Shape of Life
The Story of the Animal Kingdom

Animating the Tree of Life

Explore evolution with playful phylogenetic stories

Overview

Students first watch the animated short film "Tree of Life." Then they discuss their ideas with a partner about the science story being told and the art forms utilized. They then watch the film about the evolution of life again in an interactive format, recording observations and questions about it with the support of a graphic organizer. Afterwards, they share their ideas and questions with the class and the teacher facilitates discussion, including about the artful aspects of the film. Students then create their own cartoons about a modern group of organisms and how they are thought to have evolved over time. Enrichments and extensions are listed towards the end of the lesson to help engage all students.

Objectives

- Students will explore an animated "Tree of Life." They will record observations and questions about it and discuss them as a class.
- Students will demonstrate understanding that all living things can trace their existence to the beginning of life on Earth about 3.7 billion years ago. They will communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence, orally and in writing.

Subjects

Science, Writing, and Art

Grades 6–16

Time

45–90 minutes

Vocabulary

Adaptations, common ancestry, biological evolution, phylogenetic tree

Standards

MS-LS4-2; HS-LS4-10
See details and more standards met in the table at the end of the lesson.

Screenshot from the "Tree of Life" video featuring art by Ray Troll

Teacher Background

Evolution and Phylogenic Trees

- See the Teacher Background section in the "Constructing the Tree of Life" lesson: shapeoflife.org/lesson-plan/constructing-tree-life.
- Additional sources are listed in the Expand Knowledge + Skills section at the end of the lesson.

Fossilized skull of a *Tyrannosaurus rex* dinosaur, which went extinct about 65 million years ago. Photo by Jill White from Pixabay

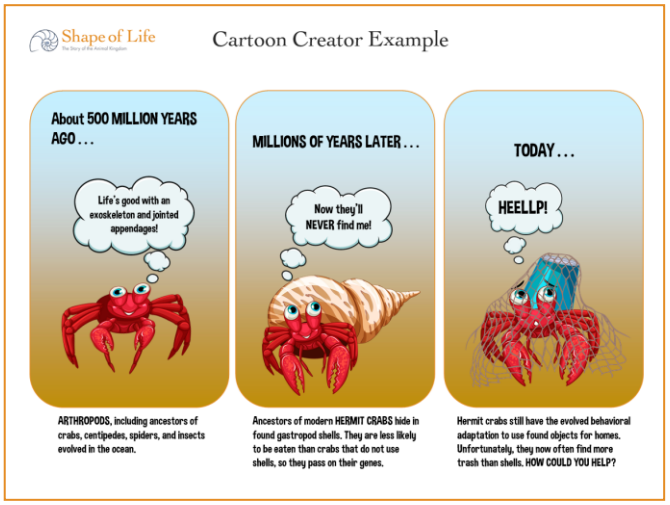
Art and Science: Mutually Supportive

Integrated STEAM lessons can use artmaking in such a way that the art and the science mutually reinforce each other, deepening and adding nuance to the understandings in both domains. For example, this lesson asks students to explore animated art used to teach about evolution, then use their own cartoon art to teach about the evolution of a favorite species. This approach allows art to be part of the process through which knowledge is generated and shared. As a learning approach, the value lies in familiarizing students with this process of creative inquiry / generative expression and fostering their ability to critique and reflect on it, rather than simply arrive at a specific artifact.

Research has shown that ALL making can be beneficial. Any opportunity to push creative expression and explorations around manipulating the material world is positive, especially in today's digitally mediated reality, in which the skills of thinking through our interactions with the physical world are deemphasized. It is important to open room for making / art and creativity.

