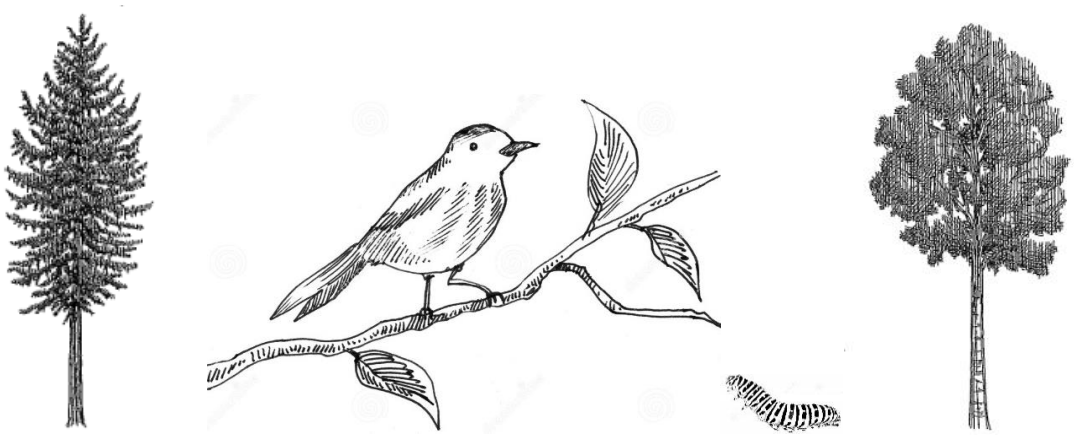
Comparative Field Investigation

And Engineering Solutions

Where are the living things at my school?

Kindergarten

PEI PACIFIC EDUCATION INSTITUTE



Comparative Field Investigation & Engineering Solutions

Where are the living things at my school?

Overview

Young students' imaginations bring so many things "to life" and they have a very intuitive sense of what "alive" versus "not alive" means. In this series of lessons students will hone their intuitive sense of biology and in the process discover what conditions are required for life. Students, in the first lesson, begin by playing a game of schoolyard bingo searching for both living and nonliving things found on the school grounds. Next, they will sort their bingo cards into what they initially think is living and non-living. Students use a pre and post sorting of items found in their schoolyard to document how much they learned through the lessons. Students will also investigate how sunlight impacts the temperature of surfaces. Finally, students will engineer and test a shelter that can change a surface's temperature to make it more compatible with a potential schoolyard creature.

Project Learning Tree Lessons

These lessons are adaptations of Project Learning Tree activities: *Tree's as Habitats #10*, and *Schoolyard Safari #46.*

Background

Kindergarten students may have trouble distinguishing between living and nonliving. For example, some may describe anything that moves as living or alive. Students may not yet understand the cycle of birth, growth, and death. Some students may not have yet cognitively reached the point of understanding that death is irreversible and may still believe it is a temporary state, like sleeping. Therefore, some students may classify nonliving things as dead.

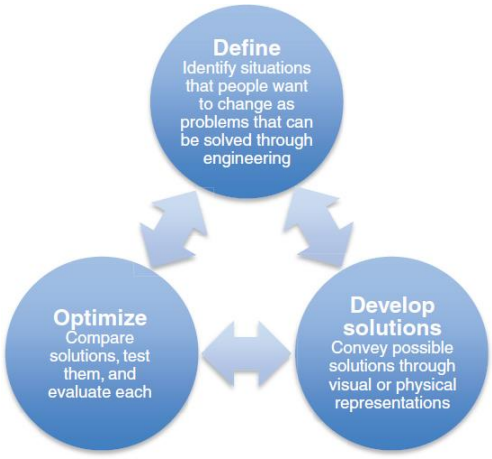
In science "living" is anything that is or ever has been alive, (examples a stick, logs, seeds, eggs, rabbits); "nonliving" is anything that has never been alive (rock, water, metal, car).

