TN Department of Education

Teacher Training Kindergarten

Tennessee Academic Standards for Science

Welcome, science teachers!

We’re excited to welcome you to our Teacher Training on the new Tennessee Academic Standards for Science. We appreciate your dedication to the students in your classroom and to your growth as an educator. We hope you are able to use the Tennessee Academic Standards for Science, the eight lessons created by Tennessee educators for your grade level, and the two days of training content, to support your students and serve as a resource to other teachers in your school and district. You do outstanding work every year, and our hope is that the knowledge you gain this week will enhance the high-quality instruction you provide Tennessee's students.

We are honored that the new science standards, training content, and sample lessons were developed by and with Tennessee educators for Tennessee educators. We believe it is important for our standards and professional development to be informed by current practitioners who work each day to cultivate every student’s potential.

—Dr. Candice McQueen, Commissioner, Tennessee Department of Education

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Digital Training Resources

Access Teacher Training Digital Resources here:

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Teacher Training Digital Resources

Training Resources	K-12 Science Framework Links	TDOE Science Documents	STEM Teaching Tools

• Training Agenda
• Presentation, Manual, and Activities
• Three-dimensional Lesson Planning Tool
	• NRC Document Cover Page
	• Science and Engineering Practices
	• Crosscutting Concepts
	• Disciplinary Core Ideas
	  ○ Physical Science
	  ○ Life Science
	  ○ Earth and Space Sciences
	  ○ Eng., Tech., & Applications
		• Tennessee Academic Standards for Science
		• TN Science Standards Implementation Guide
		• TN Science Standards Reference
			• Integrating Science Practices Into Assessment Tasks
			• Prompts for Integrating Crosscutting Concepts Into Assessment and Instruction

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Teacher Training Agenda Day One

7:30–8 a.m.	Sign-in
8–8:30 a.m.	Introduction and Goals
8:30–9:30 a.m.	Three-dimensional Activity
9:30–10:30 a.m.	Three-dimensional Instruction
10:30–10:40 a.m.	Break
10:40–11:30 a.m.	Three-dimensional Instruction
11:30 a.m.–12:45 p.m.	Lunch
12:45–1:15 p.m.	Grade-level Standards Activity
1:15–3:45 p.m. (includes break)	Three-dimensional Learning Activities
3:45–4 p.m.	Closing

Day One Activities

- Learn about the components of the new Tennessee Academic Standards for Science
- Review the science standards for our grade
- Participate in lessons aligned to the new Tennessee Academic Standards for Science

Teacher Training Agenda Day Two

8–8:05 a.m.	Welcome Back!
8:05–11:25 a.m. (includes break)	Three-dimensional Activities
11:25–11:30 a.m.	Morning Debrief
11:30 a.m.–12:45 p.m.	Lunch
12:45–3:45 p.m. (includes break)	Instructional Planning
3:45–4 p.m.	Closing

Day Two Activities

- Participate in lessons aligned to the new Tennessee Academic Standards for Science
- Discuss literacy and instructional strategies in the science classroom
- Utilize an instructional planning tool to plan a three-dimensional learning activity

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Standards Timeline

Fall 2018

New TN Science Standards in the Classroom

Spring 2019

Operational Field Test

- Data used to test the reliability of the questions
- No data reported to teachers, schools, or districts
- No accountability measures reported for science
- Grades 3-8 take TNReady field test
- No chemistry EOC field test
- EOC field test for biology
  - Students only take EOC in spring 2019
  - Students taking biology in the fall on a block schedule do not take an EOC

Fall 2019

Second Year of Science Standards in the Classroom

Spring 2020

Fully Operational Test

- Fully operational assessment
- No chemistry EOC

Summer 2020

Standard Setting

- This is the process where Tennessee educators set the performance levels based on the results of the fully operational assessment
- Based on all scores across the state

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A Framework for K–12 Science Education

Key Terms from the Framework

Term	Notes
Discipline	
Dimension	
Three-dimensional	
Phenomena	
Grade Band Endpoints	

Three-dimensional Science Instruction

Science and Engineering Practices (SEPs)

What will my students **do** to learn science content?

- Asking Questions and Defining Problems
- Developing and Using Models
- Planning and Carrying Out Investigations
- Analyzing and Interpreting Data
- Using Mathematics and Computational Thinking
- Constructing Explanations and Designing Solutions
- Engaging in Argument from Evidence
- Obtaining, Evaluating, and Communicating Information

Notes:

Three-dimensional Science Instruction

Science and Engineering Practices (SEPs)

What will my students **do** to learn science content?

