Unit Map

What is happening to the chalta trees in the Bengal Tiger Reserve?

In their role as plant scientists, students figure out why there are no new chalta trees growing in the Bengal Tiger Reserve, which is part of a broadleaf forest. Students investigate what chalta trees need to survive, and then they collect and analyze qualitative and quantitative data to solve the mystery.

Chapter 1: Why aren't new chalta trees growing in the Bengal Tiger Reserve?

Students figure out: The chalta trees in the Bengal Tiger Reserve make seeds. Only the seeds that get enough water and sunlight will sprout and grow into new adult plants. There are no new chalta trees because the chalta seeds must not be getting enough water and sunlight.

How they figure it out: Students read a book that models how scientists study habitats, and then students observe their own sample study sites to learn about the diversity of plants in a habitat. Students analyze maps of the tiger reserve from 1995 and 2015 and discover that no new chalta trees have grown during that time, but other plants have. They investigate seeds, read about seed needs, and record measurements of seeds planted in various conditions as they construct an understanding that seeds need sunlight and water to mature into full-grown plants. The class co-constructs a scientific explanation, concluding that the chalta seeds must not be getting the sunlight and water they need.

Chapter 2: Why aren't the chalta seeds getting the sunlight and water they need to grow?

Students figure out: The chalta trees in the tiger reserve use their roots to get water from the soil and their leaves to get sunlight. Growing chalta seeds need space far enough away from other plants so their roots can spread and their leaves can get sunlight. The chalta seeds must not be getting to places where they can get what they need to grow.

How they figure it out: Students investigate roots and leaves from different plants and obtain information from a book that enables them to explain how a plant is a system with different structures that work together to help the plant grow. Students play a board game and engage with a variety of models, including a digital app, as they discover that plants need to be in a place where they have space for their roots to absorb water and where the sun is not blocked by other plants' leaves. Students consolidate their understanding in a written scientific explanation to the lead scientist of the Bengal Tiger Reserve.

Chapter 3: Why aren't the chalta seeds getting to places where they can grow?

Students figure out: The chalta trees in the Bengal Tiger Reserve depend on elephants to disperse their seeds. Elephants eat the chalta fruit for food, move to other places in the habitat, and leave droppings with seeds inside in locations that might have water and sunlight. A fence built in 1996 has prevented elephants from coming inside the reserve, so elephants no longer disperse chalta seeds to places where they might grow.

How they figure it out: Students engage with a model in which they simulate animal dispersal of seeds, measure how many seeds were dispersed to places where the seeds are likely to grow, and analyze their results. Students obtain information about how the different parts of the Bengal Tiger Reserve habitat interact, and they create diagrams that show the interdependence of plants and animals. Students revisit the digital app to explain how seeds in particular habitats get dispersed. Students apply their understanding of the relationship between plants, animals, and seed dispersal as they craft a scientific explanation about why the chalta seeds are not getting to places where they can grow.

Chapter 4: How are other seeds in the reserve able to get to places where they can grow?

Students figure out: Other seeds from plants in the Bengal Tiger Reserve can get to places where they can grow because the wind disperses them. Wind picks up the sal tree seeds and red silk tree seeds and carries them to different places.

How they figure it out: Students read a text that describes how peers designed and carried out an investigation about seed dispersal for seeds without fleshy fruits. Students observe images of seeds and predict how the seeds' structures might help them be dispersed to new places. Groups of students plan an investigation of seeds with specific structures. They carry out investigations of two different wind-dispersed seeds by counting and measuring the distance the seeds traveled in the wind. Students apply their takeaways from these investigations so they can explain how other seeds in the Bengal Tiger Reserve are dispersed.

Unit Map

How can we design a glue mixture that is better than what the school uses now?

As glue engineers, students are challenged to create a glue for use at their school that meets a set of design goals. Students present an evidence-based argument stating why their glue mixture would solve their school's need for a better glue.

Chapter 1: How can you make a sticky glue?

Students figure out: Glue is a mixture of several ingredients such as flour, water, and cornstarch, and depending on the properties of those ingredients and how they are combined, you can create different glues. Some glues might be stickier or stronger than others. By understanding materials and observing and testing different recipes, you can choose the ingredients that provide the properties you are seeking.

How they figure it out: To set context, students gather evidence about materials and their properties by reading a book about everyday things and what they are made of. They investigate the properties of two mystery glues and make scientific arguments about whether they are the same or different glues. The class goes on to observe and test possible glue ingredients for their sticky properties, graph test data, and search for information about ingredients in the unit's reference book. Using all the gathered evidence, students plan, make, and test their own glue recipes.

Chapter 2: Can heating a substance (and returning it to its original temperature) make a better glue?