Scientists have yet to develop a definition of life. Instead scientists have accumulated a list of characteristics that living things have in common; 1) living things grow and change, 2) living things use energy, 3) living things reproduce, 4) living things respond to stimuli, 5) living things maintain homeostasis, 6) living things are made up of cells, and 7) living things have DNA. Not all these characteristics are appropriate for Kindergarteners to try and understand.

Kindergarteners should understand that living things grow and change. This is an easy quality for them to comprehend because they know they have grown and changed. The concept of energy is not appropriate to introduce at this grade level; however, they should be able to understand that food is energy for living things. Students are capable of understanding that animals eat food, and plants make their food from sunlight. The third item referenced above, living things reproduce, can be understood by students when described as, "living things make more of their own kind." An additional characteristic that students can and should understand about all living things is that living things respond to changes in their environment. Living things prepare and adjust for season changes, examples of trees losing their leaves and animals going into hibernation. It is not appropriate to introduce the last three characteristics of living things as they require more advanced background knowledge. Therefore, no portion of these lessons will touch on the concepts of homeostasis, cells, or DNA.

The following is an excerpt from the Next Generation Science Standards Volume 2 Appendixes – Appendix I

Engineering design in the earliest grades introduces students to "problems" as situations that people want to change. They can use tools and materials to solve simple problems, use different representations to convey solutions, and compare different solutions to a problem and determine which is best. Students in all grade levels are not expected to come up with original solutions, although original solutions are always welcome. Emphasis is on thinking through the needs or goals that need to be met, and which solutions best meet those needs and goals.



When assessing students' final engineered projects, keep in mind that originality is not a criterion. Assessing if their projects lowers the surfaces' temperature is the benchmark of success. Final assessment should not be conducted only after multiple iterations of the project. Optimization from first attempts is a crucial element of the engineering design standards, and an excellent opportunity to integrate into any growth mindset lessons teachers may do with students.

Sunlight and caterpillars are two central concepts of these lessons. It may be easier to conduct these lessons in the warmer months of the school year. If you hope to see a caterpillar, most species of Washington state moth and butterfly larvae hatch from eggs mid-May to early June. The caterpillars eat and search for a place to become a pupa late-May and June. Spotting a caterpillar on your school grounds is not required, nor is having "warm" weather. However, for assessing the effects of sunlight on surfaces and testing students' engineering solutions, days of direct sunlight are needed.

Comparative Field Investigation - Where are the living things at my school?

Engineering Solutions – Can I lower the temperature of a surface by shading from the sun?

Next Generation Science Standards-3-Dimensions

Dimensions from the Framework	What Students are Doing
Science and Engineering Practices • Asking questions • Planning and carrying out investigations • Constructing Explanations • Analyzing and Interpreting Data	Students ask questions: *What surfaces of the schoolyard will be warmer? Does sunlight change the temperature of the surface? Where will I find living things on campus? What qualities make something alive?* Students Plan and carry out investigations*: Students will test the effect of sunlight on different surfaces on their school grounds. Students will test how well their caterpillar condos shade the ground lowering the surface temperature.* Students Construct Explanations: *Students will explain why somethings are alive and other things are nonliving. Why some surface temperatures are hotter than others.* Analyzing and Interpreting data: *Students will be comparing various items found at school and analyzing what qualities of living things they have. Students will be assessing if their engineered condos do lower temperature*.
Disciplinary Core Ideas **PS3.B: Conservation of Energy and Energy Transfers** Sunlight warms Earth's surface (K-PS3-1) **LS1.C: Organization for Matter and Energy Flow in Organisms** All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow (K-LS1-1)	**K-PS3-1** Student's observe that different surfaces with different amounts of sunlight reaching it will be different temperatures. They will record their findings on a thermometer. Students will be determining if their engineered shelter provides cooling shade. **K-LS1-1** Students' use observation to describe patterns of what plants and animals (including humans) need to survive. They will sort living and nonliving items found on the school grounds based on the qualities of life the item displays.
Cross Cutting Concepts • Patterns • Cause and Effect	• Student's will be noticing the patterns that distinguish between living and nonliving things. • Student's will test their caterpillar condos and gather evidence about their effectiveness at lowering temperature.

