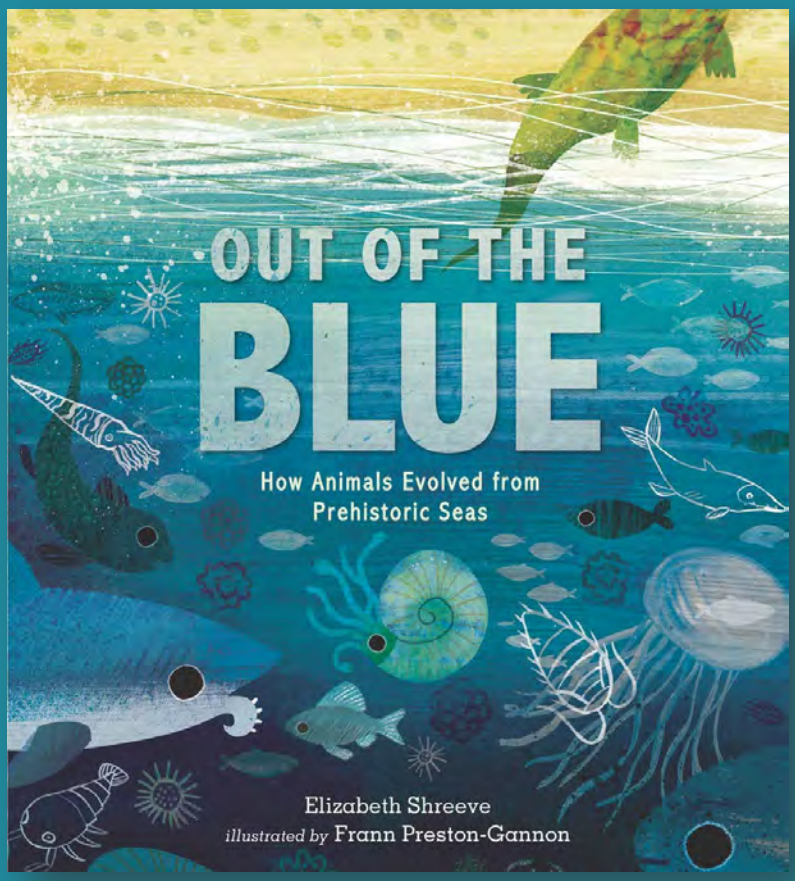
EVOLUTION

CURRICULUM PACKET

Featuring Nonfiction Picture Book

OUT OF THE BLUE

HOW ANIMALS EVOLVED FROM PREHISTORIC SEAS



CANDLEWICK PRESS

www.elizabethshreeve.com

Dear Teachers,

Kids love animals! But do your students know that all animals of today's world originally evolved from creatures in the oceans many millions of years ago?

This curriculum offers an introduction to evolution, a subject fundamental to understanding the earth and life sciences in upper grade levels and beyond. I hope these materials help your students become fascinated with the history of life on Earth. Most of all, I hope they want to learn more!

As you use the curriculum, here are a few principles to reinforce:

- Evolution is the process by which species adapt over time in response to changing environments.
- Individual animals do not change within their lifetimes; rather, populations of animals adapt and change over time. Populations adapt when individuals with certain traits survive and produce more offspring. Over multiple generations, the advantageous traits become more common.
- Evolution is a scientific theory (just like gravity!) but this does not mean it's a guess or a hunch. In science, a theory is a framework of explanations for natural phenomena, repeatedly tested using evidence. Evidence for evolution includes the fossil record, radiometric dating, and molecular biology.

For further support and resources, please see links on my website including:

National Center for Science Education: Teaching Evolution

Children's Books & Resources on Evolution (A bibliography maintained by Dr. Brian Pobiner, Smithsonian National Museum of Natural History, and myself)

Acknowledgments

Heartfelt thanks to Sierra Satterstrom, specialty STEM teacher, and her wonderful students for beta-testing this curriculum and providing invaluable suggestions, enthusiasm, and creative work products for this revised edition. Thanks also to educators Jason Jones and Nataly Vidales for their excellent input, to Frann Preston-Gannon for such beautiful artwork, and to the fabulous editors, marketers, and educators at Candlewick Press.

© 2022 by Elizabeth Shreeve. All rights reserved. This curriculum may be used solely by teachers, homeschoolers, and other not-for-profit entities.

OUT OF THE BLUE. Text copyright ©2021 by Elizabeth Shreeve. Illustrations copyright ©2021 by Frann Preston-Gannon. Reproduced by permission of the publisher, Candlewick Press, Somerville, MA

CONTENTS

	Page
USER GUIDE	1
LESSON 1: EARLY LIFE	7
Lesson Plan	
Quick Dip Video	
Classroom Activity: How Old is Earth?	
LESSON 2: THE CAMBRIAN EXPLOSION	15
Lesson Plan	
Quick Dip Video	
Classroom Activity: Eat or Be Eaten!	
LESSON 3: THE BIG MOVE ONTO LAND	21
Lesson Plan	
Quick Dip Video	
Classroom Activity: Ocean-Land Cousins	
LESSON 4: INVASION OF THE FISHAPODS!	33
Lesson Plan	
Quick Dip Video	
Classroom Activity: Fins to Feet Mini-Book	
LESSON 5: BACK TO THE BLUE	45
Lesson Plan	
Quick Dip Video	
Classroom Activity: How to Climb a Family Tree	

This curriculum features the STEM picture book
Out of the Blue: How Animals Evolved From Prehistoric Seas
by Elizabeth Shreeve, illustrated by Frann Preston-Gannon
Candlewick Press, 2021
More materials at www.ElizabethShreeve.com.

USER GUIDE

This packet contains a curriculum on evolution and Earth history, featuring the picture book OUT OF THE BLUE: HOW ANIMALS EVOLVED FROM PREHISTORIC SEAS (Candlewick Press, 2021).

- Appropriate for Grade K-5, Earth & Life Sciences
- Focus on Grade 3 NGSS standards, with crossovers to math, literacy and creative writing, and visual arts
- Five lessons, each with a 5-minute Quick Dip video and a classroom activity.

  Lesson 1. EARLY LIFE: *fossil record, age of Earth; origins of life in the ocean*

  Lesson 2. THE CAMBRIAN EXPLOSION: *natural selection; animal traits; food webs*

  Lesson 3. THE BIG MOVE TO LAND: a*daptation*

  Lesson 4. INVASION OF THE FISHAPODS: v*ariation and diversity*

  Lesson 5. BACK TO THE BLUE: *inheritance and common ancestry; geologic timescale*

The five lessons build from one to the next but each lesson also works separately. Teachers can use the curriculum at a chosen pace, whether intensively as a week-long focus or gradually through several weeks.

Additional teaching videos for Grades 3-5 provide deeper dives into STEM/Lit connections and the lives of scientists.

- "TAKE THE PLUNGE: Introduction to the Research and Writing Process." This 7.5-minute video shows kids how nonfiction books come together, from initial ideas to consultation with scientists, research, revision, and working with an artist.
- "TALKING TO THE SCIENTISTS: Interviews with Three Experts Behind the Book." This 17-minute video highlights the work of Dr. Rich Mooi (California Academy of Sciences), Dr. Petra Sierwald (Field Museum), and Dr. Neil Shubin (University of Chicago).

All resources available at www.elizabethshreeve.com

CORRELATION TO STANDARDS

This curriculum guide is designed for students in 1st through 5th grade. Content aligns with NGSS/science topics identified in each lesson and correlates with standards for literacy and math. In particular, activities and discussions support instruction of the following Common Core State Standards.

CCSS: ELA-LITERACY.RI.3.1 - Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.

CCSS: ELA-LITERACY.RI.3.2 - Determine the main idea of a text; recount the key details and explain how they support the main idea.

CCSS: ELA-LITERACY.RI.3.3 - Describe the relationship between a series of historical events, scientific ideas or concepts, using language that pertains to time, sequence, and cause/effect.

CCSS.ELA-LITERACY.RI.3.5 - Use text features and search tools (e.g., key words, sidebars, hyperlinks) to locate information relevant to a given topic efficiently.

CCSS.ELA-LITERACY.RI.3.7 - Use information gained from illustrations (e.g., maps, photographs) and the words in a text to demonstrate understanding of the text (e.g., where, when, why, and how key events occur).

CCSS.ELA-LITERACY.RI.3.8 - Describe logical connections between sentences and paragraphs in a text.

CCSS: ELA-WRITING.3.1 - Write opinion pieces on topics or texts, supporting a point of view with reasons

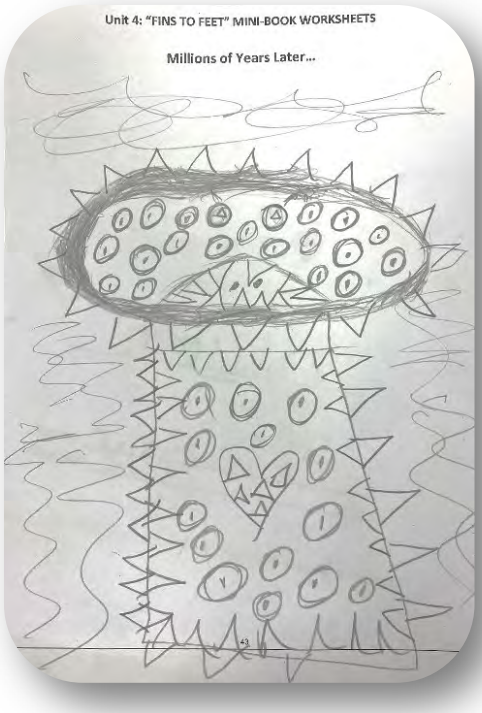
CCSS: ELA-WRITING.3.2 - Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

CCSS: ELA-SPEAKING & LISTENING.3.4 - Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace.

CCS: Math. MP.2 - Reason abstractly and quantitatively.

CCS: Math.MP.4 - Model with mathematics.

CCS: Math.3.MD.B.4 - Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch.



Out of the Blue: How Animals Evolved from Prehistoric Seas

USER GUIDE

HANDY LINKS

Pages-to-Print Package. Contains all worksheets, charts, and other pages designed to be printed.

Quick Dip Videos All Teaching Videos

Information on Author Visits. Virtual or in-person visits can range from brief Q&A sessions after students have watched videos to full presentations or writing workshops. Please contact me through my website or through Candlewick Press at *appearances@candlewick.com*

Got a local bookstore that you love? I'm happy to coordinate with them on an author visit.

FIND THE BOOK

Copies of *Out of the Blue* may be available in your school or local libraries; if not, please suggest that they consider adding it to their collection. Here are links for purchasing the book:

Bookshop.org (benefits local bookstores)

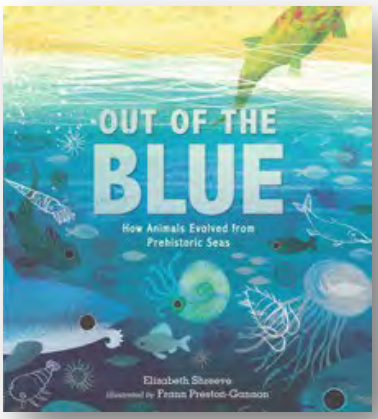
Amazon

Signed Copies (through our family toy store)

Candlewick Press *appearances@candlewick.com*

Please check back to www.elizabethshreeve.com from time to time for new and updated resources—and feel free to contact me to share students' work and offer suggestions.