Asking Questions and Defining Problems	***Developing and Using Models***
Planning and Carrying Out Controlled Investigations	***Constructing Explanations and Designing Solutions***

TN Department of Education

Three Science Words We Should Stop Using

By Rhett Allain, Associate Professor of Physics at Southeastern Louisiana University

Hypothesis:
In my opinion, this one is the worst. The worst science word ever! Well, not ever, but currently. Try this. Find some people and ask—what is a hypothesis? Just about everyone you ask will say:

> *"A hypothesis? That's easy. A hypothesis is an educated guess. BOOM! Give me another easy question."*

This is exactly why we should abolish this word. It has been reduced to a word association game. What is an educated guess anyway? That doesn't even make sense. But what about hypothesis testing? What about science fairs? How can we do these things without the word "hypothesis"? I would recommend not requiring science fair posters to use the word hypothesis. As for hypothesis testing—I will let that stay.

What does hypothesis really mean?
Well, from the Middle French *hypothese*, it means the basis of an argument. This isn't so bad, but it does *not* mean a guess. I think the best current use of the word hypothesis is the testable predictions from an idea.

Let's look at an example. Suppose I have this idea that a constant net force on an object will make it go at a constant speed. In that case, my hypothesis will be that if I apply a constant force to an object, it will indeed go at a constant speed. This could be tested in real life.

Theory:
How about we continue to pretend to ask people what this word means. Here is my generic human answer. Yes, I am gearing this response towards the general population in a slightly negative way. I'm sorry about that. I don't mean to say that humans are stupid but rather the use of this word has transformed into a negative use.

> *"A theory is a scientist's crazy idea about how something works. Really, when something is a theory, it may or may not be true. You know, like evolution. It's just a theory."*

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Three Science Words We Should Stop Using

What is a theory?
A theory can be replaced with another word - see below. But as it is, a theory is a scientific idea. It's not just a crazy made-up idea or wild guess. No, it is an idea that is supported by evidence. Does that mean it's true? Actually, science is not about *the truth.* I will talk more about this in a bit.

Scientific Law:
My favorite example of a scientific law is the law of energy conservation. This says that in a closed system, the total energy remains the same. Ok. Now, what is the common idea about laws?

> *"A scientific law is the next phase for a theory. Once it has been proven to be true, the theory becomes a law. This is just like that School House Rock video about how a bill becomes a law. Same thing, except for SCIENCE."*

What is a scientific law?
It's not really an upgraded theory. No, a law is just more like a generalization. The law of energy conservation is general in that it can be applied in many different cases. It can be used when looking at the collision of two particles, or light produced from a lightbulb, or a pot of water boiling on a stove. Does this mean it's true? No, you didn't read my last point where I said that science wasn't about the truth, did you?

One Word to Replace Them All
Take out all three of these "science" words from introductory texts. They do more harm than good. The problem is that people have firm beliefs that they mean something other than what they are supposed to mean. I don't think we can save these words.
We do have a word to replace them. Are you ready? It's the **model** - or you can call it the scientific model if you prefer.

What is a model?
If I say "model," what do you think of? Do you think of a plastic Corvette that you can pick up with your hands? Yep, that's a model. We agree on this idea of a model. Science is all about making models. Sometimes these models are just like tiny plastic cars, but sometimes they can take other forms. Here are some examples:

Three Science Words We Should Stop Using

Physical Model
Look at a globe—you know, of the earth. This is a physical model of the Earth. It has some features that are the same as the Earth (such as the relative locations of the continents)—but it is not the Earth. It doesn't have the same size or density as the Earth. It's clearly not the Earth. The model is still useful even if it isn't the real Earth.

Mathematical Model
What happens when you have a net force on an object?
That force changes the momentum of the object.
I can also write this idea as an equation (or two equations).

$$\vec{F}_{\text{net}} = \frac{d\vec{p}}{dt}$$
$$\vec{p} = m\vec{v}$$

The equation explains the idea. The momentum principle (above) is a great example of a model that is wrong—but still useful. We say that the momentum vector is the mass of the object times its velocity vector. This is very useful, but it doesn't work when the object's speed is near the speed of light. There is a better expression for the momentum that is more valid—but it is also more complicated.

Conceptual Model
If you rub a nail with a magnet, that nail (if it is ferromagnetic) will then also behave like a magnet. The conceptual model for this phenomena is the domain model of magnets. It says that a ferromagnetic material is made of magnetic domains. If these domains are all aligned in the same direction, the material will act like a magnet.

So, how does a model replace the three words I don't like? Well, if we say science is all about making models, you don't have to use the word “hypothesis.” Instead you can talk about the predictions a model makes (testable predictions). A theory is a model, so that would be a one to one replacement. What about laws? I don't think it would be terrible to also replace laws with the word "model.” Really, I doubt I would ever succeed in having people stop calling it "the law of energy conservation.” Even I would have a difficult time at that.

Science is really about making models and about playing. Yes, playing. Playing isn't just for kids; adults just get better toys. I just wish grade-level (and some college-level) books would move away from defining things and stating pieces of science and focus on the playing part. Many science classes as they are taught now are like studying the different parts of a clarinet—but never playing any music.