English Language Proficiency Standard:

ELP.K.2 participate in grade appropriate oral and written exchanges of information, ideas, and analyses, responding to peer, audience, or reader comments and questions.

Lesson 1: What is alive at my school?

Objectives

Students:

- Identify parts of their schoolyard habitat.
- Students sort objects into living and non-living and develop a working description of what living means.
- Develop criteria to decide if something is living or non-living and classify based on those criteria.
- Recognize that living things grow, change, reproduce, need food, and respond to their environments.

Materials: Clipboards, schoolyard bingo cards, pencils, scissors, glue sticks, living/non-living page, and chart paper (optional)

Learning Experience

Students will conduct a scavenger hunt to complete a bingo card of items commonly found on their school grounds. Students will cut the pages and sort into living and non-living.

Engage

1. Tell students they are going to be learning about what is alive on their schoolyard. Complete a whole class **KWL chart** from the reflection and assessment section using a large piece of butcher or chart paper. Record students' responses to sections K and W. Use separate colors for recording K, W and L statements. Keep this chart on the wall throughout this unit for student reflection and new learning.
2. Prior to conducting the scavenger hunt on the school grounds review your classroom rules and procedures for being outdoors. Ensure that each student knows the boundaries to explore and your signal to regroup as a class.
3. Show the students an example of the **bingo scavenger card** from the student pages. Review what kinds of items they will be searching for. Explain that the items they find may not look exactly like what is on the card.
4. Explain your expectations of the game. For example, what prize you will give to the first bingo finder? Making the scavenger competitive or whole class cooperative is up to your discretion. Do you want the bingo finder to show you where they found their items? How much time do they have to search, do they work in partners or teams? Customize your expectations of the game to suit your needs.

5. Distribute clipboards and bingo scavenger cards. Students should have a pencil to check off the items they find.
6. Bring students together to share what they discovered in their schoolyard.

Explore

1. Give students the **living/non-living comparison sheet** from the student pages.
2. Ask the students to cut out the boxes of their bingo card and place them in the living or non-living columns. Students can do this independently or in small groups. **This is a pre-assessment opportunity**. Students may glue their pictures to make a more permanent record of their initial understandings. Taking a photo of their first sort is another method of recording their initial understandings. Students will repeat this activity with different pictures at the end of this unit for a more formal assessment.
3. Gather class together and solicit their ideas to make a class chart of whether the items they found were living or non-living. Use an extra bingo card and display on a document camera or use larger images and hang them on chart paper on the wall. Take time to have students explain their reasoning. Ask probing questions such as, "what do the living things have in common?" or "what do the non-living things have in common?". Avoid telling students correct answers.

Explain

1. Share the scientific definition of living (anything that is or has ever been alive) and non-living (anything that has never been alive). Remember that the difference between nonliving and dead can be confusing. Give an example of something that is dead but still classified as living, such as a stick or log.
2. Distribute copies of the handout; **Characteristics of Living Things** from the student pages section. Display handout for the whole class to see via document camera or computer projection. Explain how each characteristic is depicted on the handout.
    a. **Grow and change:** examples such as humans starting as babies grow and change into adults or a seed sprouting and becoming a tree.
    b. **Use food:** either make their own food with sunlight or find it.
    c. **Reproduce:** living things can make more of themselves by laying eggs, giving birth, making seeds, etc.
    d. **Respond to change:** If an animal is cold it will shiver or find warmth. If a plant needs water the roots will grow towards water.

    Teacher Note: If you have supplemental readings to include such as some of the suggested picture books, or supporting curriculum text, you can read those at this time to support the 4 age appropriate descriptions of the characteristics of life. Biologists usually include the additional characteristics; has cells and DNA. These are conceptually beyond kindergarteners' understanding and are best avoided during this discussion.
3. Model how to use the handout - **Characteristics of Living Things** - by doing the first three columns together as a class.

4. Working in small groups, have students review their bingo card sort. Have students indicate which characteristics of life each items exhibits by putting a check in the appropriate column.