Students figure out: When water is heated and returned to room temperature, the properties go back to the way they were, but the properties of some other materials change after heating and going back to room temperature. For example, when a mixture of cornstarch and water is heated and then returned to room temperature, it has different properties than it had before.

How they figure it out: Students investigate how heating a substance may help them make a better glue by conducting tests to determine the properties of possible glue ingredients before and after heating. This supports them in determining cause-and-effect relationships.

Chapter 3: What ingredients can be used to make a glue that is sticky and strong?

Students figure out: Sometimes, the properties of glue are a combination of the properties of the substances that make up that glue, such as a flour-water combination. Ingredients can be combined to create different glues that have different properties. For example, baking soda, which is smooth, and flour, which is sticky, can be combined to make smooth and sticky glue.

How they figure it out: Students are inspired by reading a book that shows the design process in action. They decide that the glue they create for the school should have an additional design criteria—the property of strength—a key and useful feature for its intended purpose at the school. Students set about testing evidence-based plans that include the best ingredients for a strong glue mixture. By the end of the chapter, student teams make and test a second glue recipe.

Chapter 4: What is the glue recipe that best meets our design goals?

Students figure out: It will typically take multiple design cycles to find the exact glue recipe (mixture) that meets the design goals. By designing and testing mixtures that include ingredients with the desired properties, glue engineers can identify the best result and successfully meet their design goals. Students will have evidence to support each design goal, and that will inform their design arguments for the best recipe.

How they figure it out: After evaluating the second glue recipe, students plan, make, and iteratively test additional glue mixtures. By immediately analyzing their results and applying their understanding of the effects of specific glue ingredients, students are able to modify their designs. Students are able to speak knowledgeably about their choices and argue for how a particular glue mixture is best at meeting the design goals by the end of the unit.

Unit Map

Why is the edge of the ocean cliff closer to the flagpole than it used to be?

The director of the Oceanside Recreation Center got a scare when a nearby cliff collapsed, and he is worried that erosion on the recreation center's ocean cliff might have safety implications for the center's visitors. By taking on the role of geologists investigating landforms and erosion, students are able to advise the director on the prudence of keeping the center open, even though its cliff is also changing.

Chapter 1: How did the edge of the cliff get to be so close to the flagpole?

Students figure out: The shape of the cliff changed when the rock it is made of changed.

How they figure it out: Students read about and observe photos of different types of landforms as they gather evidence that landforms are made of rock. They investigate sand samples and see that sand is composed of tiny pieces of rock. They read a book about a scientist who makes inferences about the rock that the sand originated from based on its size, shape, and color. The class then visualizes how grains of sand can form and how landforms can change size and shape using a model where they shake pieces of hard candy. Students write a scientific explanation of how the shape of the cliff can change.

Chapter 2: How did the recreation center's cliff change?

Students figure out: Water hit the cliff and caused tiny pieces of the cliff to break off and move away.

How they figure it out: Students investigate the process by which landforms change. They observe images of landforms before and after big changes and discuss ideas about what might have caused the change to each landform. They identify water as an agent of change and use models with chalk to investigate how water can change a landform. They read how water—in both liquid and solid form—can erode landforms by causing pieces of rock to break off. Students diagram this process and conclude the chapter by writing an explanation of how landforms change.

Chapter 3: How did the recreation center's cliff erode without the director noticing?

Students figure out: Because the pieces are so small, it took a really long time to observe a big change to the cliff.

How they figure it out: Students are introduced to maps as a tool for geologists studying changes to landforms. Using the reference book, students discuss features of maps and explore landforms from different perspectives. They use a digital modeling tool to create their own maps of landforms. Using a model made of pom-poms that represents a mountain, students erode the model to show how many small changes (difficult to notice) can add up to a bigger change (easy to notice). Students also consider the scale of time and conclude that perceptible changes to landforms usually take a very long time. Finally, students write explanations and create diagrams that explain how the recreation center's cliff eroded without the director noticing.

Chapter 4: Could the recreation center's cliff erode quickly?

Students figure out: The nearby cliff eroded quickly because it is made of loose materials, such as clay and dirt, which are not as strong as rock. When wind or water hits the cliff, big pieces can break off. This causes the cliff to change more quickly than rock would.

How they figure it out: Students brainstorm and create diagrams of ways they think landforms can erode quickly. Using the reference book, they learn that landforms with cracks and landforms made of loose materials can erode faster than landforms made of solid rock. They use multiple erosion models to provide evidence that supports the idea that wind and water can quickly erode landforms made of loose materials. After reflecting on the many models and information sources from the unit, students use the digital modeling tool to demonstrate their understanding of why landforms made of different materials erode at different rates. Students use newly discovered evidence and key ideas to diagram and write a final explanation of why the nearby cliff eroded overnight. The class then discusses how they should advise the director about the safety of the recreation center's cliff.