I hope you and your students enjoy a journey through time!



Out of the Blue: How Animals Evolved from Prehistoric Seas

(Candlewick Press, 2021)

A lively, beautiful picture book that describes the origins of life in the oceans and adaptation of animals onto land, through Earth's amazing history.

★ *"A sweeping story thoughtfully summarized for the target age group." – Kirkus (starred review)*

★ *"A book to be read over and over for its intriguing story and illustrations." – School Library Journal (starred review)*

"This book is astonishing!"—Hannah, Grade 4

LESSON 1: EARLY LIFE

When and where did life begin?
How do scientists study prehistoric worlds?

Lesson 1 introduces students to fossils, the age of Planet Earth, and the origins of life in the ocean

Lesson Plan

Quick Dip Video

Classroom Activity: How Old is Earth?

This curriculum features the STEM picture book
Out of the Blue: How Animals Evolved From Prehistoric Seas
by Elizabeth Shreeve, illustrated by Frann Preston-Gannon
Candlewick Press, 2021
More materials at www.ElizabethShreeve.com.

Lesson Plan

EARLY LIFE began with tiny microbes in the oceans over 3.5 billion years ago. In fact, our planet is 4.6 billion years old. Billion with a "B"! That's hard to imagine!

Lesson 1 introduces students to the book and includes the first Quick Dip video. The classroom activity—*How Old is Earth?*--helps them to envision Earth's age by using their bodies to estimate the timing of major milestones described in the book. Working in groups or pairs, students compare the record of geologic history to the distance between their fingertips (arm span), make guesses about when important events occurred, and create their own timelines. The activity also supports understanding of mathematical concepts for proportion and scale.

Learning Objectives

- ✓ I understand that life on Earth began in the ocean
- ✓ I know that fossils provide evidence for prehistoric life
- ✓ I can conceptualize the age of Earth

NGSS Focus: Fossil record, prehistoric environments

3-LS4-1. Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago

LS4.A: Evidence of Common Ancestry and Diversity

- Some kinds of plants and animals that once lived on Earth are no longer found anywhere.
- Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments.

Time Required

Recommended for two one-hour sessions/class periods.

1. Read aloud quickly through the book's main text, with the understanding that the class will read captions during upcoming lessons; then watch Quick Dip Video #1.
2. Classroom Activity – *How Old is Earth?*

Lesson 1: EARLY LIFE

Materials Needed

- A copy of *Out of the Blue: How Animals Evolved from Prehistoric Seas*
- Quick Dip Video #1: EARLY LIFE (video available at www.elizabethshreeve.com or YouTube Elizabeth Shreeve Books
- Blue painter's tape (or rolls of butcher block/similar paper plus tape for hanging)
- Markers and pencils
- Print-outs of timeline tags (see below or in **Pages-to-Print Package)**

Video & Classroom Activity

STEP 1: Read and Prepare

1. Print and trim the labeled tags for timeline, provided below.
2. Open ***Out of the Blue*** to the first page showing the dolphin, shark and hippo. Prompt the question: "Which two of these animals are the closest relatives?" Have students predict which animals are more closely related.
3. Read through main narrative of the book (leaving captions for later lessons). Suggested questions:
   - What did you learn? Did anything surprise you?
   - What are some of important milestones in Earth's history that are mentioned in the book?
   - What time in Earth's history would you like to visit, if you could? Why?

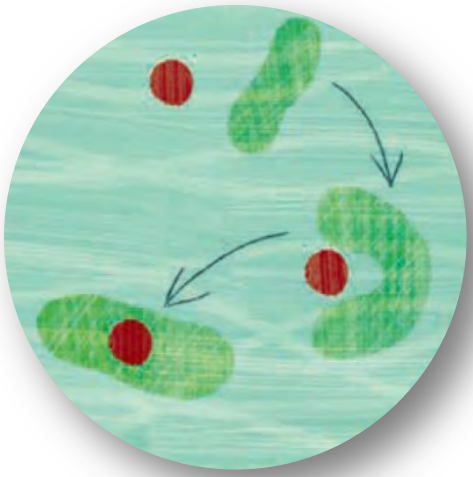
STEP 2: Watch Quick Dip Video #1

Watch the **Quick Dip Video #1: EARLY LIFE,** available with Teaching Videos at www.elizabethshreeve.com and at YouTube Elizabeth Shreeve Books

Option: Discuss questions at the end of the video.

1. Where did life on our planet begin?
2. What is a microbe?
3. Can you name a type of microbe?

4. How do scientists explore prehistoric life?
5. What is a fossil?
6. Can you name a type of fossil?
7. What can fossils tell us about the past?
8. What's your favorite prehistoric animal?



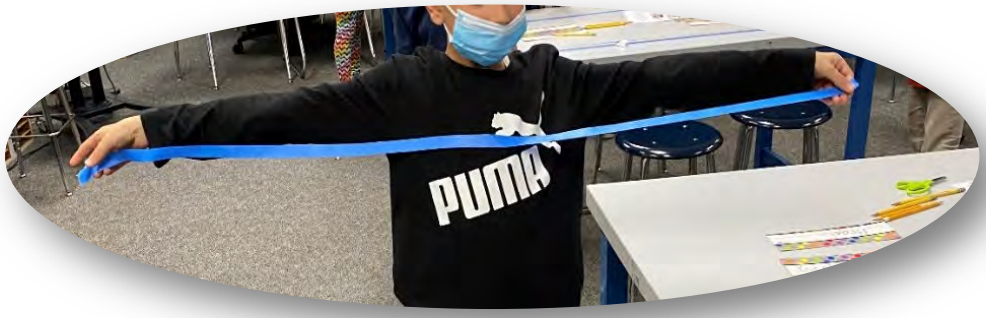
For Grades 3+, be sure to watch this additional video at YouTube Elizabeth Shreeve Books:

- "TALKING TO THE SCIENTISTS: Interviews with Three Experts Behind the Book."

STEP 3: Give Earth a Hug!

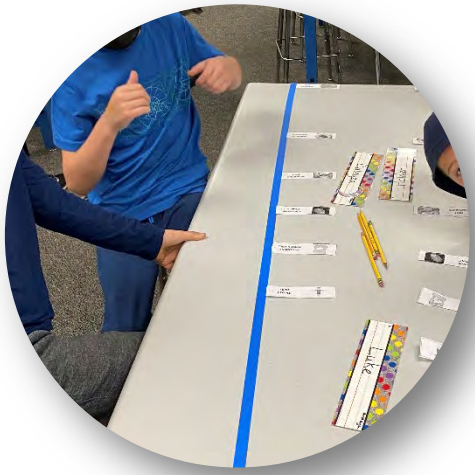
Now it's time to compare Earth's history to the distance between your fingertips (arm span). Don't worry if someone's a little shorter or has super-long fingers. It's just a rough comparison. Anyway, what's a few million years among friends?
Note: This activity includes one event not mentioned in the book: the evolution of our species, Homo sapiens*. Currently, earliest fossil evidence for "people" dates to ~330,000 years ago.*

1. Have students form into small groups or pairs; provide them with a set of labeled tags (below).
2. Choose a group member to stand against a wall and stretch their arms as if ready to hug something enormous. (Like Earth!). Other students press tape onto the wall so it extends from the left fingertip (which represents TODAY) to the right fingertip (representing FORMATION OF EARTH). Distance between fingertips (arm span) represents the entire geologic history of Earth—4.6 billion years. (Timelines can also be taped to tables.)
3. Additional math activity: students measure the timeline and divide into halves and quarters.



Lesson 1: EARLY LIFE

4. Now it's time to ESTIMATE important events in the history of Earth. Ask students to place tags on the timeline where they think the following milestones occurred. Then mark those locations with the numbers on the tags. Given that right fingertip represents the formation of Earth and the left fingertip is today…when did the following events happen?



   a. **First Microbes** emerge in the ocean
   b. **Cambrian Explosion**/First complex life
   c. **First Fish Wiggle onto Land**
   d. **First Dinosaurs**
   e. **Big Dinos Go Extinct!**
   f. **First People**

5. Hand out a copy of the ANSWERS provided below to each group. Ask students to move the tags to the correct dates on their timelines.
   a. **Earth Forms** (4.6 billion years ago) **= Right fingertip**
   b. **First Microbes** (3.5 billion years ago) = **Right elbow**

      (3.5 billion years/4.6 billion years = 76% of arm span)
   c. **Cambrian Explosion**/First complex life (500 million years ago) **= Left wrist**

      (500 million years /4,600 million years = 11% of arm span)
   d. **Fish Wiggle Onto Land** (375 million years ago) **= Center of Palm**

      (375 million years /4,600 million years = 8% of arm span)
   e. **First Dinosaurs** (230 million years ago) **= First (largest) knuckle**

      (220 million years /4,600 million years = 5% of arm span)
   f. **Big Dinosaurs Go Extinct** (66 million years ago) **= Last (smallest) knuckle**

      (66 million years /4,600 million years = 1.5% of arm span)
   g. **First People** (330,000 years ago) **= End of fingernail**

      (330,000/4,500,000,000 = 0.0073% of arm span)
   h. **Today: Left Fingertip**

STEP 4: Discuss

Each group now has a timeline of Earth marked with important milestones. The timeline is proportional to their arm span; in other words, they are comparing the history of Earth (4.6 billion years) to the distance between their fingertips.

What did the students discover about Earth's history through the activity? Were they surprised by any of the results? How did the measurements compare to their original guesses?

