



TIME TRAVELING WITH HORSETAIL PLANTS

THEME

- Forest Health
- Ecology
- Plant Conservation

TYPE OF LESSON

- Instructor-Led
- Hands-On
- Garden Exploration

POSSIBLE WAYS TO LEAD LESSON

- Outdoors
- Virtual
- Classroom
- Other:

TEACHING STRATEGY

- Place-Based Learning
- Storytelling
- Nature Play
- Art / Movement
- Other:

STANDARDS

- **NGSS, 3-LS4-2. Biological Evolution.** Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.
- **NGSS, 3-LS3-1. Heredity.** 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.
- **NGSS, 3-LS3-2. Heredity.** Use evidence to support the explanation that traits can be influenced by the environment.

GRADES 3–4

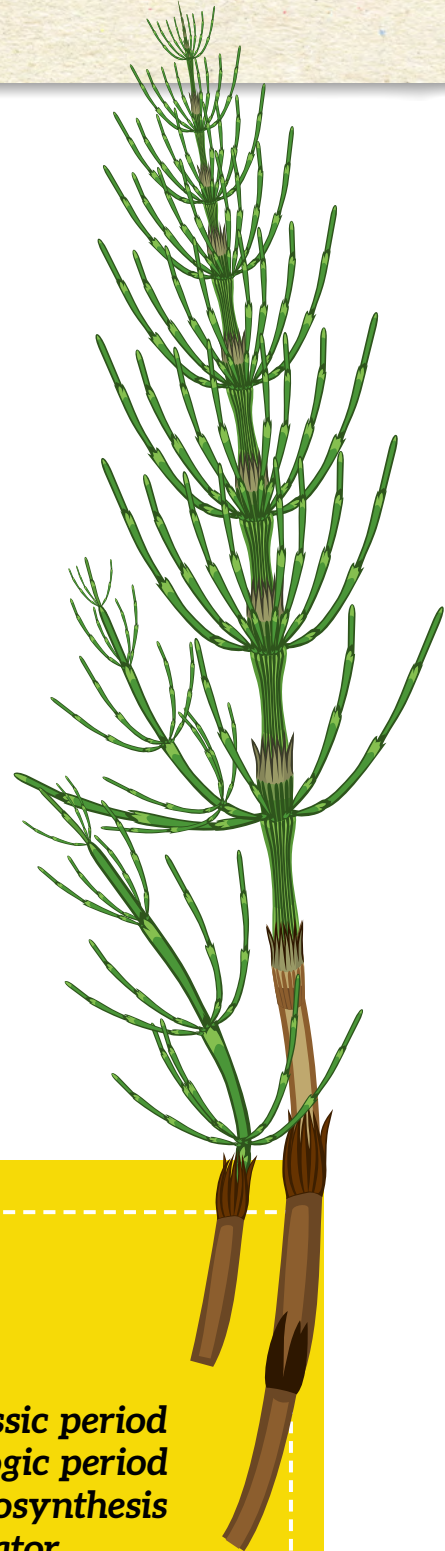
DURATION 60 minutes

LESSON GOALS

- Learners understand how a plant adapts to its environment.
- Learners use a horsetail plant as an example to explore concepts of adaptation in four environments.
- Learners identify which challenges a plant faces and which features help a plant change to survive those challenges.

LESSON SUMMARY

In small groups, learners are assigned one of four distinct environments and time periods in which horsetail plants (Equisetaceae) have grown. They identify what adaptations helped the plants survive and share that information with the whole class.



WORD BANK

adaptation
decay
dispersal
ecosystem
environments
era
Jurassic period
geologic period
photosynthesis
predator
rhizome



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PRINTED MATERIALS (INCLUDED)

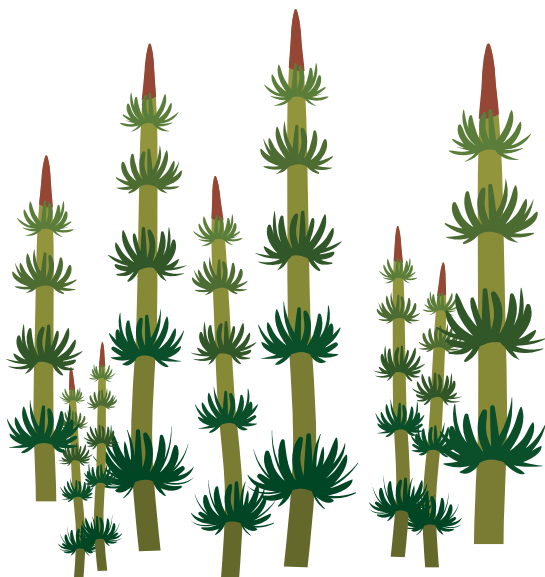
- 4 **Story Cards** (one story assigned per group)
- **Time Traveling Journal** (one per learner)

OTHER MATERIALS

- Pencils (1 per learner)
- Horsetail herbarium specimen (optional)
- Fresh horsetail samples (optional)

SETUP

1. Review the **lesson procedure**.
2. Review and consider the optional **pre-** and **post-lesson** explorations.
3. Prepare the **lessons materials**.
 - Print or pull up images of horsetail to show.
 - Print **Story Cards**.
 - Print **Time Traveling Journals**.
4. (Optional) Gather or gain access to horsetail samples (fresh or from an herbarium).