Three Science Words We Should Stop Using

Hypothesis

Say This:	Not That:

Scientific Law

Say This:	Not That:

Theory

Say This:	Not That:

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Three-dimensional Science Instruction

Science and Engineering Practices (SEPs)

What will my students **do** to learn science content?

Using Mathematics and Computational Thinking	***Analyzing and Interpreting Data***
Engaging in Argument from Evidence	***Obtaining, Evaluating, and Communicating Information***

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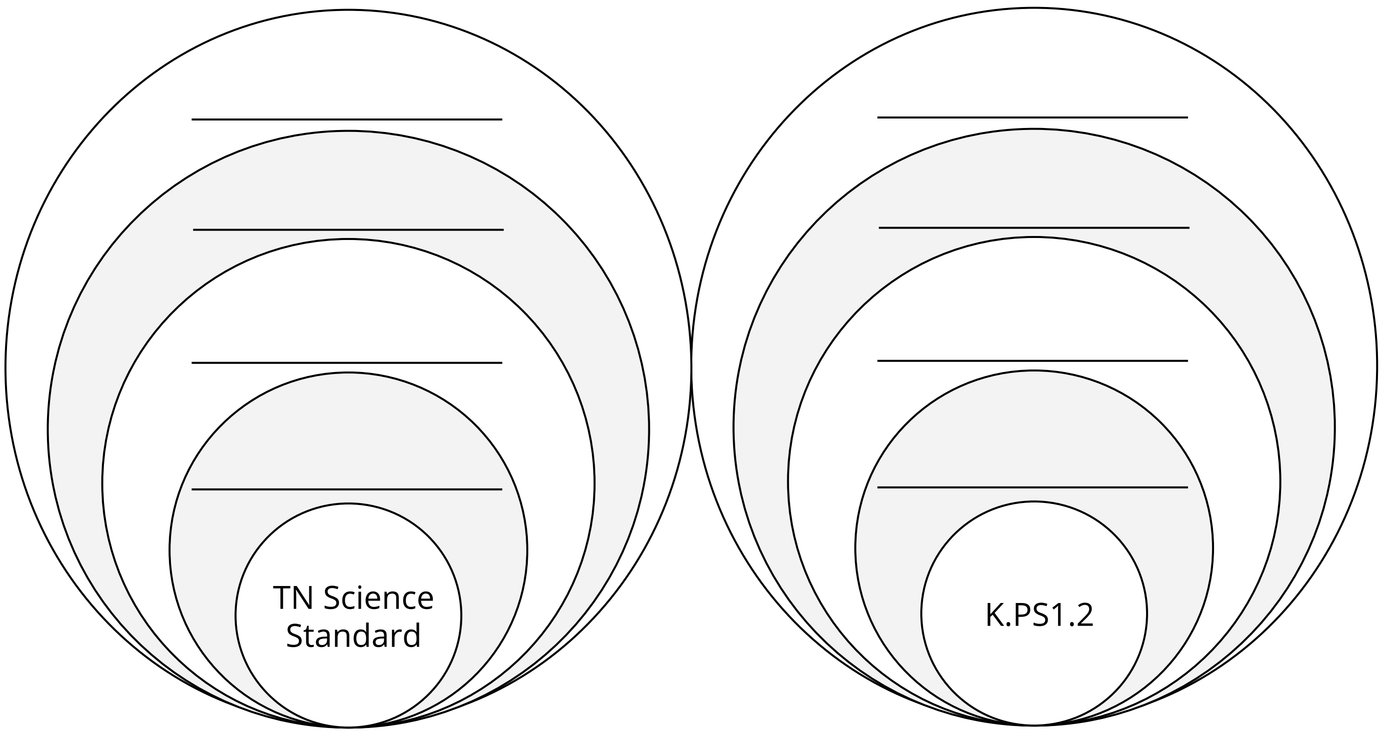
Three-dimensional Science Instruction

Disciplinary Core Ideas

What science content will my students **know**?



			Standard
			K.PS1.2 – Conduct investigations to understand that matter can exist in different states (solid and liquid) and has properties that can be observed and tested.

Three-dimensional Science Instruction

Disciplinary Core Ideas

What science content will my students **know**?

Grade Band Endpoints for LS3.A: Inheritance of Traits	Tennessee Academic Standards for Science
By the end of grade 2: Organisms have characteristics that can be similar or different. Young animals are very much, but not exactly, **like their parents and also resemble other animals of the same kind**. Plants also are very much, but not exactly, **like their parents and resemble other plants of the same kind**. (NRC, p.158)	K.LS3.1: Make observations to describe that **young plants and animals resemble their parents**.
By the end of grade 5: Many characteristics of organisms are **inherited from their parents**. Other characteristics result from individuals' **interactions with the environment**, which can range from diet to learning. Many characteristics involve **both inheritance and environment.** (NRC, p.158)	5.LS3.1: Distinguish between **inherited characteristics** and those characteristics that result from a direct **interaction with the environment**. Apply this concept by giving examples of characteristics of living organisms that are influenced by **both inheritance and the environment.**
By the end of grade 8: **Genes are located in the chromosomes of cells**, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of a specific protein, which in turn affects the traits of the individual....**Changes (mutations)** to genes can result in changes to proteins, which can affect the **structures and functions of the organism** and thereby change traits. (NRC, pp.158–159)	7.LS3.1: Hypothesize that the impact of **structural changes** to **genes** (i.e., **mutations**) **located on chromosomes** may result in harmful, beneficial, or neutral effects to the **structure and function of the organism.**

Three-dimensional Science Instruction

Crosscutting Concepts (CCCs)

What will my students **understand** about science?