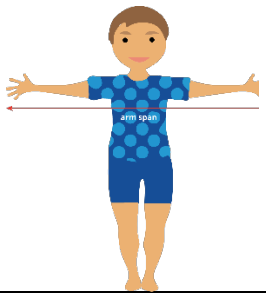
Lesson 1 classroom activity reinforces:

- The significant length of time between the first evidence of simple life (microbes) in the oceans 3.5 billion years ago and the emergence of more complex animals in the Cambrian Period, some 500 million years ago.
- The long history of Earth (especially relative to appearance of human ancestors)
- The use of percentages in understanding relative measurements

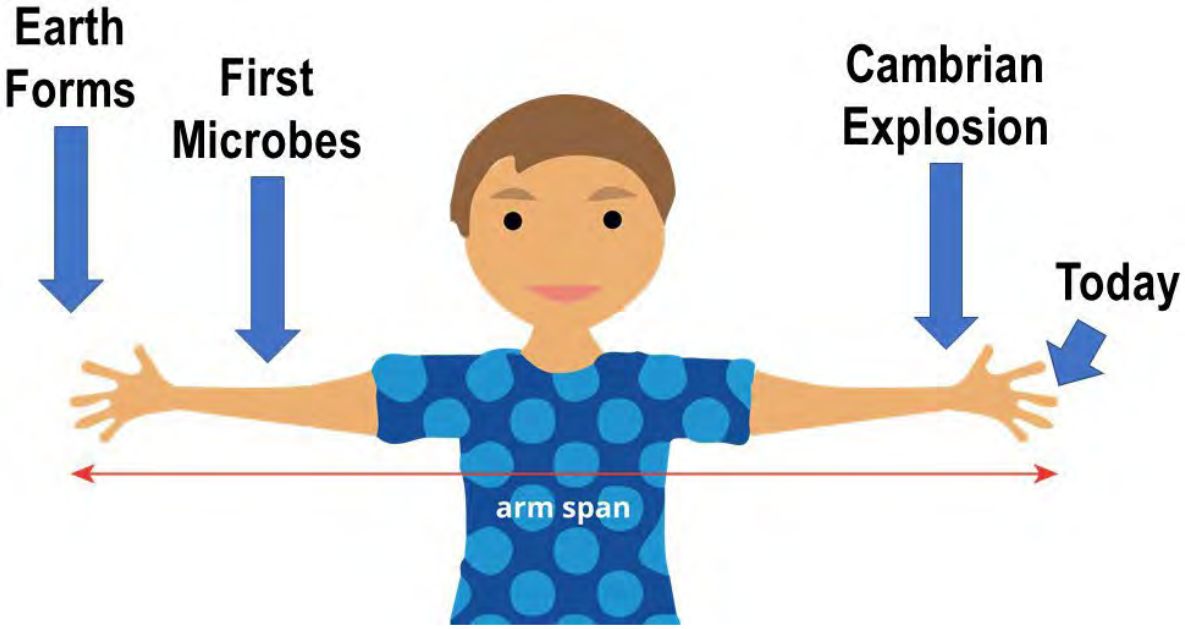
Visit www.elizabethshreeve.com for more activities and resources.

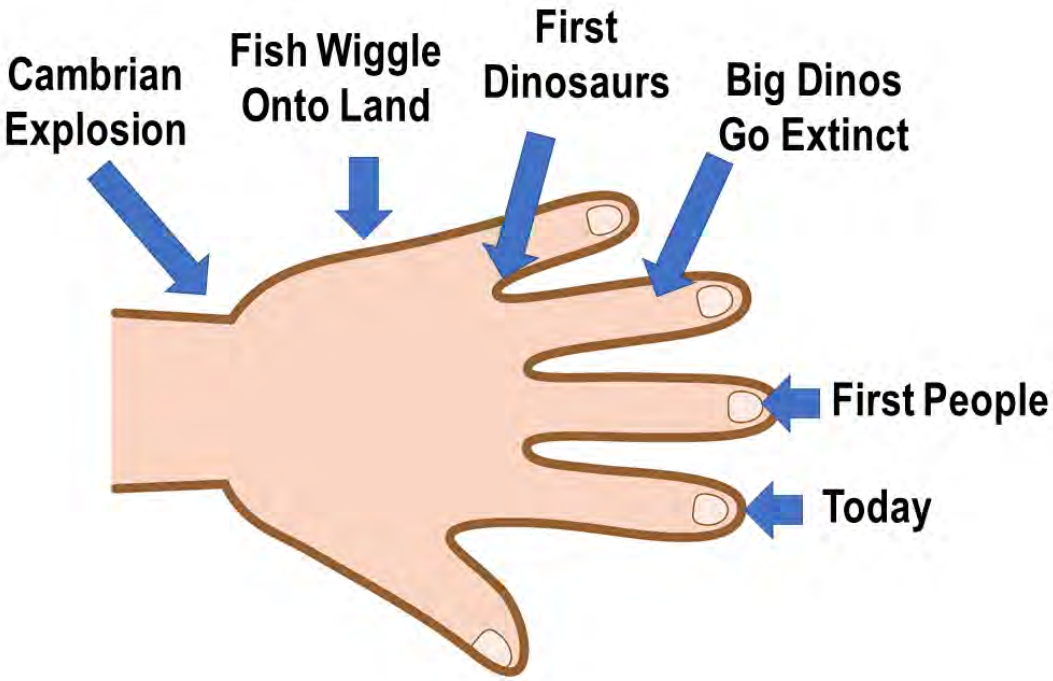
Bye for now!

Print and cut this page to make labels for the Lesson 1 “How Old is Earth?” Timeline

1	**FIRST MICROBES IN OCEAN**	Cut along this line…
2	**CAMBRIAN EXPLOSION**	Cut along this line…
3	**FISH WIGGLE ONTO LAND**	Cut along this line…
4	**FIRST DINOSAURS**	Cut along this line…
5	**BIG DINOS GO EXTINCT**	Cut along this line…
6	**FIRST PEOPLE**	

LESSON 1 – TIMELINE ANSWERS!





LESSON 2:
THE CAMBRIAN EXPLOSION

What were the first animals?
How did they survive?

Lesson 2 introduces the major animal groups and basic ideas about natural selection and food webs.

Lesson Plan

Quick Dip Video

Classroom Activity: Eat or Be Eaten!

This curriculum features the STEM picture book
Out of the Blue: How Animals Evolved From Prehistoric Seas
by Elizabeth Shreeve, illustrated by Frann Preston-Gannon
Candlewick Press, 2021
More materials at www.ElizabethShreeve.com.

Lesson 2: THE CAMBRIAN EXPLOSION

Lesson Plan

During the **CAMBRIAN PERIOD** (541-485 million years ago) biodiversity "exploded" in the world's oceans. The first complex life-forms appear in the fossil record at this time and the major animal groups (phyla) took shape, with basic body plans that endure today. The Cambrian Period also marks the transition from simple feeding strategies (e.g., filter feeding) to more complex predator-prey relationships that have spurred evolution and biodiversity ever since.

Lesson 2 begins with a read-aloud and Quick Dip Video #2, followed by an art-focused activity for students to design their own predators and prey. Working in individually or in groups, they invent and draw body features and behaviors (adaptations) that help predators to be effective hunters and enable prey animals to defend themselves. This activity encourages creative visual thinking while reinforcing principles of natural selection and adaptation.

Learning Objectives

- ✓ I can describe how the major animal groups took shape in the Cambrian Period
- ✓ I can create a predator that has physical and behavioral characteristics to help it survive
- ✓ I can understand that life-forms are constantly changing and adapting to their environments

Time Required

Recommended for two class sessions (students love the classroom activity!)

1. Review the book, up to and including the Cambrian Period spread; watch Quick Dip Video #2.
2. Classroom Activity – *Eat or Be Eaten!*

NGSS Focus: Natural Selection

Performance Expectation (3-5): when environments change some organisms survive and reproduce, some move to new locations, some move into the transformed environment, and some die.

3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.

LS4.B: Natural Selection. Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing.

Lesson 2: THE CAMBRIAN EXPLOSION

Materials Needed

- A copy of *Out of the Blue: How Animals Evolved from Prehistoric Seas*
- Quick Dip Video #2: THE CAMBRIAN EXPLOSION (video available at www.elizabethshreeve.com or YouTube Elizabeth Shreeve Books
- Markers and pencils; blank paper
- Print-outs of the "Design Your Own Animal" charts (see below or in **Pages-to-Print Package)**

Video & Classroom Activity

STEP 1: Read and Prepare

1. Introduce the topic and tell students that they be designing their own predators and prey. Confirm definitions of PREDATORS (animals that catch and kill other animals) and PREY (animals that are hunted and killed by other animals).
2. Open the book to the Cambrian Period spread; read all text including captions.

   Suggested questions:

   - Can you name some of the major animal groups and their characteristics (e.g. exoskeletons)?
   - What are some examples of living animals from these animal groups? (*e.g. insects or crabs are arthropods*)
   - Which animals on the Cambrian Period pages appear to be predators? Which do you think are prey animals? What body parts or shapes make them successful predators or help them to defend against hunters?
   - Can you name some top predators in today's oceans (*e.g., orca whales, sharks*) and on land (*e.g., wolves, hawks, grizzly bears*)?
   - How do scientists know what animals were predators or prey so long ago? What are signs of predation in the fossil record? (*Note: fossil evidence of predation includes marks of boring, biting, scrapes, fractures.)*

Lesson 2: THE CAMBRIAN EXPLOSION

STEP 2: Watch Quick Dip Video #2

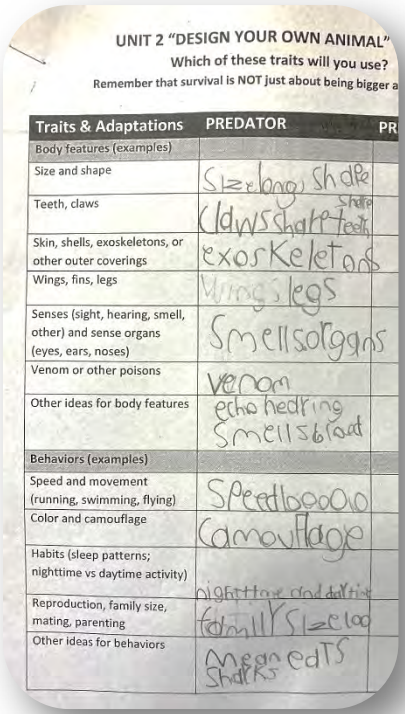
Watch the **Quick Dip Video #2: THE CAMBRIAN EXPLOSION,** available with Teaching Videos at www.elizabethshreeve.com and at YouTube Elizabeth Shreeve Books

Option: Discuss questions at the end of the video.

1. How did animals change (evolve) during the Cambrian Period?
2. What are some ways to be a better hunter?
3. What are some ways to avoid being eaten?
4. Some animals have hard outer shells (exoskeletons). Can you name one?
5. Other animals have internal skeletons (endoskeletons). Can you name one?
6. Can you name an important fossil from the Cambrian Period?

STEP 3: Design Your Own Predator and Prey

Now it's time to invent your very own animals! Some will be fierce hunters; others will be super-tough prey. Both types of animals must eat to survive and none want to be eaten. (*Note: recommend that teachers NOT draw any examples; let students invent their own!)*



UNIT 2 "DESIGN YOUR OWN ANIMAL"

Which of these traits will you use?

Remember that survival is NOT just about being bigger a

Traits & Adaptations	PREDATOR	PR
Body features (examples)		
Size and shape	Size long shape	
Teeth, claws	claws sharp teeth	
Skin, shells, exoskeletons, or other outer coverings	exoskeletons	
Wings, fins, legs	wings legs	
Senses (sight, hearing, smell, other) and sense organs (eyes, ears, noses)	smell sorgans	
Venom or other poisons	venom	
Other ideas for body features	echo hedring smell sbroad	
Behaviors (examples)		
Speed and movement (running, swimming, flying)	Speedboooo	
Color and camouflage	Camouflage	
Habits (sleep patterns; nighttime vs daytime activity)	nighttime and daytime	
Reproduction, family size, mating, parenting	family size too	
Other ideas for behaviors	Megaeats sharks	

1. Provide each student with a worksheet charts (below) and blank paper. Ask them to decide on traits and adaptations for a predator, using the chart, and then draw it.