LESSON PROCEDURE

1. Optional: Complete one or more of the **pre-lesson explorations**.
2. Share the **lesson opener**.
3. Tell learners that they are investigating horsetail adaptations from four different time periods. Each of four groups will pretend to visit a different time period by reading a story about that time. The story will describe where they are, some of the challenges the horsetail faced in the environment during that time, and what the horsetail did to survive.
4. Briefly describe the environments they will see in the four time periods:
 - Story 1: Jurassic period with marshy swamps and dinosaurs
 - Story 2: Cenozoic period with dense forests
 - Story 3: Ancient times in human history (Quaternary period) along a river's edge
 - Story 4: Modern times (Quaternary period) on a hill by Mount St. Helens after a volcanic eruption
5. Split learners into four groups. Hand out a **Time Traveling Journal** to each learner and one of the **Story Cards** to each group.
6. Instruct one or more learner from each group to read the **Story Card** to their group.
7. Learners in each group should work together to answer the story questions and record their answers in their journals. Allow about 25 minutes to complete.
8. Allow each group to share with the class the description for their time period and discuss how their horsetail survived because of its adaptations.
9. Allow time for learners to ask questions about each time period, and use this as a chance to address any misconceptions.
10. Hold a discussion using the **lesson questions**.
11. Optional: Complete one or more of the **post-lesson explorations**.



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LESSON OPENER

Share the following with learners to orient them to the topic:

- In order to survive, all organisms must develop special characteristics to help them live in their specific environments. These characteristics are called adaptations.
- Examples: some birds can migrate when it is cold; some moths are camouflaged to hide from predators; many animals hibernate to survive the winter.
- Although plants are rooted in the ground and cannot run away, they have developed many features to help them survive in sometimes harsh environments.
- Some plants are especially good at doing this. They have changed and adapted to their environments for a long time.
- The horsetail is an example of a plant that has been around since before the dinosaurs roamed the Earth. It dates back to more than 250 million years ago and is still alive today.
- What do plants need to survive? (*Guide learners to mention air, water, sunlight, and space.*)
- Today, we are going to investigate the horsetail's past and see if we can figure out some of the ways it has survived all these years.

LESSON QUESTIONS

- What are some major differences between the environments in each time period?
 - Think about temperature and the different kinds of animals and plants around.
- What challenges did the horsetail encounter in each period?
- What challenges might the horsetail face in the future?
- What was one thing you noticed that was the same in each of the stories?
- How did the horsetail adapt to the different environments?
- How is the horsetail connected to the place it lives?
- Which part of the horsetail helped it survive in each story?

PRE-LESSON EXPLORATIONS

Have learners complete any of these prompts:

- Read about the four time periods beforehand.
- Grow a seed with the whole class. Discuss what plants need to grow and the parts of the plant.

POST-LESSON EXPLORATIONS

Have learners complete any of these prompts:

- Have learners make horsetail models out of paper stacked together and see how high they can build them.
- Have students focus on the time period of one story, research the ecosystem in more depth, and learn about adaptations other plants and animals made during that time period. Have students create posters to share their findings.
- Fossils to fossil fuels: Discuss how substances that come from ancient horsetails and other plants are dug up and used to make fossil fuels; discuss renewable and nonrenewable energy.
- Discuss the structure of the horsetail and how it helps it grow, focusing on its telescopic shape. (Show a video, such as this one: <https://bit.ly/PH-Growing>)

ADDITIONAL RESOURCES

- **“Plant of the Week: Common Horsetail.”**
Background information on horsetails from US Forest Service: <https://bit.ly/PH-Horsetail2>
- **Landscape change at Mt. St. Helens.**
Time-lapse photos of landscape change from the Mount St. Helens Science & Learning Center: <https://bit.ly/PH-StHelens>
- **Horsetail spore video.** Background on horsetails and a video of their spores moving from Scientific American: <https://bit.ly/PH-SporeVideo>