Materials + Preparation

- Prepare to show the "Tree of Life" video (without interactive content) from the Shape of Life website or Vimeo: vimeo.com/934690484/fa958016ed.
- Print copies of the "OWL Organizer" handout for each student, or prepare for them to create it in science notebooks. It can be downloaded from the lesson page: shapeoflife.org/lesson-plan/animating-tree-life
- Print copies of the "Cartoon Creator" handout (3 panel and/or 6 panel) and example from the lesson page, or prepare to show them with a data projector.
- Prepare for student pairs to use the "Tree of Life" interactive animated video: engagingeverystudent.com/tree-of-life-animation.
- Prepare to show "The Tree of Life" poster with a data projector or have students view it on their devices: shapeoflife.org/sites/default/files/global/treeoflife.pdf.
- Science notebook and pencil or pen for each student
- Whiteboard or chart paper and markers
- *Optional:* Prepare for students to use the "Tree of Life" online puzzle individually or in pairs: engagingeverystudent.com/tree-of-life-game.
- *Optional:* Computer with Internet connection and data projector
- *Optional:* Colored pencils and/or markers for students to share



The Cartoon Creator Example from Shape of Life

Teaching Suggestions in the 5E Model

Engage

- Students view the "Tree of Life" poster and video and discuss the story being told. (10 min.)
    - Share "The Tree of Life" painting with a data projector or large monitor. Tell students that it is an example of a **phylogenetic tree**. Write the term on the board and ask students to write it in science notebooks. Tell them it was Charles Darwin who chose the tree of life as a metaphor for relatedness of living things.
    - Ask students what they know about how evolution works and discuss their ideas. Then ask them what evidence exists to support the theory of evolution. Why do scientists believe what they do about it?
    - Tell students that you will be showing them a video from Shape of Life that features the same fun art by Ray Troll. Ask them to think about the important science story being told by the animated art and the narrator.
    - Ask students to also think about how the various art forms, including animations, storytelling, music, and sound effects helps them to be engaged by and understand the science. Ask them to reflect on how the artistic approach can be different from, and supportive of, the scientific approach to the world.
    - Show the whole video (5:20) to the class without stopping. When the video ends, ask students to turn to a neighbor and discuss the science being explained, as well as their observations of the artist elements, such as animation and storytelling.
    - After a couple minutes, ask the groups to share their ideas with the class. One or more of them may be able to explain that the video is telling a brief history of how life evolved on Earth (the theory of evolution) and how living things are related to each other.

Ray Troll's painting "The Tree of Life" that he created for Shape of Life. Learn more and see a larger version at shapeoflife.org/blog/making-new-tree-life-shape-life.

Screenshot from the "Tree of Life" video

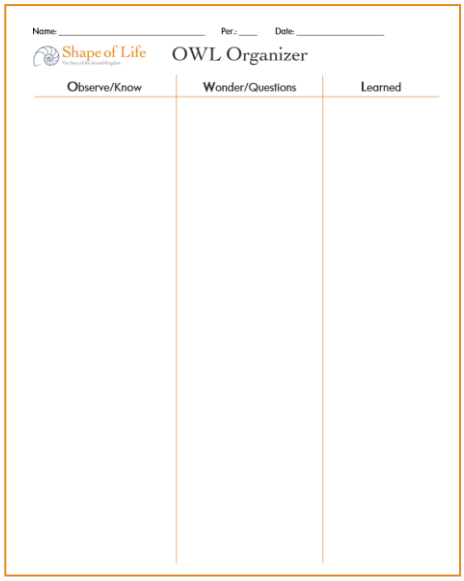
Explore

- Students record ideas about the video and the theory of evolution with a graphic organizer. (10–15 min.)
    - Pass out copies of the "OWL Organizer" handout for each student, or ask them to create the three labeled columns in their science notebooks. Explain that:
        - In the first column, they should record what they Observe in the video and/or know about the theory of evolution and the "Tree of Life." They should also list interesting artistic elements they notice, such as memorable animations and things the narrator says. Share a couple examples with students, such as how the narrator says this at (1:04):

- "Simple at first, sponges: sieving seawater to make it sweeter for jellyfish and ctenophores…"
- Tell students they can write down poetic phrases like that, which make the science more fun and memorable.
- Point out animated art that helps to engage the viewer and convey science ideas, such as the octopus (2:45) and waving human (4:47).

  - In the second column they should record what they Wonder about the video and/or evolution (questions).
  - In the third column they should record what they Learned from the video and class discussions.