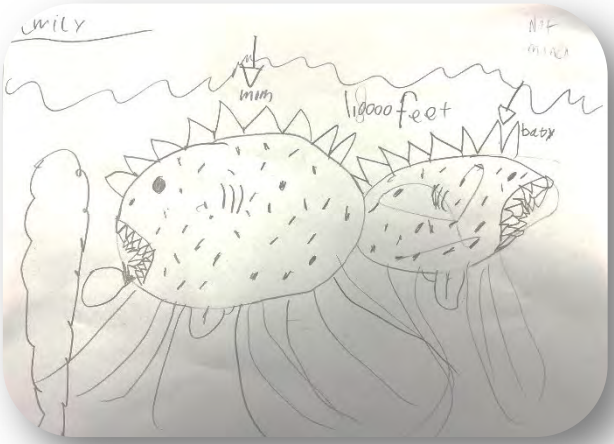
2. Each group discusses body features and behaviors that are useful for predators and prey. Students can use the chart to select a few traits for their animals and jumpstart ideas. Be sure to decide whether the animal lives in ocean or on land.

3. Have students pair up. Each student has two minutes to explain their predator to the other person, who can ask questions; then switch roles.

4. After students have explained the predators to their partner, have them switch drawings and draw a prey animal that can defend itself against their partner's predator. For example, if the predator has big sharp teeth, the prey animal might adapt by growing a tough outer shell, running faster, or hiding during the hours when that hunter is active.

STEP 4: Discuss

Each student has now designed a predatory animal and a prey animal, with features that provide advantages for survival.



- Ask students to show and describe their animals. What body features and behaviors did they include?
- How were these traits help them to survive? How were they suited to the animals' habitat?
- How did body features and behaviors of the PREDATOR affect how they designed the PREY?

This activity reinforces:

- Ways in which animals evolve in relationship to each other, changing and adapting through natural selection over time.
- The importance of adaptations, both anatomical and behavioral.
- The interconnected nature of ecosystems and food webs.

Other possible discussion topics:

- Predators eat prey, but what do prey animals eat? This is a chance to discuss food webs, starting with plants and plankton at the bottom, animals that eat plants (herbivores), animals that eat plants and other animals (omnivores), and all the way up to apex or top predators.
- In an ecosystem, are there more prey animals or more predators?
- What are some typical characteristics of predators vs. prey animals? For example, prey animals such as zebras typically have eyes on the sides of their faces, giving them a wider range of view, while predators typically have eyes that focus straight ahead.

Visit www.elizabethshreeve.com for more activities and resources.

Bye for now!

This curriculum features the STEM picture book
Out of the Blue: How Animals Evolved From Prehistoric Seas
by Elizabeth Shreeve, illustrated by Frann Preston-Gannon
Candlewick Press, 2021
More materials at www.ElizabethShreeve.com.

LESSON 2 "DESIGN YOUR OWN ANIMAL" CHART

Which of these traits will you use?

Remember that survival is NOT just about being bigger and stronger!

Traits & Adaptations	PREDATOR	PREY
Body features (examples)		
Size and shape		
Teeth, claws		
Skin, shells, exoskeletons, or other outer coverings		
Wings, fins, legs		
Senses (sight, hearing, smell, other) and sense organs (eyes, ears, noses)		
Venom or other poisons		
Other ideas for body features		
Behaviors (examples)		
Speed and movement (running, swimming, flying)		
Color and camouflage		
Habits (sleep patterns; nighttime vs daytime activity)		
Reproduction, family size, mating, parenting		
Other ideas for behaviors		

LESSON 3:
THE BIG MOVE ONTO LAND

When did animals move from ocean to land?
How did they adapt?

Lesson 3 explores the transitions of ocean animals to terrestrial environments, leading to a wide array of adaptations.

Lesson Plan

Quick Dip Video

Classroom Activity: Ocean-Land Cousins

This curriculum features the STEM picture book
Out of the Blue: How Animals Evolved From Prehistoric Seas
by Elizabeth Shreeve, illustrated by Frann Preston-Gannon
Candlewick Press, 2021
More materials at www.ElizabethShreeve.com.

Lesson 3: THE BIG MOVE ONTO LAND

Lesson Plan

It's time for **THE BIG MOVE ONTO LAND!** Starting with little millipede-like pioneers around 430 million years ago, many types of animals have emerged from the ocean and adapted to terrestrial ecosystems. These transitions drove a wide range of adaptations as animals evolved new ways to move, breathe, and find food and shelter. Sometimes animals ended up very different from their "ocean cousins" back in the water!

Lesson 3 begins with a read-aloud and Quick Dip Video #3, followed by a classroom activity that uses flashcards to help students understand how animal populations change and adapt to different conditions over long periods of time. Can your students figure out which critters are related?

Learning Objectives

- ✓ I can compare and contrast land animals to ocean animals
- ✓ I can identify adaptations that enabled animals to transition from water to dry land
- ✓ I can explain why some animals never left their ocean habitats

Time Required

This lesson can be managed in a single one-hour classroom session or divided into two.

1. Read aloud from the book, up to the Devonian Period; watch Quick Dip Video #3.
2. Classroom Activity – *Ocean-Land Cousins*

NGSS Focus: Adaptation

Performance Expectation (3-5): Environment can affect the traits that an organism develops

3-LS4-1. Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.

LS4.C: Adaptation. For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all.

LS3.A: Inheritance of Traits. Characteristics result from individuals' interactions with the environment.

This curriculum features the STEM picture book
Out of the Blue: How Animals Evolved From Prehistoric Seas
by Elizabeth Shreeve, illustrated by Frann Preston-Gannon
Candlewick Press, 2021
More materials at www.ElizabethShreeve.com.

Lesson 3: THE BIG MOVE ONTO LAND

Materials Needed

- A copy of *Out of the Blue: How Animals Evolved from Prehistoric Seas*
- Quick Dip Video #3: THE BIG MOVE ONTO LAND (video available at www.elizabethshreeve.com or YouTube Elizabeth Shreeve Books
- Pins or tape; markers
- Print-outs of flashcards (see below or in **Pages-to-Print Package)**

Video & Classroom Activity

STEP 1: Read and Prepare

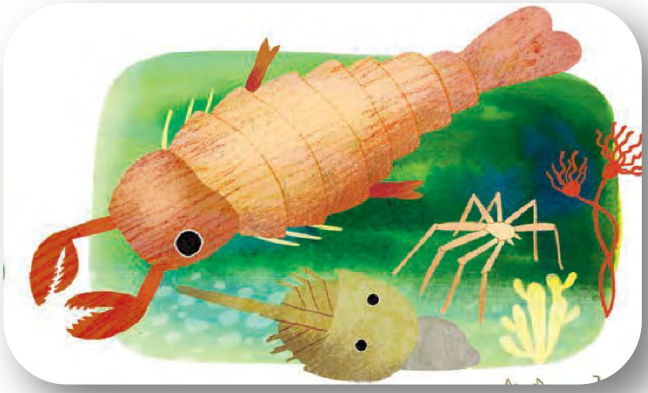
1. Print copies of the flashcards: one set of smaller images (cut in half, as indicated) for each group and one set to pin on the blackboard. Note: a full-sized set of the images is also available as part of the **Pages-to-Print Package**; these are useful for sharing on the blackboard.
2. Introduce the topic and tell students that they will be matching up pairs of animal "cousins" (animals that are related)—one "cousin" that lives in the ocean and the other on land. Ask students how they think animals that live on land will be different than those that live in water.
3. Open the book to the Devonian Period spread; read all text including captions.

- Ask students to remember that major animal groups took shape during the Cambrian Period (*annelids, arthropods, chordates, cnidarians, echinoderms, and mollusks*). Point out that some of these groups later gave rise to animals that moved onto land.
  - How would life on land be challenging for animals adapted to life in the sea? *(e.g., breathing, moving, eating, avoiding predators, making homes, drying out in the air)*
  - Which animal groups could adapt more easily to living on land? Why? *(e.g., animals with tough outer shells, like arthropods*)
- Which ones are more likely to stay in the water? Why? (*e.g., animals with soft bodies, like jellyfish, are less able to adapt to land)*

Lesson 3: THE BIG MOVE ONTO LAND

STEP 2: Watch Quick Dip Video #3

Watch the **Quick Dip Video #3: THE BIG MOVE ONTO LAND,** available with Teaching Videos at www.elizabethshreeve.com and at YouTube Elizabeth Shreeve Books



Discuss questions at the end of the video.

1. Why did some animals leave the ocean for land?
2. How did their bodies need to adapt?
3. How did their behaviors need to adapt?
4. Why do some animals (like horseshoe crabs) not change much over time? Why do others change more quickly?
5. Can you think of an animal that inhabits both water and land?
6. Can you name an ocean animal that could never live on land in its current form? Why?

Note: Alternatively, this video can be viewed AFTER the classroom activity as it provides some answers to the flashcard choices.

STEP 3: Ocean-Land Cousins Match-up

In this classroom activity, students will match ocean animals from six of the major groups (phyla) with distant cousins that live on land. They will identify types of animals that never moved onto land—and invent some new critters of their own!

1. Have students divide into small groups or pairs.
2. Provide each group with a full set of flashcards (trimmed in half, as indicated, to produce 6 green/land animals and 6 blue/ocean animals). On the blackboard, hang the full-sized set of 12 and the blank chart showing Major Animals Groups (Phyla).
3. Ask the students to spread out the flashcards on their tables. Working as a group, their job is to match up the land and ocean animals that are part of the same major animal group.
4. Once they have decided, one person from each group can come to the blackboard and pin their choice with the full-sized images.
5. Point out that two of the green/land animal flashcards are blank. What does this indicate? Did all the major animal groups give rise to land animals? Which ocean animals are less likely to be able to adapt to land—and why?

6. Ask students to invent and draw land versions of a jellyfish and a sea star (see prompts on flashcards). What adaptations would allow them to live on land?
7. Option: The flashcards contain bonus questions: *What's My Animal Group?* Students can match the flashcard animals to the blank chart showing Major Animals Groups (e*.g., the bristleworm is part of the annelid group; the octopus is part of the mollusk group).* Students can use this as a starting point for further investigations into animal biology.

