Teachers Information and Grade level NGSS Support

We would like to welcome your class to Calaveras Big Trees State Park, and hope this will be a wonderful learning experience for your class.

We have updated our guided tours to try to support you in the classroom as you begin implementing the Next Generation Science Standards. We have selected one Disciplinary Core Idea (DCI) for each grade level that we feel we can reinforce with our guided tours. The guides will include information related to that DCI during the tour and we also included some classroom activities that you can use in before your field trip that relate to the DCI. We have also included information about the trees and our park that might interest you.

The Trail

The trail through the North Grove is a gentle, well-marked loop a little less than 2 miles long and takes about an hour and a half to walk. On this trail you will be walking among the world's largest living trees. Since the beauty of the North Grove is enjoyed by thousands of people every year, your help is needed in protecting the big trees and their environment in these ways:

- **Stay on the trail and boardwalks.** This protects the shallow sequoia root systems from erosion and soil compaction.
- **Do not climb on the trees.** The protective bark is easily damaged.
- **Leave all natural objects where they are found.** Seeds from pine cones are an important food source for squirrels and even a twig is important in returning nutrients to the soils.

Giant Sequoia Characteristics

Just what is so special about giant sequoia trees? What makes them different from other types of trees? These are some of the main reasons that biologists and naturalists consider these trees to be amazing.

- Giant sequoias are the largest single stemmed tree by wood volume and mass in the world.
- Giant sequoias have unique characteristics enabling individual trees to live over 3,000 years.
- Giant sequoias grow naturally only in a 250-mile long strip in 75 groves on the western slope of the Sierra Nevada at an elevation of 4500 to 7000 ft. These trees are always found near a constant supply of water where summers aren't too hot and winters aren't too severe.
- Giant sequoias are descended from trees that forested most of the northern hemisphere during the age of dinosaurs

- Their related human history is fascinating. In this park it includes the Miwok Indians, the discovery of giant sequoias by Euro-Americans, the early use (and abuse) of the trees, and today's protection within the State Park System.

What are the characteristics that enable these trees to grow so big and live so long?

- Soft, fibrous, resinless bark can grow to 2 feet thick and provides protection from fire, insects, and disease. The presence of tannin in the wood aids in this protection and slows the process of decay even after a tree has fallen. Even if fire manages to burn through the bark, the tree is often able to live for hundreds of years or more.
- Shallow, spreading roots reach only 4 to 8 feet in depth, but may extend out more than 100 feet, encompassing over one acre of soil. Many small feeder roots are able to take up the water and nutrients required to support the growth of these giants.
- The form of a mature giant sequoia is very stable. The wide supporting base gradually tapers off to a rounded top that can withstand heavy snow and wind. If the environment around one of these trees causes it to lean it will respond by growing more wood on one side to prevent falling. Falling is one of the few things that actually kills these trees. They topple most often during heavy winds, especially if their root system has been affected by erosion or fungus, or the trunk weakened by large burn scars.

Calaveras Big Trees State Park Timeline

Pre 1833 Local indigenous people knew of the Big Trees. The Miwok word for giant sequoias was "wawona".

1833-1852- there was mention of trees of the redwood species and large trees, but no one seemed interested in checking it out especially after gold was discovered.

1852- Agustus Dowd, a hunter for the Union Water Co., stumbled onto the discovery tree and the North Grove. This was the first substantiated discovery of the giant sequoia tree.

1853 -The Discovery Tree was cut down and the bark and a section of the trunk were shipped to New York to be put on exhibit. The exhibit was a failure and the bark and the trunk were destroyed by fire. What remained of the Discovery Tree was a "Big Stump". Which through the years has been used for dances, concerts, weddings ,and even a print shop.

1854 -In an effort to capitalize on the amazing mammoth trees the " Mother of the Forest" was stripped of her bark and the bark was reassembled in the Crystal Palace in New York and then was moved on to London's Crystal palace where it was exhibited until 1866 when the crystal palace burned down.

During the rest of the 19th century and the beginning of the 20th century the Grove was owned by a variety of people, who used it as a tourist destination. It is the longest continuously operated tourist attraction in California and introduced the giant sequoia trees to millions of people. Because many people saw the beauty and majesty of the Giant Sequoia trees and were appalled at what had happened to the Discovery tree and the Mother of the Forest, a number of attempts were made to protect these trees, especially when the final owner of the groves was a lumberman.