- Pattern
- Cause and Effect
- Scale, Proportion, and Quantity
- Systems and System Models
- Energy and Matter
- Structure and Function
- Stability and Change

Notes:

Three-dimensional Science Instruction

Crosscutting Concepts (CCCs)

What will my students **understand** about science?

Pattern

Cause and Effect

Scale, Proportion, and Quantity

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Three-dimensional Science Instruction

Crosscutting Concepts (CCCs)

What will my students **understand** about science?

Systems and System Models	***Energy and Matter***
Structure and Function	***Stability and Change***

Kindergarten Standards

K.PS1: Matter and Its Interactions

1) Plan and conduct an investigation to describe and classify different kinds of materials including wood, plastic, metal, cloth, and paper by their observable properties (color, texture, hardness, and flexibility) and whether they are natural or human-made.

2) Conduct investigations to understand that matter can exist in different states (solid and liquid) and has properties that can be observed and tested.

3) Construct an evidence-based account of how an object made of a small set of pieces (blocks, snap cubes) can be disassembled and made into a new object.

K.LS1: From Molecules to Organisms: Structures and Processes

1) Use information from observations to identify differences between plants and animals (locomotion, obtainment of food, and take in air/gasses).

2) Recognize differences between living organisms and non-living materials and sort them into groups by observable physical attributes.

3) Explain how humans use their five senses in making scientific findings.

K.LS3.1: Heredity: Inheritance and Variation of Traits

1) Make observations to describe that young plants and animals resemble their parents.

K.ESS2: Earth's Systems

1) Analyze and interpret weather data (precipitation, wind, temperature, cloud cover) to describe weather patterns that occur over time (hourly, daily) using simple graphs, pictorial weather symbols, and tools (thermometer, rain gauge).

2) Develop and use models to predict weather and identify patterns in spring, summer, autumn, and winter.

Kindergarten Standards

K.ESS3: Earth and Human Activity

1) Use a model to represent the relationship between the basic needs (shelter, food, water) of different plants and animals (including humans) and the places they live.

2) Explain the purpose of weather forecasting to prepare for, and respond to, severe weather in Tennessee.

3) Communicate solutions that will reduce the impact from humans on land, water, air, and other living things in the local environment.

K.ETS1: Engineering Design

1) Ask and answer questions about the scientific world and gather information using the senses.

2) Describe objects accurately by drawing and/or labeling pictures.

K.ETS2: Links Among Engineering, Technology, Science, and Society

1) Use appropriate tools (magnifying glass, rain gauge, basic balance scale) to make observations and answer testable scientific questions.

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Why new standards?

What connections can you make from the three dimensions of science instruction (disciplinary core ideas, science and engineering practices, and crosscutting concepts) to the indicators in the TEAM rubric?

- Highlight or annotate evidence of the three dimensions in the rubric.

<table>
<tr><th colspan="2">Instruction</th></tr>
<tr><td>Thinking</td><td>The teacher thoroughly teaches two or more types of thinking:
analytical thinking, where students analyze, compare and contrast, and evaluate and explain information;
practical thinking, where students use, apply, and implement what they learn in real-life scenarios;
creative thinking, where students create, design, imagine, and suppose; and
research-based thinking, where students explore and review a variety of ideas, models, and solutions to problems.
The teacher provides opportunities where students:
generate a variety of ideas and alternatives;
analyze problems from multiple perspectives and viewpoints; and
monitor their thinking to insure that they understand what they are learning, are attending to critical information, and are aware of the learning strategies that they are using and why.</td></tr>
<tr><td>Problem Solving</td><td>The teacher implements activities that teach and reinforce three or more of the following problem-solving types:
Abstraction
Categorization
Drawing Conclusions/Justifying Solutions
Predicting Outcomes
Observing and Experimenting
Improving Solutions
Identifying Relevant/Irrelevant Information
Generating Ideas
Creating and Designing</td></tr>
</table>

Why new standards?

What connections can you make from the three dimensions of science instruction (disciplinary core ideas, science and engineering practices, and crosscutting concepts) to the indicators in the TEAM rubric?

- Highlight or annotate evidence of the three dimensions in the rubric.