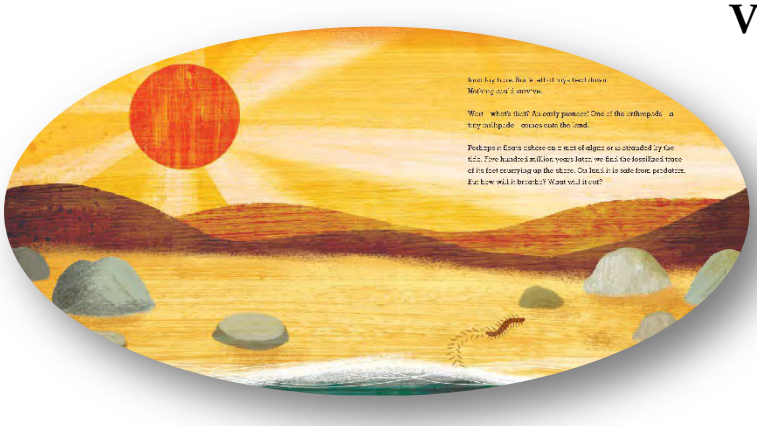
STEP 4: Discuss

Once each group has finished, it's time to share answers (see Key, below) and discuss.

- Did they match up the ocean-land cousins?
- Which ones were difficult to match? Which ones were easy or surprising?
- What adaptations allowed land cousins to survive outside the ocean? (e*.g., fish and human have backbones but fish breathe through gills and humans breathe with lungs)*
- Ask students to share their pictures of land versions of the starfish or jellyfish. What body features or behaviors did they include to help their animals survive on land?

This activity reinforces:

- Ocean-land "cousins" often look very different. Bodies and behaviors have changed drastically as animals adapted to new habitats and conditions over long periods of time.
- Ocean-land "cousins" share common ancestors (one is not "descended" from the other). That common ancestor usually looks different, too. (NOTE: see Lesson 5 for this topic.)
- All descendants of a common ancestor will continue to change through time, whether they stay in ocean habitats or adapt to life on land. Evolution never stops!
- Some groups of animals never ventured onto land.



Visit www.elizabethshreeve.com for more activities and resources.

Bye for now!

This curriculum features the STEM picture book
Out of the Blue: How Animals Evolved From Prehistoric Seas
by Elizabeth Shreeve, illustrated by Frann Preston-Gannon
Candlewick Press, 2021
More materials at www.ElizabethShreeve.com.

Lesson 3: THE BIG MOVE ONTO LAND

KEY TO FLASHCARD ACTIVITY MAJOR ANIMAL GROUPS (Phyla)	
OCEAN COUSIN	**LAND COUSIN**
ANNELIDS Segmented worms (14,000 species)	
Bristleworm	**Earthworm**
ARTHROPODS Animals with exoskeletons, segmented bodies, and jointed legs in pairs (10 million species or more)	
Horseshoe crab	**Spider**
CHORDATES Animals with backbones or notochords, a type of spinal cord (65,000 species)	
Fish	**Human**
CNIDARIANS Jelly-like animals with stinging cells (11,000 species)	
Jellyfish	**?**
ECHINODERMS Animals with internal skeletons and often prickly bodies (7,000 species)	
Sea Star (Starfish)	**?**
MOLLUSKS Animals with soft, unsegmented bodies often enclosed in shells (85,000 species)	
Octopus	**Garden snail**

Blank Chart: MAJOR ANIMAL GROUPS (Phyla)

OCEAN COUSIN	LAND COUSIN
ANNELIDS Segmented worms (14,000 species)	
_____	_____
ARTHROPODS Animals with exoskeletons, segmented bodies, and jointed legs in pairs (10 million species or more)	
_____	_____
CHORDATES Animals with backbones or notochords, a type of spinal cord (65,000 species)	
_____	_____
CNIDARIANS Jelly-like animals with stinging cells (11,000 species)	
_____	**?**
ECHINODERMS Animals with internal skeletons and often prickly bodies (7,000 species)	
_____	**?**
MOLLUSKS Animals with soft, unsegmented bodies often enclosed in shells (85,000 species)	
_____	_____

Ocean Animal:

BRISTLEWORM

My squirmy body is divided into segments. I have long bristles, too!

I am active at night and like to live under rocks.

Who's my Land Cousin?

Bonus Question: What's my Animal Group?

Ocean Animal:

HORSESHOE CRAB

I have a hard outer skeleton and jointed legs.

I live in shallow waters along the coast.

Who's my Land Cousin?

Bonus Question: What's my Animal Group?

This curriculum features the STEM picture book
Out of the Blue: How Animals Evolved From Prehistoric Seas
by Elizabeth Shreeve, illustrated by Frann Preston-Gannon
Candlewick Press, 2021
More materials at www.ElizabethShreeve.com.

Ocean Animal:

FISH

I have a backbone and breathe water through gills.

I am cold-blooded and can't warm myself up.

Who's my Land Cousin?

Bonus Question: What's my Animal Group?

Ocean Animal:

JELLYFISH

I have a jelly-like body and tentacles with stinging cells.

Here in the ocean, my relatives include coral and sea anemones.

Who's my Land Cousin?

Bonus Question: What's my Animal Group?

This curriculum features the STEM picture book
Out of the Blue: How Animals Evolved From Prehistoric Seas
by Elizabeth Shreeve, illustrated by Frann Preston-Gannon
Candlewick Press, 2021
More materials at www.ElizabethShreeve.com.

Ocean Animal:

STARFISH

My star-shaped body has five arms and spiny skin. My skeleton is on the inside. I love water but dry out in the air!

Who's my Land Cousin?

Bonus Question: What's my Animal Group?

This curriculum features the STEM picture book
Out of the Blue: How Animals Evolved From Prehistoric Seas
by Elizabeth Shreeve, illustrated by Frann Preston-Gannon
Candlewick Press, 2021
More materials at www.ElizabethShreeve.com.

Ocean Animal:

OCTOPUS

I have a soft body and eight arms.

I move quickly by shooting out a jet of water!

Who's my Land Cousin?

Bonus Question: What's my Animal Group?

Land Animal:

EARTHWORM

My squirmy body is divided into segments. I have small bristles, too!

I am active at night and like to live in moist soil.

Who's my Ocean Cousin?

Bonus Question: What's my Animal Group?

Land Animal:

SPIDER

I have an exoskeleton and eight jointed legs.

I am an expert in spinning silk.

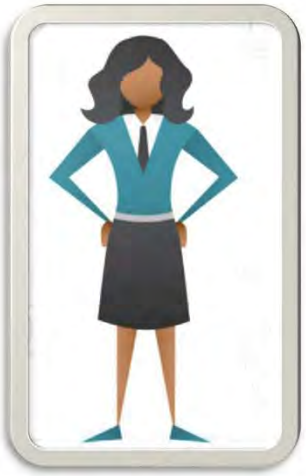
Who's my Ocean Cousin?

Bonus Question: What's my Animal Group?

This curriculum features the STEM picture book
Out of the Blue: How Animals Evolved From Prehistoric Seas
by Elizabeth Shreeve, illustrated by Frann Preston-Gannon
Candlewick Press, 2021
More materials at www.ElizabethShreeve.com.

Land Animal:

HUMAN



I have a backbone and breathe air through my lungs.

I am warm-blooded and can warm myself up.

Who's my Ocean Cousin?

Bonus Question: What's my Animal Group?

Land Animal:

SNAIL

I have a hard shell that protects my soft body.

I move slowly by gliding along on my muscular foot.

Who's my Ocean Cousin?

Bonus Question: What's my Animal Group?

This curriculum features the STEM picture book
Out of the Blue: How Animals Evolved From Prehistoric Seas
by Elizabeth Shreeve, illustrated by Frann Preston-Gannon
Candlewick Press, 2021
More materials at www.ElizabethShreeve.com.

Land Animal:

None

Can you imagine a five-armed sea animal coming onto land?

Draw a picture here!

Land Animal:

None

Can you imagine a land animal with a jelly-like body and tentacles?

Draw a picture here!

This curriculum features the STEM picture book
Out of the Blue: How Animals Evolved From Prehistoric Seas
by Elizabeth Shreeve, illustrated by Frann Preston-Gannon
Candlewick Press, 2021
More materials at www.ElizabethShreeve.com.

LESSON 4:
INVASION OF THE FISHAPODS!

When did vertebrate animals move ashore?
Why did they do it—and what did they find?

Lesson 4 highlights the evolution of tetrapods, the four-limbed animals that gave rise to famous animals like dinosaurs…and us!

Lesson Plan
Quick Dip Video
Classroom Activity: Fins to Feet Mini-Book

This curriculum features the STEM picture book
Out of the Blue: How Animals Evolved From Prehistoric Seas
by Elizabeth Shreeve, illustrated by Frann Preston-Gannon
Candlewick Press, 2021
More materials at www.ElizabethShreeve.com.

Lesson 4: INVASION OF THE FISHAPODS!

Lesson Plan

INVASION OF THE FISHAPODS! Around 400 million years ago, animals with backbones crawled onto dry land for the first time. What kind of critters were they? Why and when did they leave their watery homes—and how do we know? Answers take us back to the first chordate animals in the Cambrian Period and on through the Age of Fishes to recent discoveries of fossils that show the evolutionary transition from fish to tetrapods (four-limbed animals).

In **Lesson 4**, students delve further into the book and watch Quick Dip #4. They use creative story structure as a framework for a STEM/Lit activity, making "mini-books" that explore diversity and variation within ecosystems of long ago. This lesson helps children imagine how animals adapted to new conditions on shore long ago.

Learning Objectives

- ✓ I can show how the body structure of fish is similar to mine
- ✓ I can identify what types of animals are tetrapods, including amphibians, reptiles, birds, and mammals
- ✓ I can write and illustrate a story that shows how animals adapt to ecosystems

Time Required

This lesson can be managed in a single one-hour classroom session or divided into two.

1. Read from the book (focus on Devonian to Permian Periods); watch Quick Dip Video #4.
2. Classroom Activity – *Fins to Feet Mini-Book*

NGSS Focus: Variation and Diversity; Ecosystems

Performance Expectation (3-5): variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing

3-LS3-2. Use evidence to support the explanation that traits can be influenced by the environment.

LS3.B: Variation of Traits. Different organisms vary in how they look and function because they have different inherited information. The environment also affects the traits that an organism develops.

This curriculum features the STEM picture book
Out of the Blue: How Animals Evolved From Prehistoric Seas
by Elizabeth Shreeve, illustrated by Frann Preston-Gannon
Candlewick Press, 2021
More materials at www.ElizabethShreeve.com.

Lesson 4: INVASION OF THE FISHAPODS!