1985 – A tunnel was cut through the "Pioneer Cabin Tree"

1931 - After years of effort the North Grove became Calaveras Big Trees State Park. The South Grove was still in private ownership.

1954 –After years of private fund raising efforts and private negotiations the South Grove was purchased from the Pickering Lumber Co. for a price of $2.8 million

1967 – The South Grove was formally dedicated as a publicly owned park area.

Grade Level Next Generation Science DCI's and Activities

First Grade

DCI LS1.A All Organisms have external parts. Plants have different parts that help them survive and grow.

Big Trees State Park is a perfect place to reinforce this. The guides will talk about how the bark, roots, and branches help the tree grow and live a long time.

Classroom Activities

How Big is a Tree?

Measure out with string the height and diameter of a giant sequoia tree (Diameter up to 30 feet, height up to 300 feet, roots up to 100 ft.)

Go to a large open area and lay out the string. Have students walk along the string to appreciate the size of a giant sequoia.

Try drawing the tree on the playground with chalk, discuss and compare with known objects, (playground, height of school building or flagpole, dimensions of classroom)

Make a Giant Sequoia Book (See special link on web site.)

After an introductory discussion, students color each page illustrating the characteristics of giant sequoias:

Thick protective bark	Juniper like foliage
Shallow, spreading roots	Huge branches
Tapering trunk	Massive size
Egg-shaped cones	Tiny seeds

Make into a book then read together and discuss.

Are Other Plants Like a Tree?

Have each student find a weed, pull it up and put it on a white piece of paper. Have them observe the weed very carefully . Use magnifying glasses if you have them. Have them describe to a partner the parts of a plant they see on their weed. Then discuss ways the parts of the weed are the same or how they're different from the parts of a tree. You could make a Venn diagram showing how plants and trees are alike and different.

Second Grade

DCI LS2.A Plants depend on animals for pollination and or to move their seeds around.

At Big Trees we have a squirrel called a Douglas squirrel or Chickaree that is instrumental in releasing seeds from the giant sequoia cones. The guides leading the tour will discuss the importance to the giant sequoia tree of animals (especially the Chickaree and the long-horned beetle) for seed dispersal and pollination.

In Class Activities

Seed Need (adapted from Project Wild)

This is best done in late summer or autumn. Students can collect seeds on a walk near school, or bring them from home. A fun way to collect "hitchhiker" seeds is to walk through a field with an old fuzzy sock over your shoe or drag an old fuzzy blanket. Look closely at all seeds collected, and sort them according to the way they are dispersed.

- Some "hitchhike" on animals and people.
- Some have wings and fly.
- Some are eaten by animals and deposited in other places (with fertilizer).
- Some float on water.
- Some are shaped like parachutes and float in the wind.
- Some are even ejected by the plant itself.

Discuss why seeds need to disperse (in order to avoid competition from the parent plant). Discuss the ways in which giant sequoia seeds are released from the cone and dispersed (fire, Chickerees, long-horned beetle). When they are finished they can make a seed collage with the seeds they gathered.

Pollination Tag

Before playing this game discuss with students the role of pollinators and brain storm different types of pollinators. This game visually shows how pollen can be dispersed by a variety of pollinators. Divide your class into flowers (2/3 of the class) and pollinators (1/3 of the class). Give the flowers 5 strips of the fabric (pollen) to stick in their waistbands (like flag football). Each flower should have a different color strip. Then play tag with the pollinators being it. When the pollinator tags a flower they take one of the strips of cloth (pollen). They then go to tag another flower. They then drop the first strip (pollen) and take a strip (pollen) from the new flower and continue tagging , dropping strips and taking strips. When a flower has no more strips they sit down. When all flowers are sitting look around to see how far the pollen (fabric strips) has been dispersed and look at how the pollen from each flower is spread out.

Third Grade

DCI LS1.B Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles.

The giant sequoia's life cycle is unique because it lives so long. The guides will be able to point out the different stages in a giant sequoia's life cycle. From a seed - to seedlings - to young trees and finally to mature trees.

Factors Affecting Seedling Survival

The percentage of giant sequoia seeds that find the perfect conditions for germination and seedling survival is very low. The seeds require access to mineral soil, plenty of moisture, and ample sunlight in order to survive. Some experts estimate that one in a million giant sequoia seeds ever germinate, and that only a very small fraction of those ever grow to maturity. The trees compensate for this by producing an average of 1,500 new cones per tree every year. An individual tree may bear as many as 40,000 cones at one time. With each cone containing an average of 200 seeds, this theoretically could result in 8 million seeds on each mature tree! However, the seeds are not all released at once as each tree drops an average of 1500 cones a year.