Instruction	
Motivating Students	• The teacher consistently organizes the content so that it is personally meaningful and relevant to students. • The teacher consistently develops learning experiences where inquiry, curiosity, and exploration are valued. • The teacher regularly reinforces and rewards effort.
Activities and Materials	• Activities and materials include all of the following: ○ support the lesson objectives, ○ are challenging, ○ sustain students' attention, ○ elicit a variety of thinking, ○ provide time for reflection, ○ are relevant to students' lives, ○ provide opportunities for student-to-student interaction, ○ induce student curiosity and suspense, ○ provide students with choices, ○ incorporate multimedia and technology, and ○ incorporate resources beyond the school curriculum texts (e.g., teacher-made materials, manipulatives, resources from museums, cultural centers, etc.). • In addition, sometimes activities are game-like, involve simulations, require creating products, and demand self-direction and self-monitoring. • The preponderance of activities demand complex thinking and analysis. • Texts and tasks are appropriately complex.

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Why new standards?

What connections can you make from the three dimensions of science instruction (disciplinary core ideas, science and engineering practices, and crosscutting concepts) to the indicators in the TEAM rubric?

- Highlight or annotate evidence of the three dimensions in the rubric.

<table>
<tr><th colspan="2">Planning</th></tr>
<tr><td>Student Work</td><td>Assignments require students to:
organize, interpret, analyze, synthesize, and evaluate information rather than reproduce it;
draw conclusions, make generalizations, and produce arguments that are supported through extended writing; and
connect what they are learning to experiences, observations, feelings, or situations significant in their daily lives both inside and outside of school.</td></tr>
<tr><td>Assessment</td><td>Assessment plans:
are aligned with state content standards;
have clear measurement criteria;
measure student performance in more than three ways (e.g., in the form of a project, experiment, presentation, essay, short answer, or multiple choice test);
require extended written tasks;
are portfolio based with clear illustrations of student progress toward state content standards; and
include descriptions of how assessment results will be used to inform future instruction.</td></tr>
</table>

Tab page

Label: Day 2

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Teacher Training Day Two

Tennessee Academic Standards for Science

Literacy in the Science Classroom

Speaking	Reading
Writing	Viewing
Showing	Listening

Instructional Strategies

Spend a Buck

Delivery	What is it worth for memory?	______________
Practice by Doing		
Audiovisual		
Lecture		
Reading		
Teaching Others		
Group Discussion		
Demonstration		

Notes:

Three-Dimensional Instruction

Using a new type of teaching in the science classroom

by Joe Krajcik

Science teaching and learning in the United States are at a pivotal point. *A Framework for K–12 Science Education* (NRC 2012b) presents a new vision for science education that shifts science educators' focus from simply teaching science ideas to helping students figure out phenomena and design solutions to problems. This emphasis on figuring out is new, provocative, and exciting, and it represents a revolution in how we teach science at all grade levels.

In their learning, students must use all three dimensions of the new standards—crosscutting concepts (CCs), disciplinary core ideas (DCIs), and science and engineering practices (SEPs)—in an integrated fashion in order to make sense of phenomena or design solutions to problems (see Duncan and Cavera 2015). Classrooms incorporating three-dimensional learning will have students build models, ask questions, design investigations, share ideas, develop explanations, and argue using evidence, all of which allow students to develop important 21st century competencies such as problem solving, critical thinking, communication, collaboration, and self-management (NRC 2012a). Three-dimensional learning also helps students learn to apply new knowledge to other situations. Every student will benefit from this new instructional approach.

What is different with three-dimensional learning?

When I started my teaching career, I frequently engaged students in labs or had them observe a demonstration so they could experience science first- or secondhand. My focus, however, was on students learning the content rather than on having them make sense of phenomena. Learning content is important and necessary; it gives students usable knowledge of the big ideas of science, which serve as tools for thinking about and figuring out phenomena. However, research clearly shows that learning content alone cannot be separated from the doing of science (NRC 2007). If we want students to learn scientific ideas and apply their knowledge, then they must use the SEPs and CCs with the DCIs together. And to learn to use scientific practices, they need to use them along with DCIs and CCs as they try to figure out phenomena or solve problems. None of the dimensions can be used in isolation; they work together so that students can build deeper understanding as they grapple with making sense of phenomena or finding solutions to problems. As a result, learners can figure out more complex phenomena or design solutions to more perplexing problems.

How often should each dimension be used?

Teachers and administrators often ask how often each of the three dimensions should be used, but this is the wrong question to ask. Rather, you should ask yourself: Are my students engaged in making sense of phenomena or designing solutions to problems? Engaging students in three-dimensional learning isn't an item on a checklist; it is an orientation one takes to science teaching, and it should be used every day. Three-dimensional learning involves establishing a culture of figuring out phenomena or designs to problems where a learner builds on his prior knowledge of DCIs, SEP, and CCs to figure out a phenomena and solve a problem and in the process builds deeper knowledge.