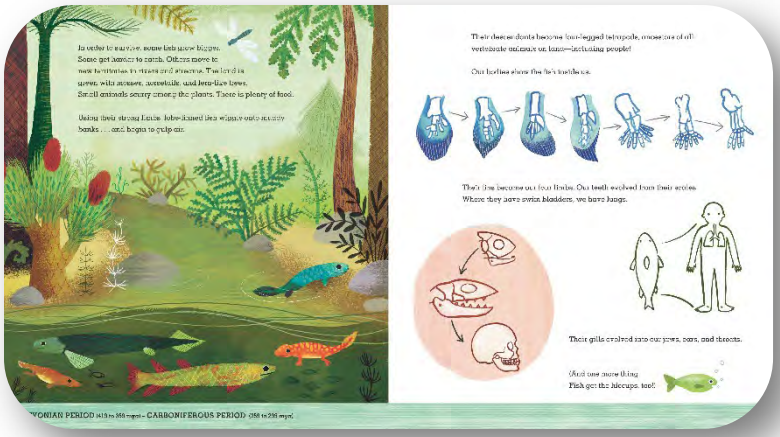
Materials Needed

- A copy of *Out of the Blue: How Animals Evolved from Prehistoric Seas*
- Quick Dip Video #4: INVASION OF THE FISHAPODS! (video available at www.elizabethshreeve.com or YouTube Elizabeth Shreeve Books
- Markers, pencils, blank paper
- Print-outs of worksheet charts (see below or in **Pages-to-Print Package)**
- Staples or clips

Video & Classroom Activity

STEP 1: Read and Prepare

1. Introduce the topic and ask students to think of a favorite animal from the book or from their own experience or imagination. They will be writing and drawing about that animal, then creating a story of how it might evolve as it adapted to conditions on land or in water.
2. Print copies of the Mini-Book Worksheets (see below or in **Pages-to-Print Package)**
3. Read aloud from the book, focusing on pages that follow the evolution of chordate animals from the Devonian/Age of Fishes to Permian Periods (up to the Permian Extinction).
   - Do fish have backbones? What are the advantages of having a backbone?
   - How would a fish need to change in order to live on dry land?
4. On the Devonian to Carboniferous spread, discuss how our bodies "show the fish inside us." One trait we share is the basic bone structure in our limbs. Using arms as the example, we have one bone in the upper arm, two bones between elbow and wrist, lots of small bones in our hands, and multiple fingers.
   - Can students feel this pattern in their arms? Wiggle some fingers!



This curriculum features the STEM picture book
Out of the Blue: How Animals Evolved From Prehistoric Seas
by Elizabeth Shreeve, illustrated by Frann Preston-Gannon
Candlewick Press, 2021
More materials at www.ElizabethShreeve.com.

STEP 2: Watch Quick Dip Video #4

Watch the **Quick Dip Video #4: INVASION OF THE FISHAPODS!** available with Teaching Videos at www.elizabethshreeve.com and at YouTube Elizabeth Shreeve Books

Discuss questions at the end of the video.

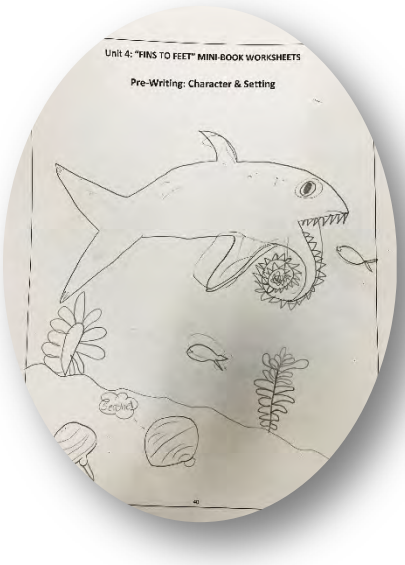
1. Animals with backbones are part of the chordate group. Can you name a chordate animal that lives in the ocean?
2. What is a tetrapod? Can you name a tetrapod that lives on land or flies in the air?
3. What are some parts of our bodies that are similar to those of fish? What are some parts that are different?
4. Can you imagine a land animal with three or five limbs instead of four?
5. If you could choose...how many legs or arms would YOU have?

For Grades 3+, be sure to check out other videos at YouTube Elizabeth Shreeve Books:

- "TAKE THE PLUNGE: Introduction to the Research and Writing Process"
- "TALKING TO THE SCIENTISTS: Interviews with Three Experts Behind the Book."

STEP 3: Pre-Writing

Now it's time to make a mini-book, starting with PRE-WRITING exercises of creating a character, establishing a setting, and deciding on a story problem or question.



This STEM/Lit activity encourages students to consider how animals adapt to new conditions. It uses a creative story structure as a framework for making original short books.

1. Supply each student with print-outs of the following charts and drawing/writing tools.

They will use these pages to describe a favorite ocean animal and its home. The animal can be from *Out of the Blue,* from a different book or video, or from their own imagination. To bring their story to life, they can even imagine BEING that animal!

2. Have students draw a picture and write words to describe their animal.
   - What does it look like? Does it have a shell? Does it have a soft squishy body, a backbone like a prehistoric shark, or an exoskeleton like a sea scorpion?
   - How does it move around? What does it eat? Is it a predator or prey?
   - Does it have a name (real or made-up)?
3. Have students describe the ocean scene using more pictures and words.
   - Does your animal live in warm, tropical seas, cold Arctic waters, or somewhere else? Does it live in the deep sea or near the surface?
   - What's around it? Are there sponges, corals, or a kelp forest? Other animals?

STEP 4: Make a Mini-Book

After pre-writing, students are ready to follow prompts on the worksheets, below, and assemble the mini-books. Make sure students make a cover using the worksheet below, including title, author/illustrator name, and artwork.

Prompts are:

Character

- What does it look like? Does it have a shell? Does it have a soft squishy body, a backbone like a prehistoric shark, or an exoskeleton like a sea scorpion?
- How does it move around? What does it eat? Is it a predator or prey?

Setting

- Does your animal live in warm, tropical seas, cold Arctic waters, or somewhere else? Does it live in the deep sea or near the surface?
- What's around it? Are there sponges or corals? A kelp forest? Other animals?

Note: It maybe be useful to remind students that in real life, animals don't actually "make decisions" during the course of evolution. Instead, when conditions change, they move to new locations, adapt new ways to survive, or go extinct. But this activity calls for artistic license!

Lesson 4: INVASION OF THE FISHAPODS!

STEP 4: Present & Discuss

Each student now has a mini-book of several pages.

- Ask students to share their stories. What were their original ocean animals?
- Did their animal move onto land or stay in the water? Why?
- How does their animal's great-great-great-great (many more "greats"!) grandchild look and live differently than its distant ancestor? How did the family line (lineage) adapt and change (evolve) over time?
- Did those changes happen quickly or over a long time?

This activity reinforces:

- Ways in which animals evolve in relationship to their environments.
- How family lineages can diverge through the course of evolution, resulting in animals that look and behave differently.
- Reporting to a group on a topic, using descriptive details.

Visit www.elizabethshreeve.com for more activities and resources.

Bye for now!

Lesson 4: "FINS TO FEET" MINI-BOOK WORKSHEETS

COVER PAGE:

Title, author/illustrator's name, artwork

Lesson 4: "FINS TO FEET" MINI-BOOK WORKSHEETS

Pre-Writing: Character & Setting

Write notes and make sketches about an ocean animal ("character") and its home ("setting").

Character

- What does it look like? Does it have a shell? Does it have a soft squishy body, a backbone like a prehistoric shark, or an exoskeleton like a sea scorpion?
- How does it move around? What does it eat? Is it a predator or prey?

Setting

- Does your animal live in warm, tropical seas, cold Arctic waters, or somewhere else? Does it live in the deep sea or near the surface?
- What's around it? Are there sponges, corals, or a kelp forest? Other animals?

Pre-writing is for brainstorming. Get messy, go wild, work fast!

Lesson 4: "FINS TO FEET" MINI-BOOK WORKSHEETS

WHAT HAPPENS NEXT?

Competition is heating up in the ocean.
There are too many predators and too little food. Yikes!

Stories usually include some kind of problem or question. So, guess what? The ocean's changing…and your animal's life is about to change, too. How will it survive? How will it adapt (over many generations!) to new places? Which brings us to…

THE FIRST BIG DECISION FOR YOU, THE AUTHOR…

- Will your animal become a **land dweller** and adapt to new conditions on land? (Go to **"A")**
    - Or will it remain an **ocean dweller** and adapt new ways to survive? (Go to **"B")**

A. Story prompts for Land Dwellers: IT'S A WHOLE NEW WORLD!

Through Earth's long history, many types of ocean animals have moved onto land and adapted to new ways of life. Over time, those populations of animals changed a lot.

- Why did your ocean animal go onto land? (More food? Fewer predators? Anything else?)
- How will life on land be different? (Breathing, moving, eating, predators, drying out)

Next, imagine the great-great-great-great *(many more "greats"!)* grandchild of your animal that has moved onto land.

- What would it look like?
- Would it live in a tree? On the beach?

On the next pages, describe your animal's story and its descendants after millions more years in the ocean. Use pictures and words!

B. Story prompts for Ocean Dwellers: LIFE IS SWISHY IN THE SEA!

Through Earth's long history, many other types of animals have stayed in the ocean. Over millions of years, they changed too!

- Why was your ocean animal happy to stay in the water? (Its body is squishy? It needs to float? It was able to hide from predators—or maybe it's already the top predator?)

Next, imagine the great-great-great-great *(many more "greats"!)* grandchild of your ocean animal.

- Has its body changed or stayed the same?
- Has the ocean changed?

On the next pages, describe your animal's story and its descendants after millions more years in the ocean. Use pictures and words!

Lesson 4: “FINS TO FEET” MINI-BOOK WORKSHEETS

Describe your animal as they look BEFORE moving onto land or evolving further in the ocean

Lesson 4: “FINS TO FEET” MINI-BOOK WORKSHEETS

Millions of Years Later…
how do they look and behave?

Lesson 4: "FINS TO FEET" MINI-BOOK WORKSHEETS

C. PUT IT ALL TOGETHER

Combine your pages, including cover, pre-writing, descriptions of original animal, how it adapted to changing conditions, and its descendants. Add more here, if you like. Staple or clip together…

Now you've got a mini-book!

LESSON 5: BACK TO THE BLUE

What about that first question about the hippo, the dolphin, and the shark? Which two are the closest relatives?

Lesson 5 provides the answer and explains the nature of inheritance and common ancestry

Lesson Plan

Quick Dip Video

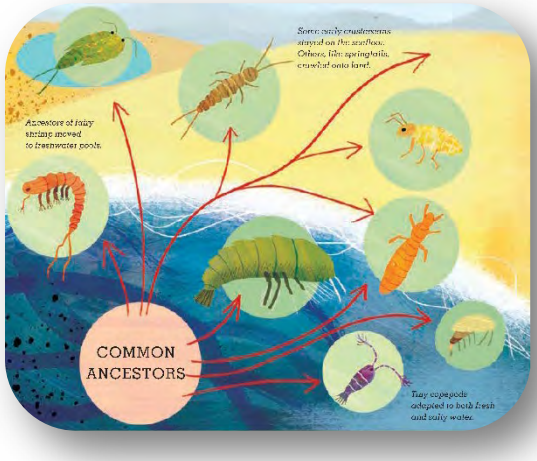
Classroom Activity: How to Climb a Family Tree

This curriculum features the STEM picture book
Out of the Blue: How Animals Evolved From Prehistoric Seas
by Elizabeth Shreeve, illustrated by Frann Preston-Gannon
Candlewick Press, 2021
More materials at www.ElizabethShreeve.com.