Elaborate

1. Discuss what characteristics ALL the living things have in common.
2. Discuss if any of the non-living things had some living characteristics? Which ones?
3. What are experiments students can do if they discover something new and want to know if it is alive? **Example:** let students imagine they are explorers under the oceans, or rarely explored jungles and they discover something no one has ever seen. How could they tell if it was living or non-living? Examples of student responses could be; "poke it to see if it moves and responds to change", "watch it over time to see if it grows or changes", "observe to see if it eats food or needs sunlight?"

Evaluate

1. Remind the students of the living/nonliving comparison that they completed at the start of the unit. This time they are going to complete the comparison with new pictures to show what they have learned.
2. Give students the **living/non-living comparison sheet** from the reflection and assessment section. This will assess progress towards standard K-LS1-1. See rubric for scoring.
3. Ask the students to cut out the boxes of their bingo card and place them in the living or non-living columns. Students should do this independently. Students should glue the pictures to the comparison chart. After the students complete the assessment, the work should be analyzed to see if the students were able to correctly identify living vs non-living things.
4. To finish assessing the standards K-LS1-1, have students independently complete the **Characteristics of Living Things** bingo card found in the reflection and assessment section. Due to the language level, you may need to scaffold by reading the characteristics of living things to students while they are checking the boxes. See rubric for scoring.
5. Return to the class **KWL chart** from the beginning of this lesson. Add additional questions or ideas students want to know and add anything students learned.

Lesson 2: Comparative investigation of how sunlight effects temperature of the earth and engineering a caterpillar shelter

Objectives

Students:

- Observe the temperature of the surface of the earth to answer the comparative question, ***"What surfaces are warmer when sunlight hits them?"***
- Build a sense of what temperature is by collecting relative data.
- Collect data and draw conclusions about which surface would be most comfortable for a living caterpillar.
- Engineer a caterpillar shelter that would modify the temperature of a surface to be more comfortable for a caterpillar.

Materials: *The Very Hungry Caterpillar* by Eric Carle, student data sheets, clipboards, pencils or crayons, scrap cardboard or clean recycled material (optional), 4 flags, pieces of string or hula-hoops.

Teacher Note: This lesson can be spread out over several days, determined by how much time you can give for students to elaborate. **At a minimum, plan for three 40-minute blocks of time.**

Engage

1. Read Eric Carle's *The Very Hungry Caterpillar*
2. Review examples of how the students know the caterpillar in the story is alive:
    a. Did he grow and change? Yes, he grew larger and changed from a caterpillar to a butterfly.
    b. Did he use food? Yes, he was very hungry and ate many things.
    c. Did he reproduce? Not in the story, but ask students if caterpillars/butterflies can make more caterpillars/butterflies? Make sure that students understand that yes, they can, butterflies lay eggs that hatch into caterpillars.
    d. Did the caterpillar respond to change? Yes, by finding and moving towards more food.
3. Ask students if they have ever seen a caterpillar on the school grounds? If they have, where? If they haven't, ask students why they might not see caterpillars on the school grounds?
4. Ask students where they found caterpillars outside of the school grounds? Do they think caterpillars like being on hot, warm, cool or cold things?

Explore

Teacher Note: For this section you will need to choose four test sites outdoors for students to feel and judge relative temperature ahead of time. Ideally you will choose a two test sites on pavement or blacktop one which has been in full sun for several hours and one that has been shaded for several hours. Two additional test sites, ideally grass, where again one has been in the sun for several hours and the second has been primarily shaded. It is good to keep the pavement and grass locations as similar as possible with the amount of sunlight being the only difference. If your school grounds do not have grass you can use any natural surface such as bare dirt, wood chips, or vegetative space in planters. You can mark these places with hula-hoops, string or flags.