WORD BANK

adaptation: a characteristic of an organism that helps it live in a particular environment

decay: to break down into simpler substances due to bacteria or fungi

dispersal: when organisms, or their seeds or spores, spread away from where they first grew

ecosystem: a community of interdependent organisms and their environment

environments: the surroundings organisms live in, including things like water, soil, air, climate, and other organisms

era: a unit of geologic time lasting hundreds of millions of years; eras may contain several geologic periods

Jurassic period: a prehistoric-period, 201 to 145 million years ago, when dinosaurs existed and birds first appeared

geologic period: a unit of time lasting millions of years; multiple periods make up an era

photosynthesis: the process plants use to make their own food from carbon dioxide, water, and stored energy from sunlight

predator: an organism that kills and eats other organisms, called prey

rhizome: an underground plant part that stores energy and can grow new plant shoots

STORY 1

JURASSIC PERIOD

(145 to 201 million years ago)

You land on top of a horsetail stalk among the giant spores. It is hot and humid, and you feel that the sun is very strong. You are high up in the sky. The horsetail grows taller than the other plants around. You look down 60 feet to the ground below. Ferns surround the massive horsetail stem buried deep in the plants that live in the marsh below. Water splashes against the horsetail's wide stem. Its roots grow down below the muddy waters, spreading wide underground to keep this massive plant standing.

A giant dragonfly zooms past; it is the size of a small bird. There are Diplodocus roaming around—85-foot-long plant-eating dinosaurs. These dinosaurs have long necks and love tasty snacks like horsetails, but the horsetail's thick green stem is hard and tough for the dinosaur to eat. The stem will wear down the dinosaur's teeth if it eats too much. You watch as the Diplodocus tries to chew on a neighboring giant horsetail beside you. Sometimes the dinosaurs win and can eat all the way through, and other times they try to find a softer plant for a snack.

When you look around you notice that horsetails are by far the most common plant. Their roots help them survive underground while their tops are eaten by animals.



STORY 2

PALEOCENE ERA

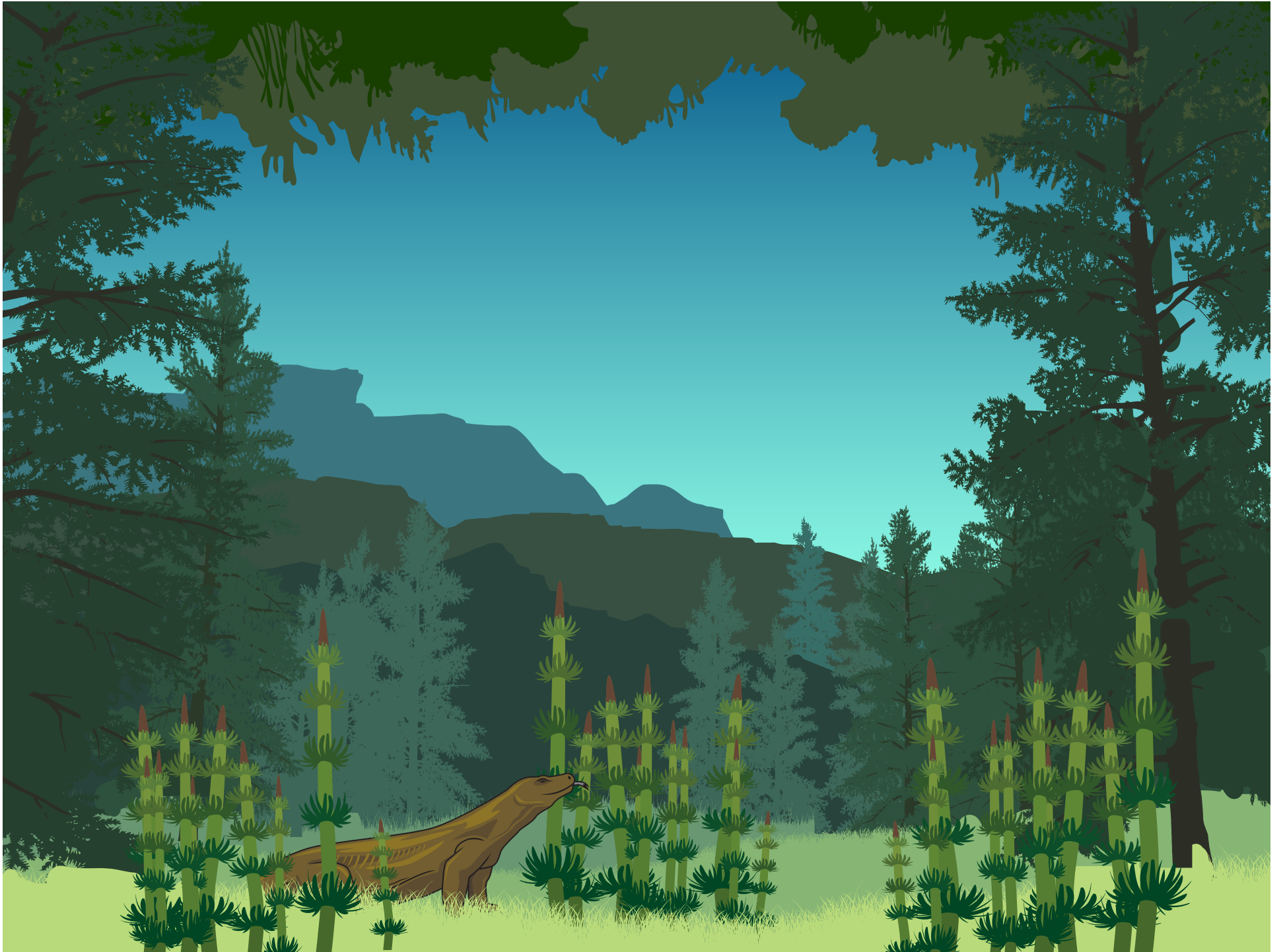
(66 million years ago)