My friend and colleague Michael Novak expressed these ideas well while we participated in a workshop on designing curriculum materials aligned to the *NGSS*. To know whether three-dimensional learning is occurring in a classroom, Michael said that teachers should ask students to explain what they are doing. Ideally, students would say that they are trying to figure out how a phenomenon works or how to solve a problem, rather than saying that they are learning about balancing equations, adaptation, or the water cycle. Figuring out permeates classrooms that focus on three-dimensional learning.

Scientists and engineers work in three dimensions

Scientists and engineers use three-dimensional learning throughout their careers. They talk about and engage in making sense of phenomena, and to do so, they simultaneously use SEPs, DCIs, and CCs to make connections among the science ideas related to their current understanding.

For example, some scientists study the question, "Do decaying maple leaves add to the ecology of lakes?" Scientists know that aquatic plants are essential to the food web of lakes. Some scientists, however, wondered and explored the question, "What role, if any, do trees along the shoreline play in the food web of lakes?" Scientists have now gathered evidence that a major component of organic matter needed for energy, growth, and repair of lake organisms is supplied by trees along the shoreline (NSF 2015). Leaves from trees and other organic matter enter lakes and are used by aquatic animals as a source of food. This new and radical way of thinking about lake food webs required scientists to change their models. To explore this question and gather evidence to support the claim, scientists needed to use DCIs related to the organization of matter and energy flow in organisms (LS1.C), the growth and development of organisms (LS1.B), energy in chemical processes and ever yday life (PS3.D), and chemical reactions (PS1.B), along with various SEPs (e.g., Asking Questions, Analyzing and Interpreting Data, Revising and Constructing Models, Arguing from Evidence) and CCs (e.g., Structure and Function, Systems and System Models, Patterns, and Energy and Matter: Flows, Cycles, and Conservation) (NGSS Lead States 2013).

Bioengineers also try to solve problems, and some are figuring out how to make artificial limbs using "smart skin" that mimics the sense of touch (Wu, Wen, and Wang 2013). To do so, they apply concepts from DCIs related to electrical forces (PS2.B), the structure of matter (PS1.A), optimizing design solutions (ETS1.C), and the structure and function of organisms (LS1.A). They also use SEPs to develop models and design and test solutions, and they apply various CCs such as Systems and System Models, Structure and Function, and Cause and Effect.

As the examples above illustrate, scientists and engineers consistently make use of the three dimensions to make sense of phenomena and design solutions to problems. It isn't a once-in-a-while activity; it is what they do every day.

Where to start?

To start incorporating three-dimensional instruction into your classroom, look for engaging phenomena or problems that build toward performance expectations.

Take note of the questions students are asking, ones that students can explore over a sustained period of time, and ones for which students can ask and explore sub-questions. In selecting phenomena, be sure that the questions are related to the learning goals toward which you want students to build understanding. Therefore, you should be familiar with the Tennessee Academic Standards for Science before you start thinking about phenomena that students can explore. Figure 1 (p. 52) presents a summary of key characteristics associated with the best types of phenomena and questions to explore in the classroom (Krajcik and Czerniak 2013).

Some potential sources of phenomena that aligned Tennessee Academic Standards for Science include:

1. Your local environment. Students find phenomena and associated questions related to the local environment to be valuable and relevant. In trying to make sense of the phenomena related to their local environment, students can make use of DCIs related to biodiversity (LS4.D), social interaction and group behavior (LS2.D), the role of water in Earth's surface process (ESS2.C), human impacts on Earth systems (ESS3.C), the structure and properties of matter (PS1.A), and interdependent relationships in ecosystems (LS2.A).
2. Your hobbies. I love to scuba dive. Teaching students the ecology of reefs and the effects of rising temperatures of seawater present fruitful opportunities for exploration. If you like to ride bikes, you might explore why it is important to wear a bicycle helmet, which addresses force and motion (PS2.A) and types of interactions (PS2.B).
3. Current challenges facing our environment. How can we reduce our dependency on fossil fuels? How can we make use of wind and solar power to supply our energy needs? Exploring such questions allows students to delve deeply into several DCIs, including energy transfer (PS3.B), electromagnetic radiation (PS4.B), and human impacts on the environment (ESS3.C).
4. The internet, journals, and magazines. Magazines and journals, such as *Scientific American* and *Science News*, are filled with current ideas about phenomena that scientists are exploring. The National Science Foundation's Discoveries web page (see Resources) can also serve as a source of ideas.
5. Other science teachers and scientists. Your fellow science colleagues can be rich sources of ideas. Sharing your own ideas with other teachers will enrich the pool of phenomena you can use in your classroom.

