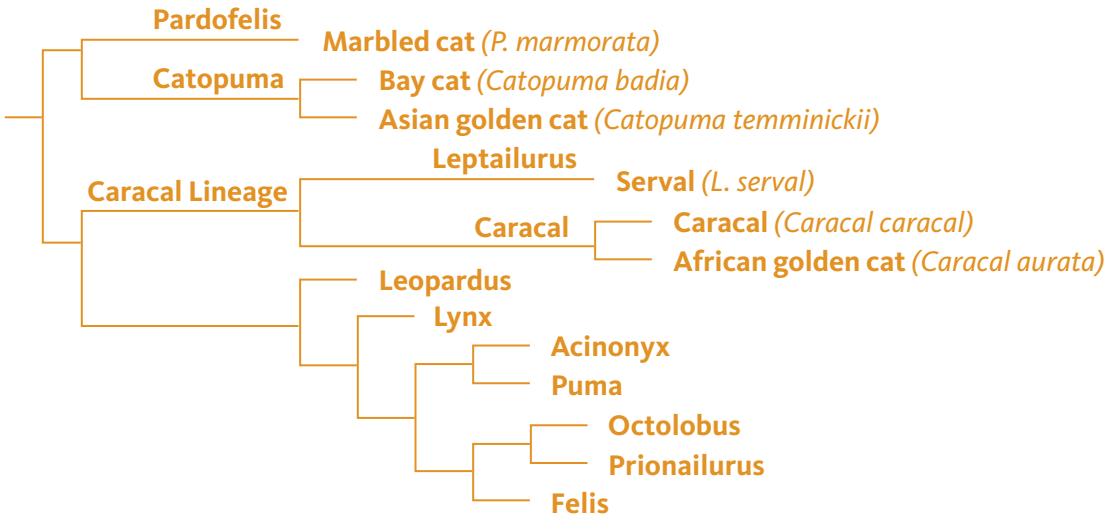
Find the African serval diorama in this exhibit. Draw a scientific illustration, or detailed sketch, of the animal and its habitat. Then, read the description on the display and write a few complete sentences about the animal:

Draw the African serval below:

Where does it live? What is its habitat like? What do you think it eats?

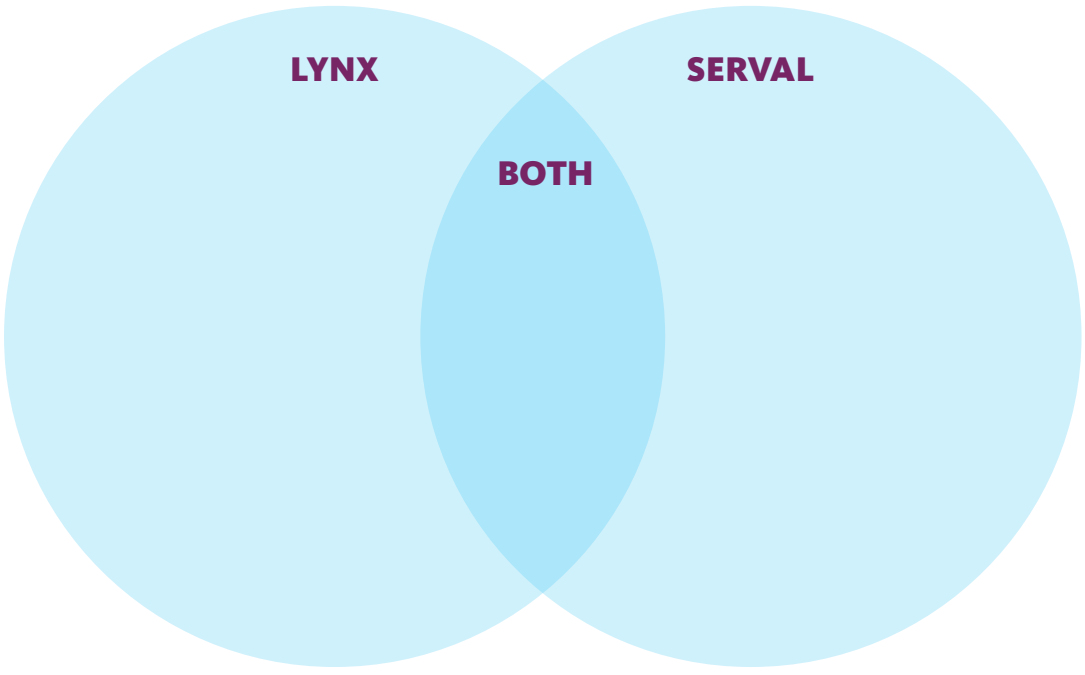
Let's think a little more about the connections between these two animals and continents: the lynx in North America and the serval in Africa. A ***phylogenetic tree*** is like a family tree that represents evolutionary relationships between different organisms.