- Ask the students to watch the video again. They could also watch the interactive version of the video with their partner at engagingeverystudent.com/tree-of-life-animation, or you could wait until a third viewing for that version if you have time. Tell students they should click the buttons that pop up, some of which have questions they should try to answer. Ask them to also record ideas and/or questions about the science in the film, as well as how the art helps to communicate the science.


Name: _____ Per: ___ Date: _____

Shape of Life OWL Organizer

Observe/Know	Wonder/Questions	Learned

The OWL Organizer handout from Shape of Life

- If you would prefer to show the regular version of the video again to the whole class, you can pause it after important points to give students more time to record ideas and/or questions on the organizer. Options include:

  ~ 0:25 First cells (bacteria)

  ~ 0:35 Eukaryotes evolve

  ~ 1:07 First animals, e.g. sponges

  ~ 1:20 Animals can move intentionally

  ~ 1:49 Spiders were among the first to pioneer life on land

  ~ 2:00 Insects branch from the crustaceans

  ~ 2:48 Octopuses are most intelligent invertebrate

  ~ 3:10 Vertebrates evolve

  ~ 3:35 Lobefins (fish relatives) begin to inhabit land

  ~ 4:00 Evolution of waterproof egg marks evolution of reptiles

  ~ 4:25 Evolution of mammals

Explain

3. Students share their ideas and discuss important concepts of evolution as a class. (10 min.)

   - Ask students to share the ideas and questions they recorded on the organizer with the class. Discuss student ideas, including those about both the science and the various art forms used in the film. Ask: How do the art forms, including animations, storytelling, music, and interactive elements help them to them understand the science? They

might point out animated animals they liked, or memorable things the narrator said.

- Fill in additional details about scientists' current understanding of evolution, highlighting popups in the video that the students didn't mention. Depending on the level of your students and time available, you might include more details below..
    - Archaea were only discovered in the 1970s. They live in extreme environments where other organisms can't survive. Ask students: "Why does the narrator call the archaea dark companions?" (They live in dark places like hydrothermal vents in the deep ocean. See "The Microbes That Keep Hydrothermal Vents Pumping" by the Smithsonian Ocean Team for fascinating background info: ocean.si.edu/ecosystems/deep-sea/microbes-keep-hydrothermal-vents-pumping.
    - The ancestors of plants evolved from green algae in the ocean and colonized land only about 515 million years ago, well after animals had evolved. Explain that it was misleading when plants were shown on a stump (land) at about 0:55 in the video, because terrestrial plants didn't evolve before fungi and animals split.
    - Discuss how during the Cambrian period, often called the Cambrian Explosion, the body plans of most animals alive today had evolved. The ancestors of the arthropod, mollusc, echinoderm and chordate branches were found throughout the seas. See "Timeline: The Evolution of Life." New Scientist: newscientist.com/article/dn17453-timeline-the-evolution-of-life.
    - Echinoderms that diversified 518 million years ago were much more diverse than they are today. They evolved from bilateral ancestors. Modern radial echinoderms, such as sea stars and urchins, have bilateral larvae.
        - You might also ask the students to think of organisms that have certain shared traits.
        - For example, they can share examples of bilaterally symmetric animals, such as vertebrates (like fish, cats, and humans), flatworms, common worms, clams, snails, octopuses, crustaceans, insects, and spiders. All of the groups evolved from common ancestors hundreds of millions of years ago.
    - The first vertebrate was probably similar to a lamprey, hagfish, or lancelet. See "Ancient fish reveals how vertebrates put their heads together" from Natural History Museum, London: nhm.ac.uk/discover/news/2023/september/ancient-fish-reveals-how-vertebrates-put-heads-together.html.