Lesson Plan

COMMON ANCESTRY, an important concept in evolutionary biology, is often misunderstood. Students may have heard that humans "descend from monkeys." In fact, humans share long-ago common ancestors with monkeys and all other primates, but monkeys have been evolving and changing ever since that split—just like humans! If students can understand this, they'll have a major leg-up in future life science studies.

Lesson 5 answers the opening question of *Out of the Blue*, using hippos and dolphins to explain inheritance and common ancestry. After a review of the book and Quick Dip #5, the classroom activity explores possibilities for future evolution of living animals. Supplementary materials show how scientists organize relationships of living things through geologic time.



Learning Objectives

- ✓ I can develop a diagram showing how animals descended from common ancestors long ago.
- ✓ I can describe how whales and dolphins changed as they adapted to life in the ocean.
- ✓ I can understand the geologic time scale and the importance of mass extinctions Earth history.

Time Required

This lesson can be managed in a single one-hour classroom session or divided into two.

1. Read from the book (review opening question, then focus on Permian Extinction through end); watch Quick Dip Video #5.
2. Classroom Activity – *How to Climb a Family Tree*

NGSS Focus: Inheritance and Common Ancestry; Geologic Time Scale

Performance Expectation (3-5): organisms have different inherited traits.

3-LS3-1. Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms

LS3.A: Inheritance of Traits. Many characteristics of organisms are inherited from their parents. Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment.

Lesson 5: BACK TO THE BLUE

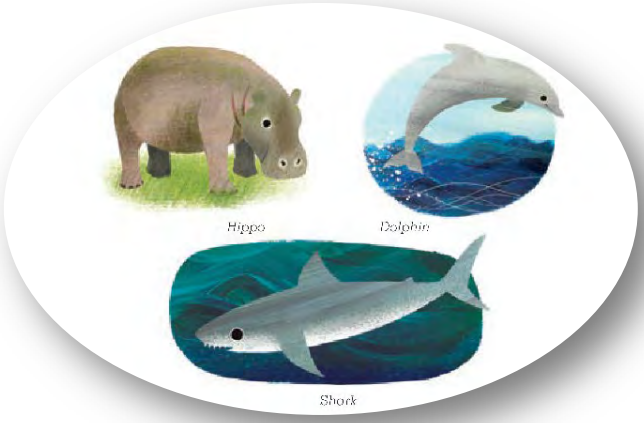
Materials Needed

- A copy of *Out of the Blue: How Animals Evolved from Prehistoric Seas*
- Quick Dip Video #5: BACK TO THE BLUE (video available at www.elizabethshreeve.com or YouTube Elizabeth Shreeve Books
- Markers, pencils, and print-outs of worksheets (see below or in **Pages-to-Print Package)**

Video & Classroom Activity

STEP 1: Read and Prepare

1. Print and trim the "COMMON ANCESTOR ANIMALS" into tags; put into a container.
2. Introduce the topic and tell students that they will be time-traveling—a million years into the future! Starting with a COMMON ANCESTOR animal selected from the container of tags, they will invent and describe two DESCENDANT ANIMALS that represent separate branches of a family tree.
3. Confirm definitions of COMMON ANCESTOR (an ancestor shared by two or more DESCENDANTS) and FAMILY TREE (diagram showing how animals within a family lineage are related through time).



4. Open the book to the first page showing the dolphin, shark and hippo; ask students to remember their guesses back in Lesson 1. Next, read through the pages near the end of the book, from the Permian Extinction through the end.
    - Were students surprised that hippos and dolphins are related?
    - Ask students to think of evidence that scientists use to trace how living animals are related to extinct animals from long ago (*e.g., fossils, anatomy, embryos, and DNA*). Explain that scientists use multiple sources of evidence to confirm family relationships through time.

Lesson 5: BACK TO THE BLUE

STEP 2: Watch Quick Dip Video #5

Watch the **Quick Dip Video #5: BACK TO THE BLUE:**available with Teaching Videos at www.elizabethshreeve.com and at YouTube Elizabeth Shreeve Books

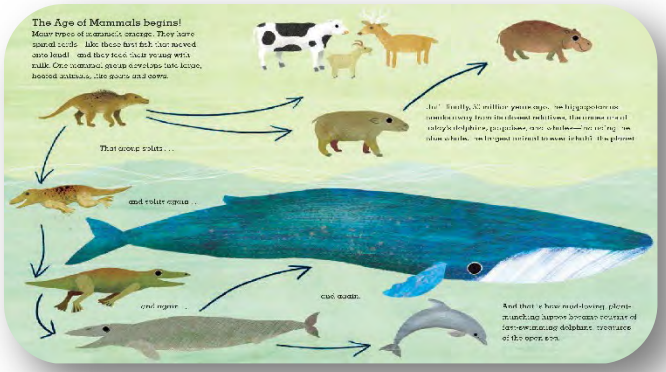
Discuss questions at the end of the video.

1. Why would a land animal start living near or in the water?
2. How would its body change as it became adjusted to a watery home?
3. What kind of food would it eat?
4. What is a mass extinction?
5. What happens during speciation?
6. Can you name a group of animals that died out in the K-Pg Extinction, 66 million years ago?
7. What is a "common ancestor"?

For Grades 3+, be sure to check out this other video at YouTube Elizabeth Shreeve Books:

- "TALKING TO THE SCIENTISTS: Interviews with Three Experts Behind the Book."

STEP 3: How to Climb a Family Tree



It's time to step into the FUTURE! In this activity, students will invent two animals of the future. Both animals will be DESCENDANTS of a living animal of today—the COMMON ANCESTOR. What will those future animals look like? Will they survive or go extinct?

Over time, both descendants will have adapted and changed in different ways. It's up to each student to decide! They can select helpful traits from the COMMON ANCESTOR or add new adaptations that will make survival more likely…or determine that some branches of the family tree will go extinct. Ideas to reinforce:

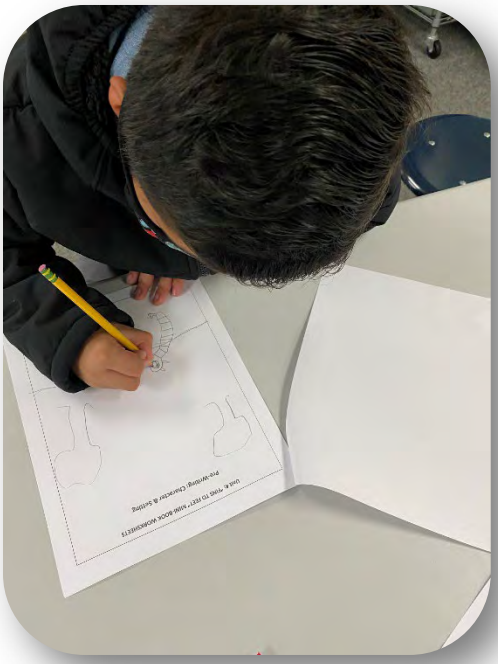
- *Evolution never stops! Life-forms are always changing and adapting through time.*
- *Species are constantly going extinct, but some give rise to new forms that are similar in some ways and different in other ways.*

Lesson 5: BACK TO THE BLUE

1. Have each student select one of the COMMON ANCESTOR tags from the container.

   Optional topic: Some of these animals are currently endangered while others are part of healthy populations. Can your students name an animal with a body shape that has not changed much since prehistoric times (*e.g., horseshoe crab)?* What types of animals seem the most resilient and likely to survive? Which are most sensitive to changes to their ecosystems and climate?

2. Provide each student with worksheet charts (below) and blank paper. Ask them to fill out information on their COMMON ANCESTOR animal. What body parts enable that animal to move, feed, and protect themselves in today's world? Where do they live? What types of habitats do need? *Note: This is a chance for students to dig into additional research beyond the book. If desired, teachers can add more animals that live nearby.*



3. Next, imagine that we have time-traveled a million years into the future. The COMMON ANCESTOR has gone extinct but left behind a number of DESCENDANTS. Those future critters have changed in response to different conditions and environments, finally splitting off to form separate new species and populations. As a result, we now have:

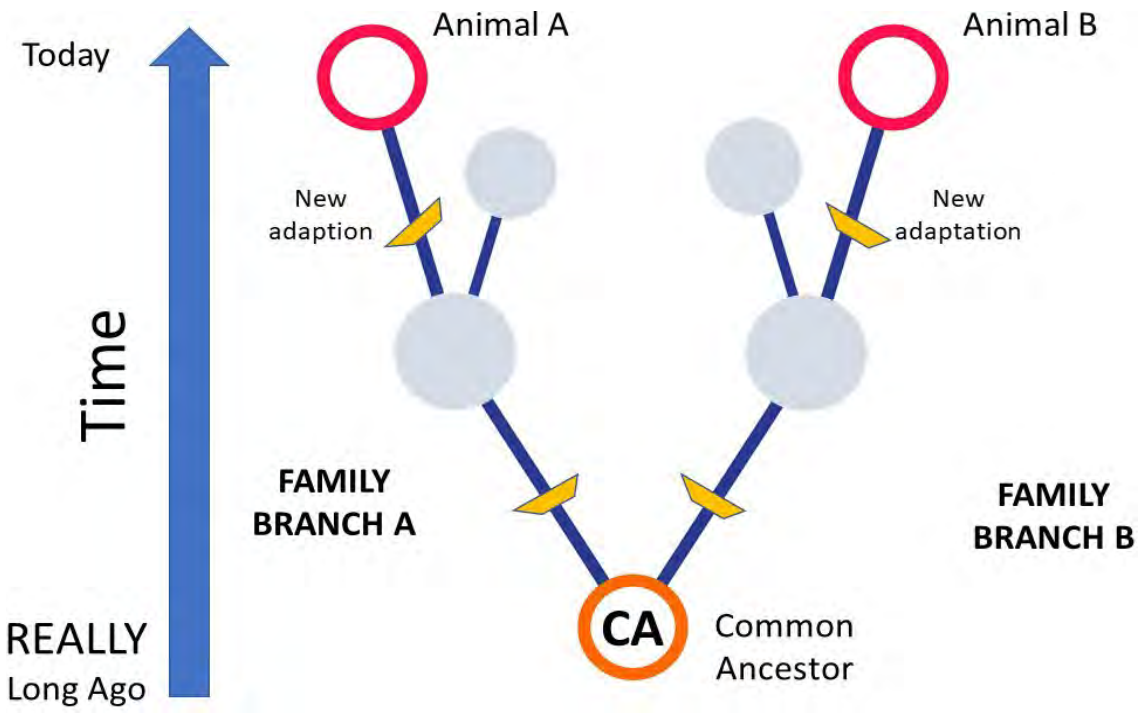
   - Animal A (a member of Family Branch A)
   - Animal B (a member of Family Branch B)

4. On the worksheet, students can decide on the CONDITIONS ("selective pressures") that shaped the evolution of the descendant animals. What new adaptations will make Family Branch A different than Family Branch B? Will one branch move to a place with dry, cold conditions and adapt thick coats of hair? Will another branch evolve a new way to fly or swim? It's up to each student to decide!