Take a look at the phylogenetic tree below showing the connections between different species of cats. Find and circle the lynx, then find and circle the serval:



Look back at your drawings and observations of these two animals. What are some traits or characteristics that these two animals have in common? What are some traits or characteristics that are different?

Using the Venn diagram below, write traits of the lynx in the left circle, write traits of the serval in the right circle, and write traits that are similar for both where the circles overlap:



Hypothesize: How is it possible that two animals that are related to one another and share some common traits exist on different continents? Use prior knowledge or make an educated guess. Be specific in your explanation:

CLUE #4:

You, Charles Darwin, the Canadian lynx, and the African serval all belong to a specific class of animals called _____ . Take a close look at the map of the museum on the first page and look for a hall called the "Age of _____ ." Head that way next!

ACTIVITY 4

OUR PLANET'S BIOGEOGRAPHY

Once you've made your way into this exhibit, look for a big video screen on the first floor. Watch the first minute of the video and describe what you see. What is happening to Earth's continents?

The study of biology that focuses on where living things are found on our planet (and how they got there) is called ***biogeography***!

Using information from the video about how the continents have moved, what inference can you make about how the two cats we learned about can be related but live on different continents?

____

____

CLUE #5:

Using the code below, solve the word puzzle to figure out where to go for your next stop!

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
O	G	P	U	S	A	T	I	R	N	D	F	H	E	X	B	C	W	L	J	M	K	Z	Y	V	Q

H J G M H E N O M H P H G, B A D C E G O R I E F J K L H J K G M N

__ ____ ________, __ _________ ___ ____ ___

F J Q N E G A I A L G M N E N F Q A R .

_________ __ ___ ___ ___.

ACTIVITY 5 REMNANTS OF THE PAST

Have you cracked the code? Find the animal and read the display card. Look closely at all the details of the animal's skeleton and do a quick sketch:

Draw the skeleton below:

Vestigial structures are parts of an animal's body that are "left over" from an ancestor. The descendant doesn't use that organ or body part anymore (maybe because the environment has changed and that old organ no longer offers an advantage in the new environment) but there is still evidence of it in an animal's body! These residual structures help show that living organisms have evolved in response to varying selective pressures over time.

Can you think of any vestigial organs or structures in humans? Jot down some of your ideas: *Example: Appendix*

1

2

3

Do you notice any vestigial structures on this animal's skeleton? Look really closely at the posterior (or rear-end) of this animal and see if you can find remnants of hind leg bones. **Once you've found them, circle them in your drawing** – or add them in if you didn't see them the first time!

The remnants of hind leg bones on this animal are vestigial structures because this animal doesn't use those appendages anymore. What do you think this might tell us about this animal's ancestors?

CLUE #6:

We're heading to our final stop! Look for a display in the exhibit you are currently in that looks like this: What part of the body is this display showing?

ACTIVITY 6

SIMILAR STRUCTURES

The panel in front of you shows the hand skeletons of various species. All of these species belong to the same class of animals. What is that group called again? *Hint: They are warm-blooded:*

Choose two of the hand skeletons and sketch them and label them:

HAND OF: _____ **HAND OF:** _____

Take a look at the display again. What do the colors on each hand signify?

Why are all of these hands different from one another?

Explain: How are these hands and the **homologous** bones, or bones that are similar due to shared ancestry, evidence that these animals might share a common ancestor?

EXPLAINING IT ALL

You've explored the museum, but do you know how some of the animals on display here are related? Using the word bank, help us fill in the blanks and explain what we learned about below:

WORD BANK

ancestor	traits	birds
hands	continents	environment
connected	mammals	vestigial structures

At our first stop, we noticed that animals like _____ might have similar _____, but parts of their body are different depending on what they eat or their habitat.

How did we explain the fact that there are related animals, like the Canadian lynx and African serval, that are found on completely separate _____ ? We saw that map that showed us the continents used to be _____ and that they moved over time!