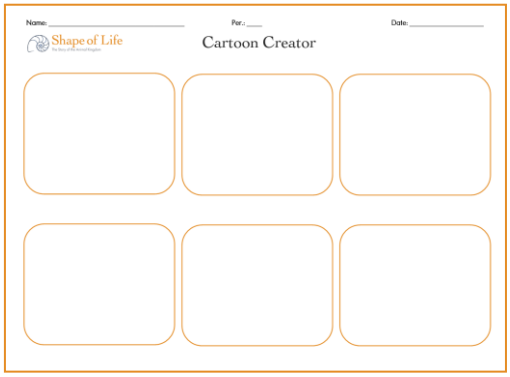
Fossil of an extinct trilobite
Image by Daderot CC0

    - Fossil evidence shows that animals were exploring the land 500 million years ago. The first animals to do so were probably the ancestors of centipedes and millipedes. About 420 million years ago, after the Cambrian Explosion, other arthropods moved onto land and evolved into early spiders.
    - Ammonites, in the cephalopod group, lived in shallow seas around the world. They built a chambered shell that they used for buoyancy. Ammonites are now extinct, but one relative, the nautilus, is still alive today. Source: Natural History Museum, London: nhm.ac.uk/discover/what-is-an-ammonite.html.

- Birds are the only living descendants of dinosaurs.
- One of the first mammals was a small 'shrew-like' animal that measured around 20 cm in length. They existed at the same time as some of the oldest dinosaurs. Source: Natural History Museum, London: nhm.ac.uk/press-office/press-releases/earliest-known-mammal-is-identified-using-fossil-tooth-records.html.
- Placentas (and live birth) in mammals probably evolved right before the asteroid killed off the dinosaurs 65 million years ago. Although placentas appeared once in the common ancestor of mammals, live birth has arisen independently multiple times within other classes, such as fish and reptiles.
- Several *Homo* (human) species existed at the same time along with *Homo sapiens*. Humans most likely evolved from *Homo heidelbergensis*, the common ancestor we share with Neanderthals, our closest extinct relatives. See Smithsonian: humanorigins.si.edu/evidence/human-fossils/species/homo-sapiens.
- From about 40,000 years ago, *Homo sapiens* were the last humans standing out of a large and diverse group of bipedal hominins. Our closest living relatives are the great apes.

- Explain that common ancestry and biological evolution are supported by multiple lines of evidence. Ask students to share their ideas about the evidence supporting the science of evolution (fossils, radio carbon data, DNA evidence, similarities between related organism, etc.)

6. Students create their own cartoons about the evolution of a group of modern organisms. (15–20 min.)



The 6-panel version of the Cartoon Creator from Shape of Life

- Ask students to work with a partner to create a 3–6 panel cartoon about a modern group of organisms, such as insects, crustaceans, reptiles, or mammals, or an extinct group of animals, and how scientists believe their ancestors evolved over time. Pass out copies of the "Cartoon Creator" handout and example, or show them with a data projector.

  Encourage students to:

  - Start by brainstorming ideas in science notebooks, then documenting the process of idea development to fully elaborated ideas for their science cartoons.
  - Utilize inquiry methods of observation, research, and experimentation in the process of planning and artmaking.
- Encourage students to incorporate evidence for evolution, such as fossils, similarities between related organisms, and DNA evidence. They can also include fun speech bubbles or thought bubbles that explain concepts to help engage other students.
- Ask students to think about how the visual art and writing will help teach the science concepts in fun ways.
- Ask the groups to show you drafts of their cartoons when they are ready, and encourage them to be ready to explain their cartoon art and the science to the class.
- Please share completed student cartoons with Denise Ryan from Shape of Life at denisearyan8@gmail.com. We will be happy to send you the beautiful "The Tree of Life" poster from Ray Troll as a thank you. 😊