Conclusion

Developing a classroom culture that focuses on students using the three dimensions to make sense of phenomena or find solutions to problems will initially be challenging. Many teachers haven't been prepared this endeavor has its advantages. First, all students will develop deeper knowledge of the three dimensions, which will allow them to apply their knowledge to new and more challenging areas. Second, as all students engage in figuring out phenomena or solutions to problems, they will also develop problem-solving, critical-thinking, communication, and self-management competencies. Third, and perhaps most importantly, three-dimensional learning will help foster all students' sense of curiosity and wonder in science. "I wonder how ... ?" and "How might ... ?" are extremely important questions that have largely disappeared from science classrooms. Three-dimensional learning brings the focus back to curiosity and wonderment, and it can support all students in developing a deeper and more useable knowledge of science. ■

FIGURE 1 Characteristics of phenomena and questions

Feasible
- By making sense of the phenomenon, students are building understanding toward various performance expectations.

Worthwhile
- By making sense of the phenomenon, students are building understanding toward various performance expectations.

Contextualized
- The phenomenon is anchored in real-world issues or in the local environment of the learner.

Meaningful
- Learners will find making sense of the phenomena interesting and important.

Ethical
- By exploring the phenomenon, learners do not harm living organisms or the environment.

Sustainable
- Learners can pursue exploration of the phenomenon over time.

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Resources

National Science Foundation: Discoveries: *www.nsf.gov/discoveries*

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The Science Teacher

Article adapted from Krajcik, Joe. 2015. Three-Dimensional Instruction; Using a new type of teaching in the science classroom. *The Science Teacher* (November 2015): 50-52."

TN Department of Education

Sample Three-dimensional Planning Tool

Underlined text is for additional instructions (or hyperlinks).

Italicized text is the sample response.

Step 1: Select a Standard

Standard:

4.LS2.1: Support an argument with evidence that plants get the materials they need for growth and reproduction chiefly through a process in which they use carbon dioxide from the air, water, and energy from the sun to produce sugars, plant materials, and waste (oxygen); and that this process is called photosynthesis.

Step 2: Identify and Break Down Disciplinary Core Idea

A. Identify Disciplinary Core Idea and (Optional) Component Idea

Disciplinary Core Idea:

LS2: Ecosystems: Interactions, Energy, and Dynamics

Component Idea: (optional)

LS2.B: Cycles Of Matter and Energy Transfer in Ecosystems

B. Break Down Disciplinary Core Idea and (Optional) Component Idea

What content could be covered within this disciplinary core idea and (optional) component idea?

This area is for brainstorming content and clarifying ideas.

- *Needs of plants for survival*
- *Plants take in air and water and use light and minerals for growth*
- *Plants acquire materials for growth from the air (carbon dioxide) and water*
- *Photosynthesis is the process that allows plants to use the energy from the sun to grow and maintain internal conditions*
- *Sugar (glucose) as food source for plants*
- *Role of light (as energy from the sun) in photosynthesis*
- *Distinguishing between role of soil and water in plant growth/photosynthesis*
- *Oxygen is released during photosynthesis*
- *Environments needed for plants to grow.*

Sample Three-dimensional Planning Tool

C. Identify Instructional Focus

What content will be the focus of this lesson?

The content only needs to focus on a small part of the standard or disciplinary core idea you are addressing. If you have an instructional focus that that encompasses the entire standard or multiple standards, then that may serve better as a multi-day lesson or unit.

- *Plants use energy from the sun to produce sugar. The production of sugar in plants allows for the generation of plant materials. (Think about CO_2 as the source of the plant matter)*

Step 3: Brainstorm Instructional Scenarios and Select One to Use

- *Use different colors of light on several plants*
  - *Compare growth using different filters?*
- *Put plants in a jar vs. on a table*
  - *Less CO_2 available leads to less growth*
- ***Plant in a window vs. plant in a closet—Selected***
  - *Same level of CO_2 and water but no energy to start photosynthesis*
- *Use bromothymol blue to show conversion of CO_2 for water plants*

Sample Three-dimensional Planning Tool

Step 4: Identify and Break Down a Science and Engineering Practice

A. Identify a Science and Engineering Practice

Which science and engineering practices lend themselves to the lesson, activity, or the disciplinary core idea?

Consider all that apply and select one for this lesson:

1. Asking questions and defining problems
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics, information and computer technology, and computational thinking
6. Constructing explanations and designing solutions
7. **Engaging in argument from evidence—*Selected***
8. Obtaining, evaluating, and communicating information

B. Break Down the Science and Engineering Practice

Brainstorm how you will have students demonstrate their understanding of the disciplinary core idea through the science and engineering practice. Use the task formats to guide your brainstorming.

Look up your selected practice in STEM Teaching Tools Brief #30: Task Formats for the Science and Engineering Practices, review the presented formats, and select which one will work best for your selected instructional scenario.