As the continents moved, the animals moved with them. Some animals adapted to new environments and changed over time. Now we know that animals that are related but live on separate continents share a common _____ . And even if the continent doesn't move the individuals of a species physically apart, they can change if there are changes in their _____ , like the finches!

Some helpful clues, like _____ on living animals, show us what their ancestors used to be like because they inherited those parts from them, even if they don't use it anymore.

We share a more recent common ancestor with the lynx and serval because we are all _____ . One of the ways we saw evidence of this was looking at homologous structures in our _____ .

ACTIVITY 7

BONUS CHALLENGE: THE PLATYPUS

Somewhere in the museum, there is a taxidermied platypus.

Hint: It can be found in the oldest part of the Natural History Museum.

This animal has some very unique traits! Write down some of the platypus' characteristics (or features of its body) below:

1

2

What continent are platypuses found on? _____

The platypus is a very unique animal in that it is one of the only mammals that lay eggs! The only other animal that does this is called the echidna (and it also lives on the same continent as the platypus).

Can you think of some other animals that are found on that continent? Jot down a few below:

1

2

You may have written a few ***marsupials*** in the list above! These are animals that carry their young in a pouch.

Hypothesize: Given what you learn about biogeography in the scavenger hunt, why do you think many unique animals like marsupials and rare egg-laying mammals (like the platypus and echidna) are found on this specific continent?

_____

_____

Concept by Roxane Rogers Buetens

2019–2021 NHMLAC Teacher Advisory Council

Roxane Rogers Buetens studied Environmental Science and Latin American & Latino studies at UC Santa Cruz, which is where her passion for natural history developed. After completing her undergraduate degree, she taught environmental education in the field for Nature Bridge and then went on to get a Master's degree in Science Education from UC Berkeley. Roxane now teaches science, health, and art at Central Tri-C Continuation High School in Los Angeles Unified School District. She absolutely loves her job as a continuation school teacher where she teaches her students about the natural world through their thriving urban school garden.

STANDARDS

- Common Core ELA: RST.11–12.7
- NGSS: HS–LS4–1

ANSWER KEY

- CLUE #1: **HALL OF BIRDS**
- number, beak, drought, fewer, survive, right, bigger
- Graph B
- CLUE #2: **NORTH AMERICAN MAMMAL HALL**
- CLUE #3: **AFRICAN MAMMAL HALL**
- CLUE #4: **MAMMALS**
- CLUE #5: **IN THIS EXHIBIT, GO UPSTAIRS AND FIND THE ANCESTOR OF THE SEA COW.**
- CLUE #6: **HANDS**
- birds, traits, continents, connected, ancestor, environment, vestigial structures, mammal, hands

The Natural History Museum's Statement on Evolution

NHMLAC is a collections-based research and educational institution that relies on science to enhance our knowledge of the natural world. The goal of science is to acquire an ever-increasing understanding of the objects and events we encounter. Such understanding is obtained through the continual critical evaluation of testable hypotheses and theories.

Evolution is a central concept in modern science. Evolutionary theories are supported by evidence from such diverse fields as genetics, paleontology, chemistry, and physics. The use of evolutionary biology as a means of acquiring understanding is consistent with the overall goal of science, as the theories involved are available to critical evaluation. Evolutionary biology allows us to explain the amazing diversity of life on Earth today and how diversity has changed over time.

Because understanding evolution is important for both scientists and the public, NHMLAC emphasizes that evolutionary biology belongs in school curricula and textbooks as well as in public museums. Although the topic is sometimes portrayed as controversial, it is no more controversial among scientists than are the theories explaining gravity, light, sound, or electricity.

NHMLAC, with its mission to inspire wonder, discovery, and responsibility, recognizes that evolutionary biology is fundamental to understanding biological diversity and is critical for both scientific research and museums. The museums welcome people of all beliefs and backgrounds to join us as we explore, through science, the wonders of the natural world.

Good starting places for finding additional information about evolution and its relation to other concepts and issues include:

Science, Evolution, and Creationism (a publication of the National Academy of Sciences)

Evolution 101 (Museum of Paleontology, University of California Berkeley)

National Center for Science Education

The Clergy Letter Project

Fossils & Evolution

Many of our researchers study how life changes over time – the fundamental process of evolution. With fossils, modern specimens, or both, our scientists learn more about the history of life on Earth, how species past and present lived or went extinct, and how they're related to each other.

Learn more about the various fossil research happening at the Natural History Museum

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