1. Review what it means for something to be warm or cool. Have the students practice touching different surfaces in the classroom to detect if they feel warm or cool. For example, have students touch a book and compare it to the metal leg of a desk or chair.
2. Ask students if they have ever had their temperature taken with a thermometer? Students may describe different types of thermometers, such as the kind used in the ear, scanned over the skin, or put under the tongue.
3. Explain to students that these are tools to measure how warm your body is. A body fighting germs, that make you sick, will get warmer to kill the germs. All living things like temperatures that are just right.
4. Ask students if they have been outside and it felt too cold or too hot? Add that humans are lucky, if we get too cold, we can put on clothes to keep us warmer, or we can wear different clothing if we want to be cooler. Humans are very good at living at lots of different temperatures.
5. Ask students if caterpillars can put on cooler or warmer clothes if it feels too warm or too cold? Caterpillars will look for locations that feel best for them. Ask your students what types of surfaces they think would feel best for a caterpillar? Give examples of different surfaces; grass, leaves, pavement, blacktop, woodchips, gravel, or bare dirt.
6. Tell your students they are going outside to be scientists and investigate how the sun makes different areas of the school ground warmer than others that are shaded and therefore cooler. This investigation will help them decide which surface a caterpillar would prefer.
7. Tell students you marked four test sites outside they will feel/touch and determine if it is warm or cool.
8. Show the students the **Temperature Data Table** from the student pages to record their measurements. Tell the students that when they go outside to four test sites. At each site they will:
    - Decide if the site is sunny or shade and write an "x" in the box under the appropriate symbol (sun or cloud).
    - Feel the surface with their hands and record if it feels warm or cool. Students can record a "W" for warm or "C" for cool.

9. Students will then color in the thermometers for the two different areas. If it is warmer, they will color in more of the thermometer, if it is cooler, they will color in less.
10. Review your behavior expectations for going outside and your signals to regain students' attention.
11. Take students outside and show them your 4 marked test sites. Allow students to feel and collect their relative data of the surface temperatures.

Explain

1. Have students review their **Temperature Data Table** and write the number 1 on their warmest, the number 2 on their next warmest, the number 4 on the coolest thermometer data sheet and the number 3 on the thermometer that is remaining.
2. Create a class chart for each of the sites that were tested. Determine, as a class, which site had the most "1's" and therefore the warmest. Which site had the most "2's" and therefore the second warmest site. Which site was the warmest?
3. Ask the students "did the sunny places feel warmer or cooler than the shady places?".
4. Ask the students if sun shining on a surface always makes it warmer compared to the same places that get shade?
5. Ask the students to **think-pair-share** which of the four sites they think a caterpillar would like best? Any choice is acceptable if the student can give a reason. **Examples:** *The sunny sidewalk because it is the warmest and the caterpillar needs extra heat to turn into a butterfly*. Explain to students it is okay for classmates to have different choices and reasons. Encourage students to think of ways they could test their ideas.

Elaborate

Teacher Note: for this section have a large assortment of items. Recyclables are a good source, such as clean yogurt containers, empty juice boxes, junk mail, centers of paper towels, and cardboard food boxes.

1. Ask students, "what if a cloud blocked the sunlight and made the area shadier?", "what if there was a cloud out when the caterpillar started moving out to the places you investigated and then the cloud went away, and it became much sunnier and therefore much warmer than the caterpillar expected?".
2. Explain that animals need shelter. Some animals build their own shelters, like bird nests, mole tunnels, or beaver lodges. Some animals find shelter like a squirrel in the hollow of a tree, or a bear in a cave. Explain that caterpillars do not build their own shelters and must find one when it rains, gets too hot, or too cool. **Optional:** read the Eric Carle flip book, *My Very First Book of Animal Homes*.
3. Explain to the students that they are going to build a caterpillar shelter. It is optional to have students work independently or their build shelter in pairs. The shelter has three **criteria**, explain to students that criteria is a word for "must". Their shelter must:

   a. be large enough to fit a caterpillar, they can use their own finger to test that a caterpillar can crawl in and out
   b. stand up on its own
   c. block the sun and make shade for the caterpillar to feel cooler
4. Provide the students with an assortment of materials.
5. Allow students to experiment with materials, develop solutions, test their ideas, optimize and test again. **Teacher Note:** It is okay for students to borrow ideas from each other, and that a student does not have to design a completely original idea.
6. Students should build their first design and have time to look at others' designs, gain feedback from classmates/teacher and optimize their design before the evaluate portion of this lesson.

