



GRADE LEVEL

4th

STUDENT OUTCOMES

-Recognize different types of adaptations that plants have evolved in order to survive in their environment

-Identify challenges that plants have to face in order to survive in different environments

TIME FRAME

Year-round
45 minutes

LOCATION

Climatron®/Linnean House
/George Washington Carver
Garden

KEY TERMS

Adaptation
Environment
Desert plants
Cactus
Tropical plants
Drip tips
Buttress roots
Aquatic plants

PLANT ADAPTATIONS

Topic: Plant Survival

MATERIALS NEEDED

For each small group:

- Leader sheets: "Plant Adaptations"
- Plant Adaptations Pictures and Info set
- Pencils
- Clipboards (recommended)
- Colored pencils (optional)

For each student:

- Student sheets: "Plant Adaptations" (Desert, Tropical, and Aquatic plants)

PREPARATION BEFORE ARRIVAL

Make sure that all adult chaperones know that they can start at any location—Climatron®, Linnean House, or George Washington Carver Garden—to begin the lesson and from there rotate to the other locations to see various plant adaptations.

PRE-VISIT ACTIVITY

Students can learn about plant adaptations by watching a video on YouTube called "Adaptations in Plants, What Is Adaptation? The Dr. Binocs Show on Peekaboo Kidz" (https://www.youtube.com/watch?v=ca99WW_v0bA)

After watching the video, have a whole class conversation about what is the definition of an adaptation and which plant adaptations they remember from the video.

Students can then research online different plants that have adaptations that allow them to survive in their specific environments. Focus can be on aquatic plants, desert plants, and tropical rainforest plants or any plant of their choice.

BACKGROUND INFORMATION

An **adaptation** is a characteristic of a living thing that helps it survive in its environment. An **environment** includes everything living and non-living in the area that a plant or animal lives in. All living things have adaptations, even humans.

Adaptation is all about survival. When the environment changes dramatically, some animals or plants die, others move to another location, and some develop adaptations over generations that help them survive.

Sometimes the environment changes dramatically due to a natural disaster and sometimes it changes slowly over thousands of years. In each case, over many generations, animals and plants may develop new adaptations to help them survive in their new home.

Aquatic plants, like water lilies, live in water. Living in water has certain advantages and disadvantages. One advantage is that water is always available to help the plant grow. One disadvantage is that sometimes living on the water makes it difficult for the plant to be pollinated.

Desert plants like cacti have adapted to live in environments that are very hot, dry and have little rainfall. Cacti have spines, not leaves because this helps them retain water. The prickly spines also protect the cacti plants from being eaten by animals looking for water inside the plants.

Tropical plants normally have big leaves with V-shaped drip tips at the ends. The drip tips help guide rain off the leaves. And the big leaves allow them to absorb as much sunlight as possible in an environment where there is tremendous competition for light.

POST-VISIT ACTIVITY

Conduct a whole class experiment about what plants need to survive! Watch this video: <https://www.youtube.com/watch?v=ZdOmVDRNXys> Seeds that germinate quickly, like beans, work best. (Be sure to soak the beans in water overnight before beginning the experiment.) When ready to begin, get three clear plastic cups and label them A, B, and C. Place dampened soil/cotton balls at the bottom of each cup along with 10 bean seeds. Place **Cup A** near a sunny window and water it daily. Place **Cup B** near a sunny window, but do not water it. Place **Cup C** in a place with little light and water it daily. Observe for 5 days in a row and record observations.

PLANT ADAPTATIONS

LEADER SHEET

Page 1 of 2

1. Linnean Plaza

Make sure that each small group has a set of the "Plant Adaptations" pictures and information. The adults in each small group will use these pictures and information to conduct the lesson in the Garden with the children.

Today we are going to explore plants that have fascinating adaptations here at the Garden. Before we go, let's review some of the plants that we've been studying.

1. Desert Plants

- What challenges do you think a plant in a desert would face to survive?
- If you were a plant in a desert, what would you need to survive?

2. Tropical Plants

- What challenges do you think a plant in a tropical rainforest would face to survive?
- If you were a plant in a tropical rainforest, what would you need to survive?

3. Aquatic Plants

- What challenges do you think aquatic plants (plants living in water) would face to survive?
- If you were an aquatic plant, what would you need to survive?

2. Choose starting location

You can start at any location—Climatron®, Linnean House, or George Washington Carver Garden—to begin the lesson and from there rotate to the other locations to see various plant adaptations.

1. Observe

Let's observe what the environment is like where these plants grow. You can ask:

- How does it feel here?
- How strong is the sunlight?
- Is it very humid or very dry?

We are going to learn about different adaptations that plants in this environment have that help them survive.

2. Activity

Let's look closely at this plant (choose any tropical/aquatic/desert plant to look at with the group)

- What do you notice about this plant?
- What do you wonder about this plant?
- Does this plant remind you of anything?