Once a seed has reached moist mineral soil, and has succeeded in germinating, it must continue to receive favorable conditions in order to survive. The first 2 years of life are the most critical. If the seedling does not stay moist and receive the proper amount of sunlight, it will die. Field studies have shown that giant sequoia seedlings have a very high mortality rate. The large amount of seeds produced ensures that at least a few seedlings will survive. When a seedling has become established, it can grow very quickly if it receives enough water and plenty of sunlight. When young, these trees can add up to 4 feet in height a year. Eventually the pyramid-shaped young giant sequoias grow into massive round-topped trees with huge, gnarly branches. The average giant sequoia does not become mature until about age 75, when viable seeds begin to be produced.

In Class Activities

What Do Plants Need

Discuss what conditions seeds need to germinate and grow into plants (soil, water, sunlight and air) and how changes in those things vital for plant germination can change the outcome for the plant.

- Plant some seeds in wet paper towels to observe actual seed germination. These sprouts will die when they use up the energy stored in the seed.
- Plant some seeds in soil. After they germinate, try growing the plants under different conditions:
  - In darkness
  - With no water
  - With no air
- Chart the growth of the plants, comparing growth under different conditions. Do giant sequoias need the same things in order to grow? (yes) Giant sequoias also depend on fire, which clears the layers of forest litter and duff from the soil surface, enabling the seedlings to survive.
- Try growing seeds on top of a layer of pine needles or leaves covering the soil. Vary the depths of the layer and chart your results. You can usually buy giant sequoia seeds at the park Visitors Center if you would like to try growing them yourselves.

Grow a Tree

An avocado makes a good grow- your- own-tree. By suspending an avocado in water students can see how a seedling's roots and stem grow. Peel the brown thin covering from the seed, poke three toothpicks into it at equal distances and let the seed sit in a glass of lukewarm water with the large end submerged. Make sure the water continues to cover the bottom of the seed and replace with lukewarm water once a week. Avocados will sprout in about 3 weeks. When the stem and roots are a few inches long plant in a pot that is an inch wider than the avocado. As the avocado sprouts discuss with the students how the seeds develop and the things the seedling needs to grow.

Fourth Grade

DCI LS1.A Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior and reproduction. (Examples of structure could include bark, leaves, branches, roots, cones etc.)

The giant sequoia tree offers great examples of how the structure of a plant can help with its survival and long life. The guide will talk about how the various parts of the tree are crucial to its survival and long life.

Classroom Activities

Build a Tree

- Divide the students into five groups of roughly equal sizes. Each group will dramatize one part of the trunk of the tree:

  Heartwood — Inner Bark (phloem)
  Sapwood (xylem) — Outer bark
  Cambium

- Each group will need to come up with sounds and actions that describe the function of their tree part. Their major functions are:

  Heartwood - Provides stability, but is dead. It is filled with resin-like materials and no longer transports water and minerals.

  Sapwood – the most recently formed layer of wood. It is made of thick walled cells that transport water and minerals from the roots throughout the tree. (xylem)

  Inner Bark - also called phloem, is a pipeline of cells that transports sugar and nutrients to all parts of the tree.

  Cambium – a thin layer of cells next to the phloem (inner bark) that makes the trunk, branches, and roots of the tree grow thicker.

  Outer bark – protects the tree from insects, fire, and disease.

- In the order given above, have each group come up and act out their sounds and actions until all the groups are assembled as would be a living tree.

  Heartwood in the center, encircled by the layer of **sapwood**, Then a layer of **cambium**, then the **inner bark,** and finally the **outer bark**

- Have the students act out their parts as you play the insect, fire, or disease trying to penetrate the outer bark.
- To extend this activity include other parts of the tree roots, foliage, branches , seeds.

A Trip Through a Tree
(Guided Imagery)

This guided imagery will take the students on a "visit " to the inner working parts of a tree. Before reading the guided imagery, direct the students to put down all objects and sit in a comfortable position with their eyes closed. Wait until the class has relaxed before starting. Read slowly and steadily, allowing students enough time to create their own visual images. Once finished , ask the students to review all of the images they saw in their minds. After at least one minute, ask them to open their eyes. Have them discuss their thoughts and impressions. Where did they go and what was happening. Bring closure to the imagery by having the students draw a picture of any of their mental images.