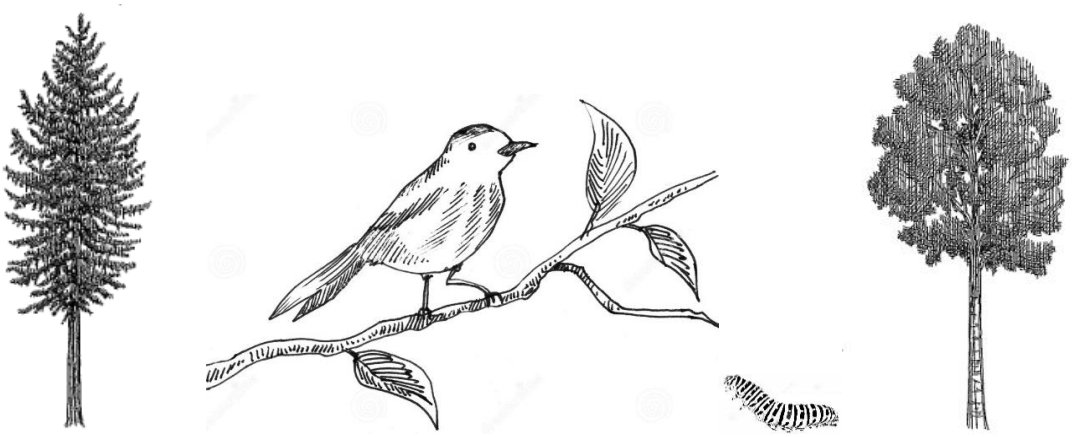
Evaluate

Teacher Note: This section will need to be conducted on a sunny, calm day. Inform users of the school grounds that you will be conducting an experiment and that the students' caterpillar shelters are not to be disturbed.

1. Place students' caterpillar shelters in the sun for a minimum of 20 minutes. It is okay to allow the shelters to sit longer in the sun if they are not in danger of blowing away or being disturbed. Utilizing the **Caterpillar Shelter Checklist** from the reflection and assessment section determine if the students engineered shelter met the criteria listed in the elaborate section. This will assess progress towards standard K-PS3-1.
2. Have students repeat the same touch/feel for temperature test they did when they compared the sunny surface to the shady surface only this time students are testing to see if the inside of their shelter is cooler than the surface outside the shelter.
3. **Optional** – have students complete another **Temperature Data Table** from the student pages when they test if their caterpillar shelter lowered the surface temperature.
4. Ask students to predict where they will find the most living things on the school grounds? In the sunny spots? The areas that are shaded? Places that are a combination of the two?
5. To end the unit, return to the KWL chart. Review and added new knowledge to the section.

Extensions

1. Introduce the idea of degrees to measure temperature. Have a thermometer that you can safely and hygienically measure students' body temperature in both Fahrenheit and Celsius. Demonstrate reading the temperature in the classroom.
2. Have students measure, using digital thermometers, in Celsius, the temperature inside and outside of their caterpillar shelters. Have students record their data by circling the numbers they read on the thermometer on a hundreds chart.
3. Have students share pictures of their caterpillar shelters using the art techniques of Eric Carle.