After they have shared their observations, have each student find the correlating page on "*Plant Adaptations Student Sheet*"

Look at the first question together.

- "What challenges do you think this plant has to face to survive?"

Encourage students to share their ideas and then write/record them on the page.

Next show students the pictures of the plants that correlate with the environment.

- These are pictures of plants that have adaptations to help them survive in their environment.
- As we walk and observe, I am going to read aloud about these plants.
- Try to spy their adaptations while I read

PLANT ADAPTATIONS

LEADER SHEET

Page 2 of 2

3. Draw & Label

Now that you have learned about plants from this environment, choose one that you would like to draw.

Extra Challenge:

See if you can remember the different adaptations that help the plant survive. Label them on your plant drawing. You can ask me how to spell the adaptation if you need.

3. Conclusion

We have seen many plants today and they have some amazing adaptations to help them survive in their environment.

- Which plant was your favorite?
- Which plant adaptation did you think was the most interesting?
- If you were a plant, which environment would you like to live in?

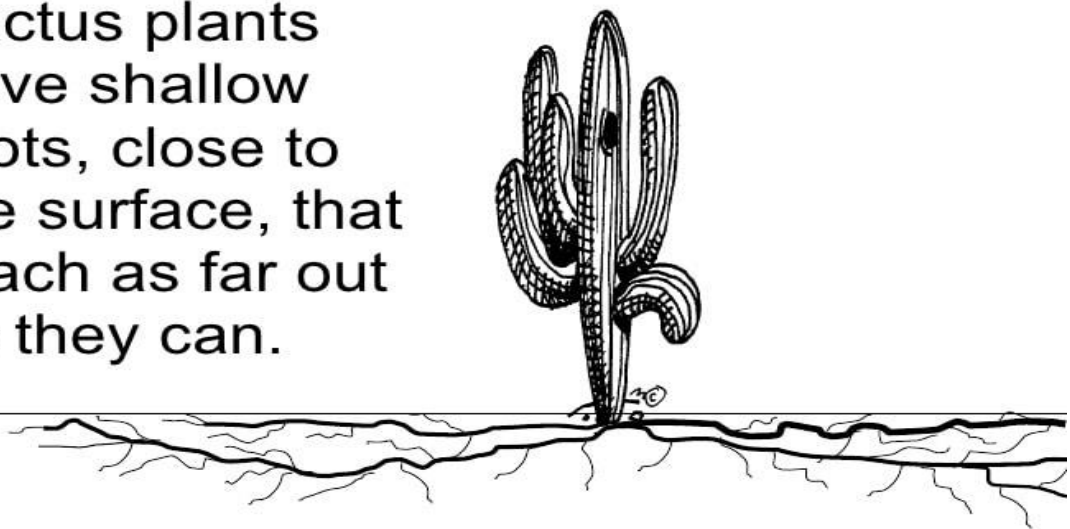
Teacher's Notes

PLANT ADAPTATIONS

Pictures: Cactus



Cactus plants have shallow roots, close to the surface, that reach as far out as they can.



PLANT ADAPTATIONS

Info: Cactus

Introduction

Few plants are able to survive in climates as harsh as the deserts of the Americas. Temperatures can range from well over 100 degrees Fahrenheit during the day, to well below 40 degrees Fahrenheit at night. With extremes like this, plants need to find ways to survive the challenges of life in a desert. One kind of plant that is able to survive these harsh conditions is the cactus. Cacti have numerous adaptations for absorbing and storing water, preventing water loss, protecting themselves from predators, limiting damage from the hot sun, saving their energy, requiring few resources, and attracting pollinators.

Roots

Desert cacti live in dry regions that get very little precipitation. When it does rain, it comes in short bursts. Cacti have adaptations in their roots to collect water quickly and efficiently before the moisture evaporates away in the dry air. Their root systems are extensive, but usually shallow, and spread out wide around the plant. This allows the cacti to soak up as much of the moisture on the ground as possible in a short amount of time. With these wide, shallow root systems, cacti are also able to gain access to moisture that may occur at the surface from fog, mist, or morning dew.

Spines, Not Leaves

Unlike most plants, cacti do not have leaves. Leaves give off moisture into the atmosphere through a process called transpiration. If a plant had leaves in a desert, it would quickly lose far too much water and die. Instead of leaves, cacti evolved to have prickly spines that cover and protect them. These spines help the cactus retain water inside of its body and protect the cactus from being eaten by animals.