Evaluate

7. Student sharing / discussion / reflection / writing (5–15 min.)

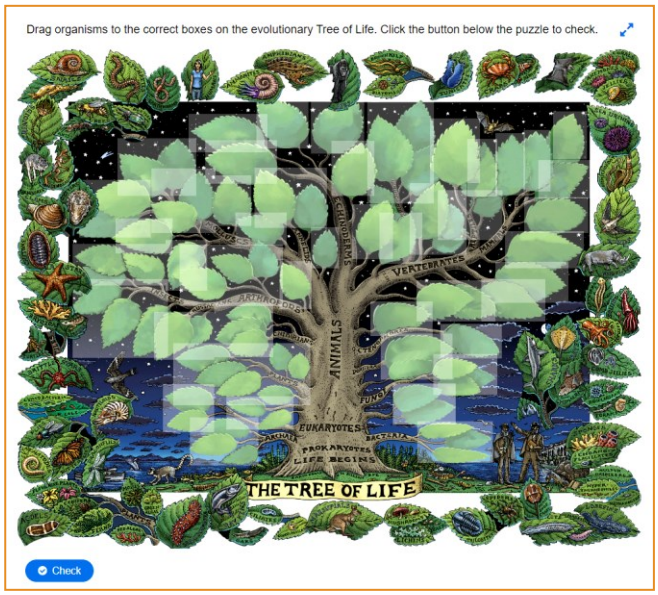
    - Ask students to share their completed cartoons with the class using a document camera, if available. They should also explain their art and how they are using it to explain the science.
    - Ask students to record written reflections about the art and science of the animation, including about how they think art can help communicate science. Reflections could be added to science notebooks and/or to the Learned column on the OWL Organizer.
    - They can also apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships. (MS-LS4-2)

8. Review notebooks, organizers, and cartoons.

    Provide feedback. You may also wish to give students a rubric when you ask them to create projects, such as the one on the "Constructing the Tree of Life" lesson page: shapeoflife.org/lesson-plan/constructing-tree-life.

Enrich / Extend

- Students play the online Tree of Life game.
    - Ask students to work in pairs to complete the online version of the Tree of Life puzzle at engagingeverystudent.com/tree-of-life-game.
    - See the "Constructing the Tree of Life" lesson from Shape of Life for details and a paper-based version of the game: shapeoflife.org/lesson-plan/constructing-tree-life.
- Students choose one or more species and create an educational game or video to teach other students about them and their evolution. (30 min. or more)
    - It can be a board game, animation, card game, a simulation, scavenger hunt with outdoor exploration, etc.
    - Provide a rubric such as the one on "Constructing the Tree of Life" lesson page: shapeoflife.org/lesson-plan/constructing-tree-life.
- Students can create detailed scientific illustrations and/or conduct in-depth research projects about a specific species from one of the groups shown on the Tree of Life. (60 min. or more)
    - Students can include details about the species' adaptations that evolved over millions of years and/or create detailed scientific illustrations of them.
    - Students can add annotated labels to the illustrations that explain the species' key evolutionary traits.



The online Tree of Life game from Shape of Life; there is also a paper-based version.

- Provide the students with information about "The Tree of Life" artist, Ray Troll, and his art. (2–3 min.)
    - Visit trollart.com/bio, shapeoflife.org/news/featured-teacher/2024/10/17/ray-troll-artist-scientist-teacher-and-science-communicator and shapeoflife.org/blog/making-new-tree-life-shape-life.
    - See more examples of his science art at trollart.com/art/2010-recent.
    - Ask students to share their thoughts about the images orally and/or in writing.

Artist, scientist, and educator Ray Troll

- Conduct a "Gallery Walk" of student work. (5 – 7 min.)
    - As students are progressing through the gallery, they should make observations, note patterns, and define problems.
    - Encourage students to ask questions and clarify the concepts as they take notes.
    - Ask students to share constructive feedback with each other and revise their works.
    - Learn more about Gallery Walks: theteachertoolkit.com/index.php/tool/gallery-walk
- Invite the wider community to view and celebrate student projects. (Will vary)
    - Display the final student art projects publicly in community centers, school spaces, partner businesses, etc.
    - Invite families and community leaders to attend a "Graphic Art" celebration.
    - Invite groups such as local science, environmental, and/or governmental organizations to participate and share information about how the community can take action to address issues in the community. These might include the need to clean up trash and/or restore wildlife habitat by planting native plants to protect and enhance biodiversity, which also builds resilience to climate change and more extreme weather events.