You land in a dense forest. You smell warm, still air. You are standing among ferns and next to a horsetail plant. Giant pine and sequoia trees tower above you. The ground is wet and soggy. The horsetail is about your size, reaching just a little above your head.

Horsetails' green stalks get energy from the sun through photosynthesis. They take in sunlight and release oxygen, just like the trees do. They need the sunlight, but they are shaded by the massive trees above them. The horsetails grow as tall as they can using the sunlight that reaches them.

Suddenly, you hear a noise. There is a splash 50 feet away. You see a giant reptile crawling past, on the hunt. It rushes past you. Even though it does not seem to notice you, you still try to hide in a nearby patch of horsetails. You notice that some of the horsetail stalks have been chewed on by an animal. As you crouch down to hide, you realize you can see inside one of the chewed-up horsetails.

You realize the horsetails are made of hollow pieces that fit together like a puzzle. The hollow structure acts like a straw and allows the plant to suck up the water and nutrients it needs. The stem grows piece by piece, like snap-together blocks that fit one on top of another. When the top part is eaten for a snack, the whole plant is not destroyed. You see some parts of the plant have started growing back already.



STORY 3

ANCIENT TIMES: HOLOCENE EPOCH

(1000 BCE)

You land on a riverbank. The air feels cold, and you can see your breath. Horsetails grow everywhere here, on both sides of the river. Their tall stalks come up to your knees. Nearby, you see people gathering a few horsetails. They take the small new sprouts and the taller stalks. One person starts cleaning a bowl with a stalk. You think to yourself that the horsetail looks like a scrub brush. Another person seems to be boiling the horsetail and making something over a fire. After it has cooked for a little while, they drink the liquid in the pot. It looks like tea. Eventually, everyone stops to take a break and nibble on the sprouts. This plant seems useful to many people here. It starts to rain, and the people gather their things and leave the riverbank.

You try to get a good look at the horsetail yourself. You see a brown cone at the top of one tall horsetail. You touch it, and it feels bumpy. Although you can't see them, you release some of its spores when you touch it. Some fall to the ground and some are blown away by the rain and wind. Now, more horsetails will grow for people to use.



STORY 5

MODERN TIMES: HOLOCENE EPOCH

(1980 CE)

You land on a hill near a small pond. It is warm and sunny here, but not too hot. You look around and realize you don't see many plants growing. You do see many burnt trees and ash covering the rocky ground. It looks like there was a fire. You see a mountain in the distance. Its flat top looks funny to you. It is different from the cone-shaped mountains you are used to seeing. Aha! It must be a volcano that has erupted.

Horsetail are the only living plants you see here. Many new shoots are growing up from the ground. There are no other plants shading the horsetails because the horsetails are the first of many that will grow back after the eruption. They are getting all the sunlight they want. Here, near the pond, they also have plenty of water. Even when the horsetails' tops were damaged by lava or fire, they could still grow underground unharmed. They continued to spread their roots and rhizomes underground, and then they sent new shoots up from their rhizomes, which look like bulbs.

When you look at the horsetails, you see the cone-shaped top where the spores are. The spores are like seeds. When they fall off the plant, they can grow and spread in places where there is moisture after it rains or where there is water nearby. You think this is a very strong plant—it is the only plant around that has survived the volcano so far.



_____ 's Time Traveling Journal

Record your horsetail discoveries in your journal.

Time Period: _____

Describe your environment:

What are some conditions the horsetail faces in this environment?

Temperature, predators, lots of water ... ?

How did the horsetail adapt to survive the challenges it faces?

Draw a picture of the horsetail.

Circle the part of the plant that helps it survive.

