Plant Adaptation Lesson Plan

LEVELS:
Grades 3 to 6

SUBJECTS:
Science, language arts

CONCEPTS:
The conditions at White Sands National Monument, the world's largest gypsum dunefield, create a unique environment for plant survival. The monument encompasses an ecosystem within an ecosystem where, of the 244 plants found in the desert environment, only 60 have developed strategies for survival in the dunefield itself. Our study will focus on three basic survival techniques used by plants within both the dunefield and the desert.

1. Moisture retention
2. Stem elongation
3. Pedestal building

SKILLS:
- Matching
- Creative thinking
- Cause and effect

OBJECTIVES:
- Students will learn how enough nutrients exist within the dunefield to support plant life.
- Students will study the three different plant survival techniques and identify which plants utilize which techniques and why.

VOCABULARY:
- ***Cyanobacteria*** – microscopic algae that fixes nitrogen from the atmosphere to the soil.
- ***Adaptation*** – a change in a plant's lifestyle that improves its chances of survival in its environment.
- ***Stemelongation*** – the ability of a plant to grow tall faster than a dune is moving.
- ***Evaporation*** – the way a plant loses water through its leaves.
- ***Leaf hairs*** – a way plants create their own shade.
- ***Pedestals*** – structures formed by certain plants that try to hold on to part of the dune.

MATERIALS:
- Picture of plants within the interdunal area
- Picture of yuccas growing through a dune
- Picture of pedestals formed by skunkbush sumac, rosemary mint, and Rio Grande cottonwood tree
- Picture of "popcorn" soil

BACKGROUND:
Although the desert is not an easy place for plants to live, a dunefield makes life even more difficult. To begin with, the sand in a gypsum dunefield has no nutrients like nitrogen, potassium, and phosphorous that plants need to live.

In order for these nutrients to get into the soil, a good layer of "popcorn" soil needs to be created. This process is started by some cool stuff called "cyanobacteria," which falls out of the air and then pulls other good stuff down to the ground. If enough time passes without a dune coming along to cover it all up, the "popcorn" soil gets rich enough for seeds to sprout and plants to grow. Then the struggle to survive in the dunefield really begins.

In the dunefield, all plant life begins in the interdunal areas, and an assortment of grasses, flowers, and other plants grow there. In order to survive the sun, the wind, and the lack of rain, many of these plants have developed moisture retention adaptations shared by their cousins in the desert.

Growing small leaves covered with leaf hairs is one adaptation used by many plants to create their own shade and to prevent water evaporation. These plants tend to grow quickly, but not very tall, many putting out thousands of seeds and then dying when a dune comes along and smoothers them. In the desert, growing a waxy leaf covering helps members of the cactus family hold onto water.

The soaptree yucca grows in both the desert and the dunefield. The yucca plants that begin life in the interdunal area use a technique called stem elongation to keep from being buried by a dune. When the soaptree yucca feels itself being smothered by a dune, it grows very quickly trying to keep its head above the sand. This stem elongation technique works nicely-for a while.

You see, the yucca puts so much energy into growing up it doesn't have enough energy left over to grow a big enough stem to support itself without help. As long as the dune is there surrounding it, the yucca is fine. But when the dune moves away, the yucca usually falls over and dies.

Three other plants that begin life in the interdunal areas use another technique called pedestal building to survive being covered by a dune. While the skunkbush sumac, the rosemary mint and the Rio Grande cottonwood tree all use stem elongation like the yucca, they also add another step to the process. Instead of just growing up really fast, they also put branches and roots out to the sides. These branches and roots act like arms and fingers that grab the sand and hold it close to the plant.

As the dune begins to move away, the sand that is trapped by the "arms" and "fingers" hardens enough to support the plant. Even after the dune has moved on, the pedestal-building plants continue to grow and wait for another dune.

ADAPTATIONS FOR THE TEACHER:

1. Small leaves
2. Low growing plants
3. Waxy leaf coverings
4. Leaf hairs
5. Stem elongation
6. Pedestal builders
7. Seed dispersal

GETTING READY:

Pictures on board:

1. Desert area with plants
2. Dunefield without plants
3. Interdunal area
4. Dune with yucca growing through it
5. Pedestal
6. Cactus – claret cup
7. Sand verbena
8. Cyanobacteria

DOING THE ACTIVITY:

Have students read the background information on plants. Discuss adaptation. Have the students write down as many adaptations as they can find from the background information.

REINFORCEMENT:

Divide the class into five groups:

1. Cyanobacteria
2. Dunes
3. Grasses and flowers
4. Yuccas
5. Sumacs, rosemary mints, & cottonwood

Have the "cyanobacteria" students "fertilize" the center of the classroom or other cleared area that will represent the interdunal area.
Have the "plant" students kneel down in the interdunal area.
Have the "dune" students off to one side.
Have the "wind" begin to slowly blow the "dunes" into the interdunal area.
Have the "plants" respond in the appropriate manner to being covered by the dune. (The grasses and flowers fall down and die; the "yucca" stretch up and up standing as tall as they can while keeping their arms by their sides; and the "sumac," "rosemary mint ," and "cottonwoods," while also standing tall, stretch their arms out to grab hold of the wet sand and hold on.)
As the "dune" moves off, have the "cyanobacteria" students "re-fertilize" the interdunal area.

EVALUATION:
Using the White Sands National Monument Worksheet, have students match the adaptation to the appropriate picture.

ADDITIONAL VOCABULARY FOR OLDER AND/OR ADVANCED STUDENTS:

- ***Water table*** – the level below the earth's surface at which the ground becomes saturated with water.
- ***Perched water table*** – a water table that occurs above the regional water table due to an impermeable layer of rock or sediment separating the two.

ADDITIONAL BACKGROUND FOR OLDER AND/OR ADVANCED STUDENTS:
You know that in the process of outgrowing the dune the yucca grows only a skinny stem. But did you also know that using all that energy to keep its head above the sand could leave the plant without enough energy to flower that year? Wow. Just staying alive can be a lot of work.

Now the pedestal builders have it a little bit easier. Unlike most dunes, the gypsum dunes here at White Sands are wet all the way through. That's because the dunefield sits on what is called a perched water table and an interesting characteristic of gypsum is that it wicks water just like a sponge. So the pedestal builders have something of an edge in that they have nice, wet sand to grab hold of and hold on to.

VARIATION ON ACTIVITY FOR OLDER AND/OR ADVANCED STUDENTS:
While role playing, older or advanced students need to verbalize, in one or two sentences, what they are doing. (i.e. – the "yucca" might say "I'm growing very, very fast and getting very, very skinny. I'm using so much energy growing up that I might not flower this year.")