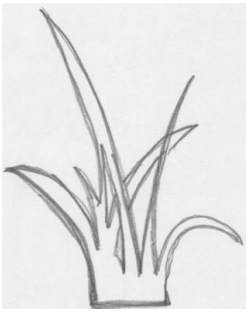
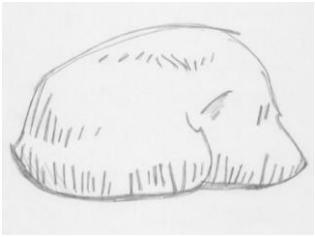
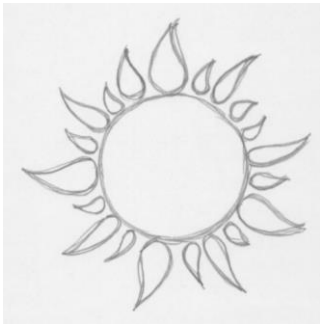
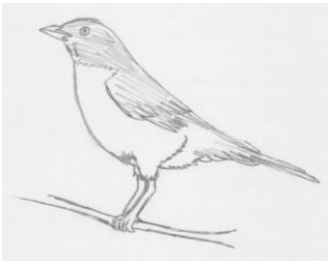
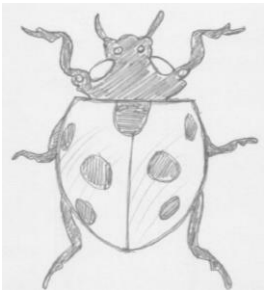
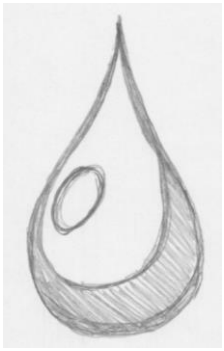
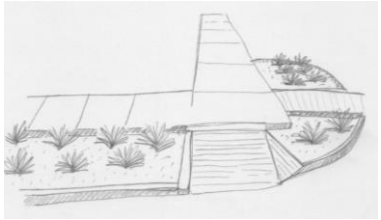
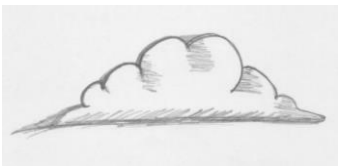


Where are the living things at my school?

Student Pages

Name: _____

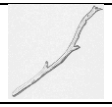
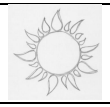
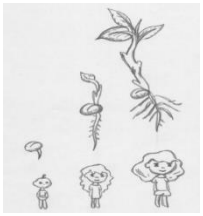
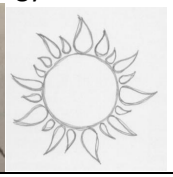
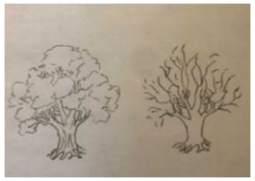
Living and Nonliving Scavenger Hunt

 LEAF	 GRASS	 TWIG	 ROCK
 SUN	 TREE	 BIRD	 BUG
 PLAYGROUND	 WATER	 BARK	 DIRT
 SIDEWALK	 DANDYLION	 CLOUD	 FLAG

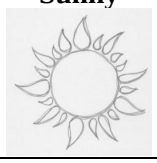
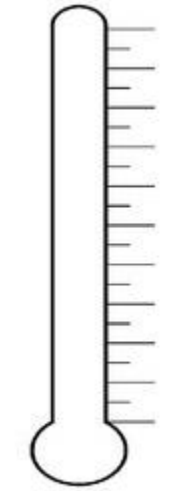
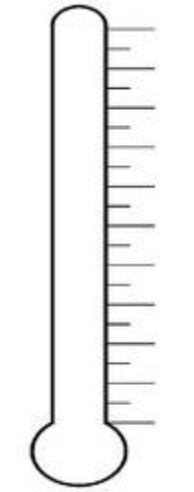
Living

Nonliving

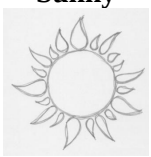
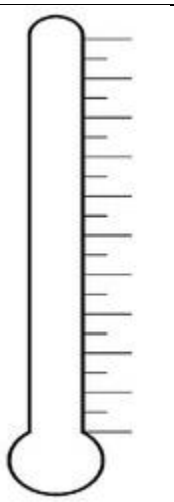
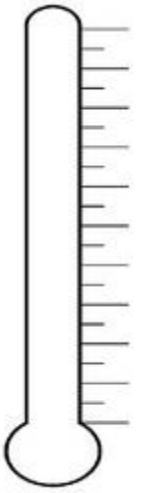
Characteristics of Living Things

	LEAF	GRASS	TWIG	ROCK	SUN	TREE	BIRD
							
 Grow and Change							
Need Food or Sunlight = Energy  							
 Responds to Change							
 Reproduce – Make more							