Stems

The stem of the cactus is where it performs photosynthesis. Photosynthesis is the process where a plant transforms the energy from the sun into food to eat. Normally, for most plants, this process takes place in the leaves. Since cacti do not have leaves, they conduct photosynthesis in the stem. The stem of a cactus is green because it contains chlorophyll (the natural compound found in most plants that help them absorb energy from the sun). These green stems mean that the entire organism can perform photosynthesis. A waterproof waxy coating covers the stem and helps retain moisture. This waxy coating also acts as a sunscreen protecting cacti from the sun's rays. The shape of the stem is ribbed, like an accordion. This shape plays an important role in water storage and retention. After a rain, cacti soak up the moisture through their roots and store water in their stems. With the stem shaped like an accordion, it can expand to increase the volume of water moisture it can hold without bruising or damaging itself, and then retract as it loses water.

Areoles

Areoles are structures unique to cacti. Although variable, they typically appear as woolly or hairy areas on the stems from which spines emerge. Flowers are also produced from areoles.

Flowers

All cacti are capable of producing flowers. Their flowers can attract a range of pollinators. During the day, bees and hummingbirds will visit cacti flowers to pollinate them. And at night, moths and bats arrive. It can take a cactus anywhere from 1-10 years to bloom and conditions need to be just right.

Slow metabolism

Anyone who has cared for a cactus know that cacti are slow growers. Their slow growth rate is connected to their slow metabolism rate. This is one of the most essential adaptations for surviving in the desert for multiple reasons.

- **Energy Conservation.** Rather than expending their energy on developing the leaves that other plants need to maintain their more rapid growth, cacti can concentrate on maintaining the structures that help them survive.
- **Fewer Needs.** Desert landscapes often have poor soil fertility in addition to little rainfall, so taking it easy and being able to survive with fewer resources is a great advantage for cacti to have developed.
- **Long Lifespans.** Cacti are in it for the long haul with typical lifespans lasting anywhere from 10 to 200 years!

PLANT ADAPTATIONS

Pictures: Tropical Plants



PLANT ADAPTATIONS

Info: Tropical Plants

Introduction

Tropical rainforests are teeming with life and represent one of the most diverse and important ecosystems on the planet. While only covering 2% of the earth, tropical rainforests are home to more than 50% of all plants and animals found on land. Rainforests have 170,000 of the world's 250,000 known plant species. That is more than two-thirds of all the plants in the world! To put it into perspective, an area of rainforest the size of two football fields (one hectare) may have more than 400 species of trees, while an equal area of forest in the United States may have fewer than 20.

While there is tremendous life in a tropical rainforest, there are also many environmental challenges as well. Tropical rainforests are humid and wet. A typical year sees anywhere between 79 to 394 inches of rain per year. In St. Louis, the average rainfall during a typical year is less than 34 inches. Also, while there is sunlight in the upper canopy of a forest, at the forest floor it is usually heavily shaded. Plants have adapted to survive in these wet and humid environments with high competition for sunlight. The following adaptations are ways that plants have evolved to better suit themselves to a tropical rainforest ecosystem.

Buttress roots

These are large roots, which have high ridges. These ridges create a larger surface area that help to support large trees in ground that is often damp and loose. They spread out wide, allowing a tree to have a more stable base and grow tall.

Drip tips

This structure on a leaf forms a V-shape pointy tip. It allows water to run off the leaves quickly without retaining too much water on the leaf and weighing them down damaging them.

Epiphytes

These types of plants live on the trunks and branches of trees high up in the forest canopy. They get their nutrients from the air and water, not from the soil.

Big leaves

Many of the plants in a tropical rainforests have large leaves. In a tropical rainforest, there is tremendous competition for light. Often times, plants will grow on top of other plants in the effort to reach sunlight. A plant with big leaves has a larger surface area from which to access sunlight and so has a greater likelihood to survive.