Guided Imagery: A Trip Inside a Tree

What if, instead of going on a trip to Calaveras Big Trees State Park, you could go on a trip inside the cells of a giant sequoia tree? What do you think you would find there? The first thing you need to do is find a giant sequoia tree. You are going outside the classroom now…away from the school…. Away from our town…. You travel until you find a huge giant sequoia tree. You are now standing next to a very tall and very, very wide tree with soft, reddish-brown bark. Look up. Can you see the top? As you look up, you notice that everything around you seems to be getting bigger, and you seem to be getting smaller. Now you can't see the top of the tree at all. In fact, a nearby flower is taller than you. The ground seems to shake a little and you notice a huge ant walking toward you. You can see its big hairy legs and vicious looking mouth as it steps over you without even noticing you. You look up again and see a raindrop, which looks like a huge ball of water falling from the sky. The raindrop lands next to you. It makes a huge splash, and you find yourself sinking into the wet ground. You quickly grab onto a nearby water molecule, a shimmery, round, object.

Sssshhhlllluuupppppp. Both of you are being sucked down into the ground and into a tiny dark tunnel along with thousands of other water molecules. They are like a sea of shiny, bouncy, spheres moving along together. You are pulled through the tunnel, which joins another tunnel, and then another. As this connecting system of passageways becomes more and more complicated, you wonder if you'll ever be able to find your way back. There are other kinds of molecules around you too…some are very large, and they are all different shapes and colors.

You now find yourself in a narrow tube that is taking you straight up. As you move slowly skyward, you look next to you and see another tube. It looks like the one that you're in, but it is full of a syrupy liquid, and is moving down, not up. On the other side of the tube is a dark, solid looking wall. Pretty soon, things start to move very slowly, and then stop completely. Nothing moves for a long time. It's getting cold. You begin to wonder if you'll be stuck inside this tree forever. After what seems like hours, you start slowly moving up the tube again, and the syrupy liquid next to you starts moving down

again. As you go higher and higher, you begin to hear loud knocking and chewing noises. You feel safe from whatever is knocking and chewing in the dark wall next to you.

All of a sudden, you begin moving sideways. Soon everything around you is a beautiful color of green, and you feel very warm. The green walls around you are made of cells that look like boxes stacked on top of each other. As you look closer, you notice some of the syrupy liquid coming out of the green cells. It is like a busy factory inside each cell. There are molecules inside the cells that grab other molecules and bring them into the cells. Those molecules are broken apart and combined with other molecules, which makes the syrupy liquid. You also notice that there are tiny holes in the floor, and every once in a while, an oxygen or water molecule falls through a hole. You wander around, watching the molecules moving about. Without realizing it, you have stepped into one of the tiny holes. You begin to fall. You are outside the tree now, floating down , past branches and leaves and a woodpecker and a beetle, and dark red bark… down all the way to the ground. How does it feel to be back on solid ground again? You look around and see that the flower, the ant, the tree , and you are all back to your normal sizes. You wave goodbye to the tree as you travel back to your town… back to your school… back to your classroom… When you are ready you may open your eyes.

Tree Parts in the story (in order of appearance)

- Tunnels and passageways----------root system
- Tubes going up----------Sapwood or xylem tissues transporting water and minerals
- Tubes with syrupy liquid----------inner bark or phloem tissues transporting sugars
- Dark wall----------outer tree bark
- When you stop moving----------night time
- Knocking and chewing noises---------- ----------woodpecker and beetle
- Green warm area----------leaf in the sunshine
- Factory----------Photosynthesis, which produces the sugars
- Holes in the floor---------- ----------stomata in the leaf

Fifth Grade

DCI LS.2A Interdependent relationships in ecosystems. The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat the plants. Some organisms such as fungi and bacteria break down dead organism (both plant or plant parts and animals) and therefore operate as "decomposers". Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their need in a relatively stable web of life. Newly introduced species can damage the balance of the ecosystem.

At Calaveras Big Trees, the main forest community present is called the Sierra mixed conifer forest community. It is an interrelated group of plants and animals that occurs in a belt between about 2,000 and 7,000 feet elevation in the Sierra Nevada mountains. The distribution of plant and animal communities in the sierra is controlled by such factors as topography, slope, aspect, altitude, temperature, rainfall and soil type. The guides on your tour will help your students see the connections between the members of this forest habitat by discussing the importance of each member to the food chain.