Standards		Middle School / High School
Next Generation Science Standards	Performance Expectations	HS-LS4-1: Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. MS-LS4-2: Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.
	Disciplinary Core Ideas	LS4: Biological Evolution: Unity and Diversity LS4.A: Evidence of Common Ancestry and Diversity LS4.C: Adaptation
	Crosscutting Concepts	• Cause and effect • Systems and system models

	Science & Engineering Practices	• Developing and Using Models • Obtaining, Evaluating, and Communicating Information

Common Core ELA	Writing	7
	Speaking & Listening	4, 6
	Language Standards	1, 2, 3, 6

Arts Standards	California Visual Arts Standards	VA:Cn10: • Document the process of idea development, from early-stage ideas to fully elaborated ideas. • Utilize inquiry methods of observation, research, and experimentation to explore unfamiliar subjects through artmaking..

Expand Knowledge + Skills

Evolution Background / Chronology

- Bell, G. (2015). *The Evolution of Life.* Oxford University Press. In print or preview online: books.google.com/books?id=80aPBQAAQBAJ
- "Big History: Examines Our Past, Explains Our Present, Imagines Our Future." DK – Penguin. In print or preview online: books.google.com/books?id=wCcCDQAAQBAJ
- Evans, L. (1999). *Nature's Holism.* iUniverse. In print or preview online at: books.google.com/books?id=k1_wEXk8WtcC
- "Evolution: Deep Time." PBS: pbs.org/wgbh/evolution/change/deeptime/paleoz.html
- "Evolution of Mammals." Wikipedia (and sources referenced in article): en.wikipedia.org/wiki/Evolution_of_mammals
- Gore, R. "The Rise of Mammals." National Geographic: nationalgeographic.com/science/prehistoric-world/rise-mammals
- Marshall, M. "Timeline: The Evolution of Life." New Scientist: newscientist.com/article/dn17453-timeline-the-evolution-of-life
- National Academy of Sciences. (1999). "Evidence Supporting Biological Evolution." National Academies Press: ncbi.nlm.nih.gov/books/NBK230201
- "Timeline of Human Evolution." Wikipedia (and sources referenced in article): en.wikipedia.org/wiki/Timeline_of_human_evolution
- "Which Came First, Shells or no shells? Ancient Mollusk Tells a Contrary Story." sciencedaily.com/releases/2012/10/121003132326.htm

Related Videos + Articles

- "Tree of Life." Shape of Life: vimeo.com/934690484/fa958016ed
- "Jenny Clack, Paleontologist." Shape of Life: shapeoflife.org/scientist/jenny-clack-paleontologist

- "Kristi Curry Rogers, Paleontologist." Shape of Life: shapeoflife.org/scientist/kristi-curry-rogers-paleontologist
- "Discovering the Tree of Life." Khan Academy: khanacademy.org/science/high-school-biology/hs-evolution/hs-phylogeny/v/discovering-the-tree-of-life

Related Lesson Plans / Activities

- "Modeling Evolutionary Relationships with Trees." Shape of Life: shapeoflife.org/lesson-plan/modeling-evolutionary-relationships-trees
- "Annelid Adaptations + Art." Shape of Life: shapeoflife.org/lesson-plan/annelid-adaptions-art
- "Our Chordate Family Tree." Shape of Life: shapeoflife.org/lesson-plan/sol/our-chordate-family-tree
- "The Secrets of Fossils." Shape of Life: shapeoflife.org/lesson-plan/sol/secrets-fossils
- "A Paleontologist Searches for Bilateral Ancestors." Shape of Life: shapeoflife.org/lesson-plan/sol/paleontologist-searches-bilateral-ancestors
- "Teach Evolution." Understanding Evolution: evolution.berkeley.edu/teach-evolution
- "Evolution Lab." Game and Educator Guide from NOVA: pbs.org/wgbh/nova/labs/lab/evolution

Standards

- Next Generation Science Standards, including a link to the *Framework for K-12 Science Education* to which this lesson was aligned: nextgenscience.org/framework-k%E2%80%9312-science-education
- Common Core State Standards and links to the complete documents: corestandards.org
- California Art Standards: cde.ca.gov/be/st/ss/vapacontentstds.asp

Appreciation + Thanks

Thank you for using Shape of Life resources and helping to inspire the next generation of thinkers and scientists!

We welcome your questions or comments.

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Shape of Life