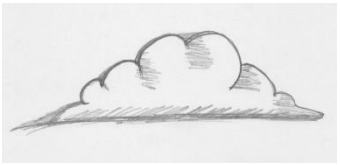
Temperature Data Table

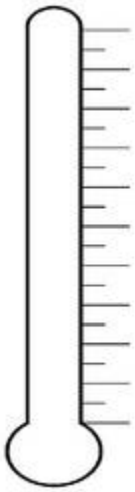
	Sunny 	Shady 	How does it feel? **Warm or Cool**	Temperature
Test Site 1				
Test Site 2				

Temperature Data Table

	Sunny 	Shady 	How does it feel? **Warm or Cool**	Temperature
Test Site 3				
Test Site 4				

Caterpillar Shelter Data Sheet



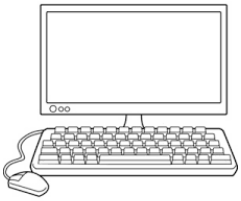
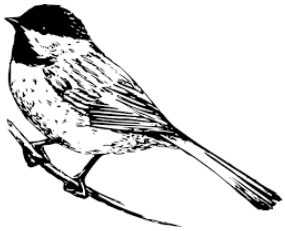
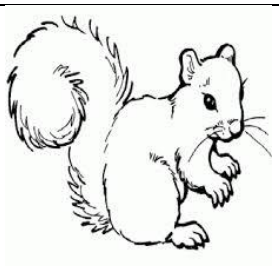
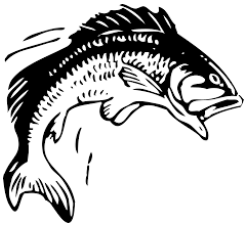
Inside	Outside
	

Reflection and Assessment

K-W-L (Teacher Sample Chart-not needed in student journal)

K- This is what I KNOW about living things in my schoolyard.	W- This is what I WANT to find out about my schoolyard.	L- This is what I LEARNED about my schoolyard.

Living and Nonliving Scavenger Hunt

 **Flower**	 **Book**	 **Computer**	 **Butterfly**
 **Tree**	 **Boat**	 **Bird**	 **Squirrel**
 **Water**	 **Pencil**	 **Fish**	 **Frog**

Living

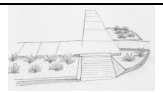
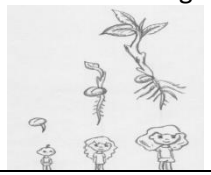
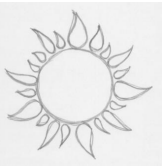
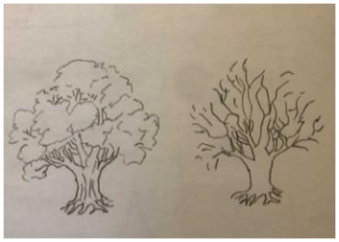
Nonliving

Rubric for Living and Nonliving Comparison

Standard:K-LS1-1 Use observations to describe patterns of what plants and animals (including humans) need to survive.

*This assessment is working towards meeting the full standard.

Score of 4	Score of 3	Score of 2	Score of 1
Student was able to sort all pictures correctly.	Student sorted all but one picture correctly.	Student was able to sort all but two to three pictures correctly.	Student sorted more than four pictures incorrectly.

Characteristics of Living Things	BUG	PLAYGROUND	DIRT	SIDEWALK	DANDYLION	CLOUD	FLAG
							
Grow and Change 							
Need Food or Sunlight = Energy  							
Responds to Change 							
Reproduce – Make more 							

Rubric for Characteristics of Living Things

Standard: K-LS1-1 Use observations to describe patterns of what plants and animals (including humans) need to survive.

Score of 4	Score of 3	Score of 2	Score of 1
Student was able to identify all characteristic correctly.	Student was able to identify most characteristics; one or two were incorrect.	Student was able to identify some characteristics; three to four were incorrect.	Student was able to identify a few characteristics correctly.

Caterpillar Shelter Criteria Checklist (teacher)

Student Name	Is the shelter large enough for the caterpillar?	Can the shelter stand up on its own?	Does the shelter provide shade?