Lianas

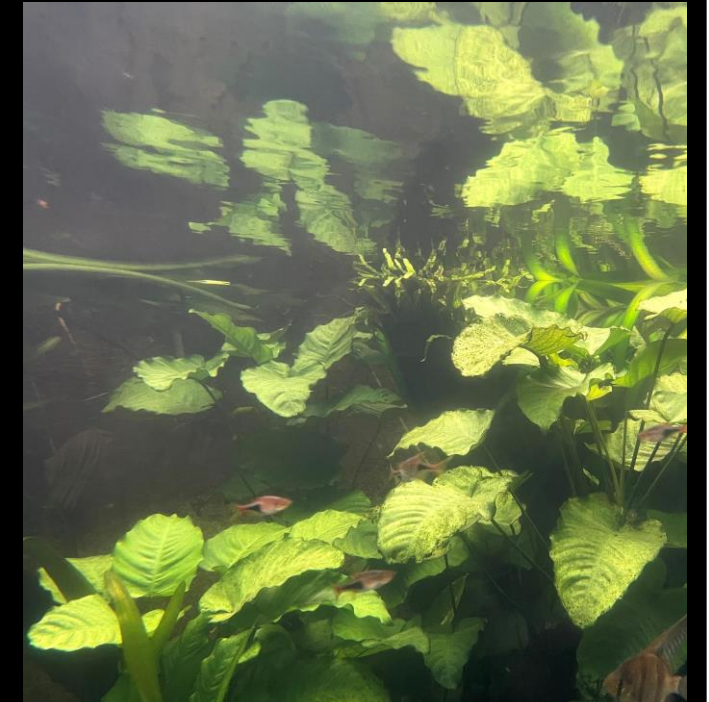
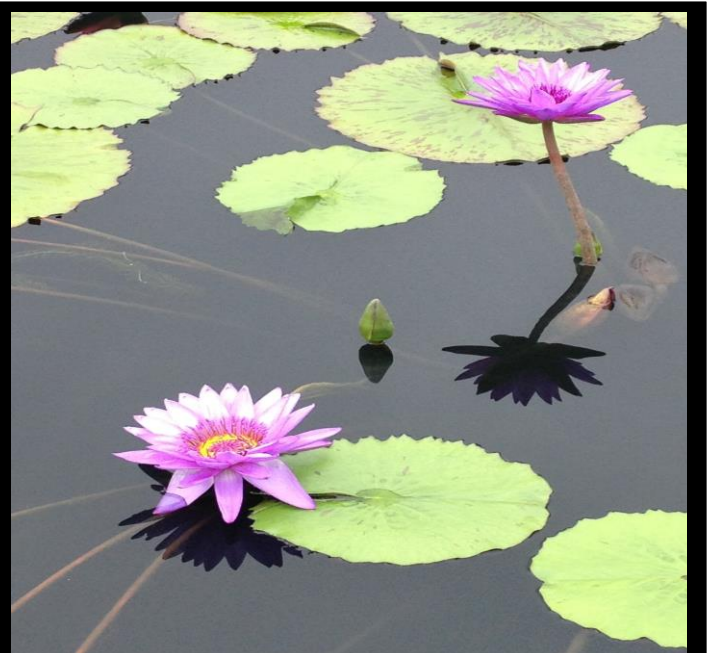
These are woody vines that have roots in the ground, but climb up the trees to reach the sunlight. Their leaves and flowers grow in the forest canopy.

Bark

In tropical rainforests, most trees have smooth, thin bark. The smoothness of the bark may make it difficult for other plants to grow on their surface. This limits the competition for sunlight and resources. And unlike plants in temperate zones like North America where the winters are cold and harsh, the trees in tropical rainforests do not need to insulate themselves with thick bark. The bark of tropical rainforest trees is often quite thin since they live in very warm, humid environments year-round.

PLANT ADAPTATIONS

Pictures: Aquatic Plants



PLANT ADAPTATIONS

Info: Aquatic Plants

Introduction

Very few plants have adapted to life in the water. Plants need water, but too much water can be dangerous. Of all the plants on earth, only a small fraction of them grow in the water. Those that do have special adaptations to help them survive.

Anchored Roots

Aquatic plants have roots that are anchored in the soil below which keeps the plant from floating away.

Spongy Tissue in Stems and Leaves

Spongy tissue helps the plant move the oxygen in the air down to the roots. The spongy tissue also provides buoyancy. The leaf veins are filled with air, which help the leaves float on the water.

Floating Horizontal Leaves

Some water plants have leaves that float on the water's surface. Horizontal leaves that float on the surface of the water expose as much of the leaf surface as possible to the sun. Water reflects light, so leaves underwater get less light than leaves on the surface. Floating horizontal leaves help plants capture as much sunlight as possible for photosynthesis. Sometimes certain aquatic plants will have a waxy coating on the tops of their leaves. This waxy coating reflects the heat from the sun, but allows the leaf to still absorb the light from the sun.

Emergent Leaves

Water reflects light, so leaves underwater get less light than leaves on the surface. Emergent leaves are leaves that rest of the top of the water. This adaptation helps plants capture as much sunlight as possible for photosynthesis.

Floating Fruits

Many fruits of aquatic plants float on water, which increases their dispersal as fruits and seeds float to far off places.

PLANT ADAPTATIONS

STUDENT SHEET: DESERT PLANTS

Page 1 of 3

What **challenges** do you think this plant has to face to survive? Write your ideas here.

Draw and **label** the plant and its adaptations that help it to survive.

PLANT ADAPTATIONS

STUDENT SHEET: TROPICAL PLANTS

Page 2 of 3

What **challenges** do you think this plant has to face to survive? Write your ideas here.

Draw and **label** the plant and its adaptations that help it to survive.

PLANT ADAPTATIONS

STUDENT SHEET: AQUATIC PLANTS

Page 3 of 3

What **challenges** do you think this plant has to face to survive? Write your ideas here.

Draw and **label** the plant and its adaptations that help it to survive.