5. Now it's time to describe **Animal A** and **Animal B**. Use the worksheets to describe the future descendants of the COMMON ANCESTOR. Remember a million years has passed! Through time, these cousins have come to look and behave very differently—but they still have one or more body parts that are similar to that long-ago great-great (*a lot more "greats")* grandparent. It might not even be visible, but it's there.

6. The last big question for students to decide: will both Animal A and Animal B manage to adapt and survive…or will they go extinct?

Lesson 5: BACK TO THE BLUE



Family Tree Diagram

STEP 4: Discuss

Students have now invented a family tree including a common ancestor (a living animal of today's world) and two future descendants. Through time, many members of the family may have gone extinct but Animal A and Animal B have survived…at least so far.

- Ask students to describe their common ancestor and the adaptations and changes that happened over time. What adaptations helped some members of the family lineages to survive? What body features did the adaptations include? What behaviors?
- What was the common feature that the descendant animals of the future still have in common with their shared ancestor?
- How are the two living animals different from each other and from their common ancestor? How are they similar?

Lesson 5: BACK TO THE BLUE

This activity reinforces:

- Animals that look different and have different lifestyles (like a hippo and a dolphin) may actually be descended from common ancestors.
- Common ancestry can be identified by anatomical features, such as skeletal structures. Other evidence includes dates of fossils (based on geologic samples), embryonic development, and DNA. This evidence enables scientists to confirm what they observe in the body shapes (anatomy) of fossils and living creatures.
- More closely related animals usually share a more recent common ancestor.

Visit www.elizabethshreeve.com for more activities and resources.

Bye for now!

LESSON 5: HOW TO CLIMB A FAMILY TREE

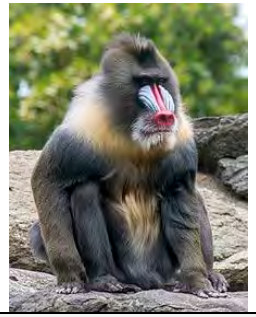
COMMON ANCESTOR ANIMALS

Print and cut into tabs for classroom activity (one animal per tab)

Alligator REPTILE		**Anteater** **(Giant Anteater)** MAMMAL	
Bat **(Megabat/Fruit Bat)** MAMMAL		**Beetle** **(Lady Beetle/bug)** INSECT	
Capybara MAMMAL		**Crab** CRUSTACEAN	
Elephant MAMMAL		**Frog** **(Golden Frog)** AMPHIBIAN	

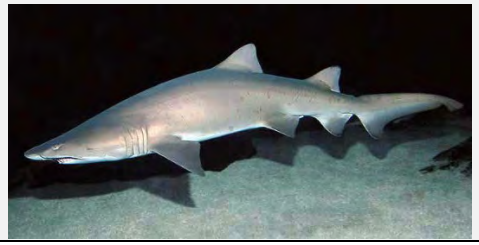
This curriculum features the STEM picture book
Out of the Blue: How Animals Evolved From Prehistoric Seas
by Elizabeth Shreeve, illustrated by Frann Preston-Gannon
Candlewick Press, 2021
More materials at www.ElizabethShreeve.com.

LESSON 5: HOW TO CLIMB A FAMILY TREE

Horseshoe Crab CHELICERATA		**Jellyfish** CNIDARIAN	
Mandrill MAMMAL		**Millipede** MYRIAPOD	
Mosquito INSECT		**Octopus** MOLLUSK	
Ostrich BIRD		**Salmon** FISH	

This curriculum features the STEM picture book
Out of the Blue: How Animals Evolved From Prehistoric Seas
by Elizabeth Shreeve, illustrated by Frann Preston-Gannon
Candlewick Press, 2021
More materials at www.ElizabethShreeve.com.

LESSON 5: HOW TO CLIMB A FAMILY TREE

Scorpion CHELICERATA		**Sea Urchin** ECHINODERM	
Shark **(Gray nurse shark)** FISH		**Worm** **(Bristleworm)** ANNELID	
Other animals to be added			

This curriculum features the STEM picture book
Out of the Blue: How Animals Evolved From Prehistoric Seas
by Elizabeth Shreeve, illustrated by Frann Preston-Gannon
Candlewick Press, 2021
More materials at www.ElizabethShreeve.com.

LESSON 5: HOW TO CLIMB A FAMILY TREE

Name of Common Ancestor Animal (from tag): _____

**Draw your COMMON ANCESTOR animal in the space below.
Label the body parts that enable them to move, feed, and protect themselves. **

Now circle the body features that will NOT change into the future. These might help them to survive! For example:

- Number of legs
- Types of bones (heavy, light, stiff or flexible)
- Type of skeleton (on outside or inside of body)
- Type or color of hair or skin
- Horns, scales, body armor, or another feature

This curriculum features the STEM picture book
Out of the Blue: How Animals Evolved From Prehistoric Seas
by Elizabeth Shreeve, illustrated by Frann Preston-Gannon
Candlewick Press, 2021
More materials at www.ElizabethShreeve.com.

LESSON 5: HOW TO CLIMB A FAMILY TREE

Describe your Common Ancestor animal:

_____

_____

_____

_____

_____

Habitat (where does it live?)

_____

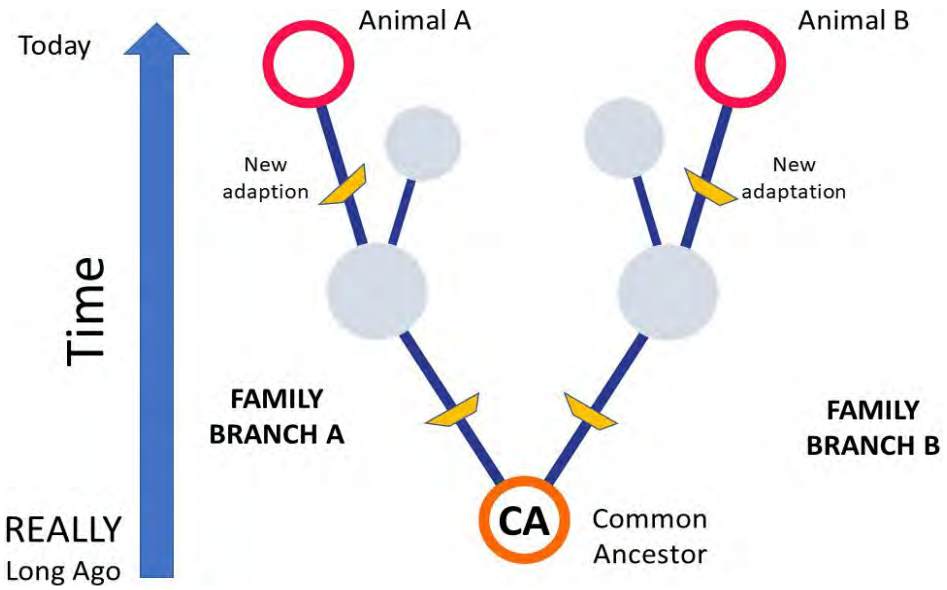
_____

_____

_____

_____

FAMILY TREE DIAGRAM



A MILLION YEARS GOES BY!

The COMMON ANCESTOR animal goes extinct, but its offspring live for many generations.

Two branches of the family split apart, becoming more and more different as they adapt to new conditions.

These changes produce two cousins:

Animal A and Animal B.

They are both DESCENDANTS of the Common Ancestor but they are very different from each other.

How are they different?

YOU DECIDE!

This curriculum features the STEM picture book
Out of the Blue: How Animals Evolved From Prehistoric Seas
by Elizabeth Shreeve, illustrated by Frann Preston-Gannon
Candlewick Press, 2021
More materials at www.ElizabethShreeve.com.

LESSON 5: HOW TO CLIMB A FAMILY TREE

Animal A (a member of Family Branch A)

Select conditions that shaped the evolution of this animal:

_____Drier climate
_____Wetter climate
_____Hotter climate
_____Colder climate
_____Volcanoes erupting like crazy
_____Changes to atmosphere
_____New predators, pests, diseases
_____Physical barriers like mountains or rivers
_____Asteroid Strike
_____Alien Invasion!
_____Other

As a result of these conditions, Animal A has changed.
What does it look like? How does it survive?

Animal A name: _____

Draw your Animal A on the next page

Animal B (a member of Family Branch B)

Select conditions that shaped the evolution of this animal:

_____Drier climate
_____Wetter climate
_____Hotter climate
_____Colder climate
_____Volcanoes erupting like crazy
_____Changes to atmosphere
_____New predators, pests, diseases
_____Physical barriers like mountains or rivers
_____Asteroid Strike
_____Alien Invasion!
_____Other

As a result of these conditions, Animal B has changed.
What does it look like? How does it survive?

Animal B name: _____

Draw your Animal B on the next page

This curriculum features the STEM picture book
Out of the Blue: How Animals Evolved From Prehistoric Seas
by Elizabeth Shreeve, illustrated by Frann Preston-Gannon
Candlewick Press, 2021
More materials at www.ElizabethShreeve.com.

LESSON 5: HOW TO CLIMB A FAMILY TREE

Draw your Animal A in the space below

Draw your Animal B in the space below

This curriculum features the STEM picture book
Out of the Blue: How Animals Evolved From Prehistoric Seas
by Elizabeth Shreeve, illustrated by Frann Preston-Gannon
Candlewick Press, 2021
More materials at www.ElizabethShreeve.com.

LESSON 5: HOW TO CLIMB A FAMILY TREE

Describe **ANIMAL A** including new/weird body features or adaptations

_____

_____

_____

_____

_____

_____

Habitat (where does it live?)

_____

_____

_____

_____

_____

_____

Describe **ANIMAL B** including new/weird body features or adaptations

_____

_____

_____

_____

_____

_____

Habitat (where does it live?)

_____

_____

_____

_____

_____

_____

This curriculum features the STEM picture book
Out of the Blue: How Animals Evolved From Prehistoric Seas
by Elizabeth Shreeve, illustrated by Frann Preston-Gannon
Candlewick Press, 2021
More materials at www.ElizabethShreeve.com.

Out of the Blue: How Animals Evolved from Prehistoric Seas

CURRICULUM

ELIZABETH SHREEVE is the author of the award-winning *Out of the Blue: How Animals Evolved from Prehistoric Seas* (Candlewick, May 2021) for which she has created videos and activities for kids and teachers. Upcoming books on evolution include *The Upside-Down Book of Sloths, The Oddball Book of Armadillos*, and *Fast Feet, Big Brains: The Story of Human Origins* (Norton Young Readers, publications in 2023-2024). Her books for kids celebrate the origins and diversity of life on Earth, combining well-researched science with kid-friendly narratives.

Elizabeth lives in northern California with her family, including Hector the PaleoDog. Visit her at https://elizabethshreeve.com/

@ShreeveBooks

YouTube Elizabeth Shreeve Books