The following is a brief description of the parts of a food chain:

- **The sun** provides the energy to power the process of photosynthesis in green plants.
- Green plants are called **producers** because they use solar energy combined with carbon dioxide, nutrients, and water to produce their own food in the form of sugars, proteins and other organic compounds.
- Animals are called consumers because they cannot make their own food, but must consume other plants or animals to acquire energy and the building materials for their bodies.
- **Herbivores** are animals that get their energy and nutrients by eating plants.
- **Carnivores** are animals that get their energy and nutrients eating other animals.
- **Omnivores** are animals that get their energy and nutrients by eating both plants and animals.
- **Scavengers** are animals that feed on dead animals (that they haven't killed).
- **Decomposers** are organisms that break down dead plants and animals into various chemicals, which are then returned to the soil and used as nutrients by plants. They can be insects, bacteria, fungi, or protozoans.

Classroom Activities

Food Web Yarn Game

- A food web is made of interconnected food chains (students should be familiar with the food chain concept before doing this activity).
- Students sit in a circle. You are the sun, and hold a ball of yarn. Ask the students to name a living thing that makes its food using sunlight energy.
- Holding the end of the yarn, toss the ball to the student that answers correctly (any green plant). That student holds the string and tosses the ball of yarn to the student who can name something that would eat the plant. That student might toss the ball of yarn to someone who could name an animal that is eaten by the first animal or one that would eat the first animal. Then they could toss the yarn to something that would eat the animal when it dies. And then something that uses the nutrients from the dead animal and on and on.
- Continue until each student is holding a part of the "web" and all parts of the food web have been mentioned (see previous page). You can also include soil, water, and air. Notice how each member of the food chain is connected to all other members by the yarn.
- To demonstrate the importance of each member to the whole community, eliminate one member. That member drops his yarn. Anyone who felt their yarn go slack then drops theirs… an so on, until everyone in the in the web has felt the effect. Ask- How is this like a real food web? Because of these connections, we (humans) often have a larger impact on natural systems than we realize.
- Read the following passage to your students and ask them to discuss its meaning.
  Man did not weave the web of life; he is merely a strand in it. Whatever he does to the web, he does to himself. – Chief Seattle

Who Eats Who?

The definition of a food chain is:

The transfer of energy from the source in plants through a series of animals with repeated eating and being eaten. – Project WILD

- As you describe the food chain, invite students up one at a time to act out the part you are describing.
- Start with the **sun** shining down on a green plant which is making food in its leaves.
- The **producer** (grass) is eaten by an **herbivore** (mouse) which is eaten by a **carnivore** (snake).

- When the snake dies, it is eaten by a **scavenger** (turkey vulture) and the nutrients are returned to the soil by **decomposers,** which will be used by green plants. Emphasize the transfer of energy and nutrients in this process.
- Have the students draw a food chain using plants and animals they may see at the park, that live in your area, or that includes themselves.

Sixth Grade

DCI ESS3.C Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to the Earth's environment can have different impacts (+&-) for living things.

There are a number of ways human activities have had an effect on the mixed conifer forest of which the giant sequoia trees are a part. Fire suppression, forest density, the drought, and pine bark beetles have had a dramatic effect on the forest. The guides will discuss problems of forest density due to fire suppression and the long term effect of the drought and pine bark beetles on the mixed conifer forest.

Classroom Activities

What's Happening to California's Forests

There are many topics that show how human activities have altered the mixed conifer forests here at Big Trees State Park. Explore these topics by having your students divide into groups and research some of the ways the forest is changing and how the changes will impact the forest and human activities within the forest. Each group can report back to the class report back to the class.

Here is a list of possible topics:

- **Pine bark beetle infestation –** Evidence of the impact of the pine bark beetle can be readily seen as you drive through Arnold on the way to the park. This is an infestation that will impact the California's forests for a long time. What caused it? Can anything be done with the dead trees? Were humans responsible in any way for the damage caused? Is there anything we can do in the future to prevent this kind of devastation?
- **Fire suppression –** There is a lot of discussion about how fire suppression has impacted the forests. A forest fire was very close to Big Trees in 2015 and the park had to look at ways to protect the giant sequoia trees, which lead to questions about fire in the forest. How has fire suppression impacted California's forests? Are wild fires good or bad? What happens to a forest after a wild fire? What is forest succession?
- **Forest Density-** The amount and type of trees in the forest can affect the health of the forest. What does a healthy forest look like? How does the number of trees affect the trees ability to thrive? Why does the type of tree in a forest matter to the health of the forest and the other trees?