Engaging in Argument from Evidence #2:

- ***Describe a phenomenon,***
  - *Plants use energy from the sun to conduct photosynthesis and, therefore, need light to grow.*
- ***ask students to construct a claim about the phenomenon,***
  - *Plants will grow more when placed in a window vs. placed in a closet*
- ***ask students to identify evidence that supports the claim,***
  - *Plants in a window will have a higher mass than those in the closet*
  - *Plants in a window will be taller than those in the closet*
- ***and articulate the reasons for how scientific principle(s) connect each piece of evidence to the claim.***
  - *Plants acquire the materials for growth chiefly from air and water, but they require light to perform the process of photosynthesis.*
  - *Light provides the energy needed to convert carbon dioxide from the air into the sugars needed for plant growth.*

Sample Three-dimensional Planning Tool

Step 5: Identify and Break Down a Crosscutting Concept

A. Identify a Crosscutting Concept

Which crosscutting concept is related to the disciplinary core idea or science and engineering practice?

Consider all that apply and select one for this lesson:

1. Patterns
2. Cause and effect
3. Scale, proportion, and quantity
4. Systems and system models
5. **Energy and matter—*Selected***
6. Structure and function
7. Stability and change

B. Break Down the Crosscutting Concept

Think through how students can show their understanding of the crosscutting concept. Use the question prompts to guide your thinking.

<u>Look up your selected practice in STEM Teaching Tools Brief #41: Question Prompts for the Crosscutting Concepts, review the presented questions prompts, and select which one will work best for your selected instructional scenario.</u>

What kind of material is the plant made of?
Where is the matter coming from that is needed for the plant to grow?
What evidence is there that matter is conserved in these changes?

Step 6: Write a Three-dimensional Learning Performance

Possible Template:

"Students will
Science and Engineering Practice
in order to show
Disciplinary Core Idea
highlighting that
Crosscutting Concept."

Sample:

"Students will
compare and refine arguments based on an evaluation of the evidence presented
in order to show
organisms obtain gases and water from the environment and release waste matter back into the environment
highlighting that
matter is transported into, out of, and within systems."

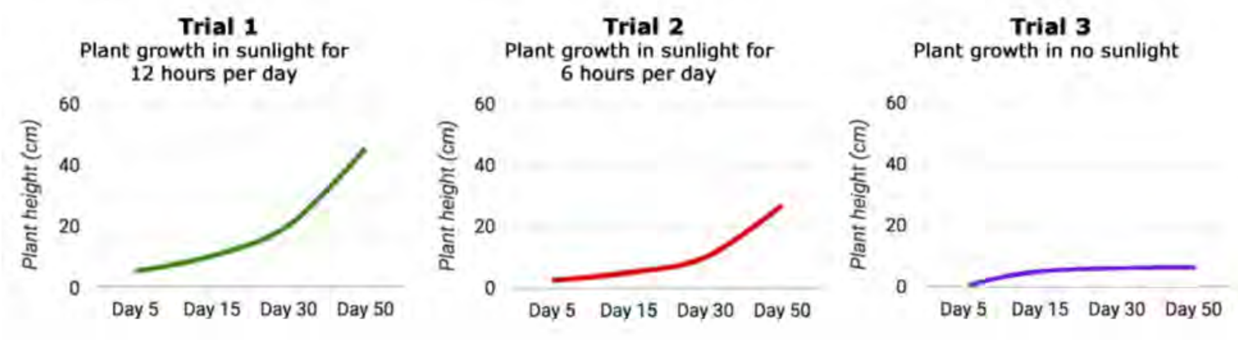
TN Department of Education

Sample Three-dimensional Planning Tool

Step 7: Write Multidimensional Questions

A. Write a Two-dimensional Question
This question should demonstrate understanding of **the content** presented in the lesson through the use of a **science and engineering practice**.

Josh, Tonya, and Marie analyzed their data after completing an investigation. Based on the data, they all gave explanations to why there is a difference.



Josh: *The reason why there was not a significant increase in plant growth from Trial 1 to Trial 3 is because the plant did not receive enough water, and water is required in order for photosynthesis to begin.*

Tonya: *Plants really do not need light to thrive.The reason why there was a decrease in plant growth from Trial 1 to Trial 3 is due to the fact that the plant was in a closet and not receiving any carbon dioxide.*

Maria: *The reason why there was a decrease in plant growth from Trial 1 to Trial 2 is because the amount of light that the plant is receiving is reduced. Photosynthesis occurs when there is light.*

Using the data above and what you know about how plants grow, which student do you most agree with, and what evidence supports their claim?

Sample Three-dimensional Planning Tool

B. Write a Two-dimensional Question
This question should demonstrate understanding of **the content** presented in the lesson and a **crosscutting concept**.

Jasmine wants to start a learning garden at her school. She has learned that plants have to undergo photosynthesis in order to thrive. However, she is not completely sure what plants need to undergo photosynthesis. She plants four flowers in the outside garden and then conducts four investigations to test how the plants would thrive.

	Plant Consumed			Plant Produces	
	water	air	sunlight	oxygen	sugar
1.	✔	✔	✔	✔	✔
2.	-	✔	✔	-	-
3.	✔	✔	-	-	-
4.	✔	-	✔	-	-

Using Jasmine's data table, explain which plant had what it needed, and describe how you know that photosynthesis occurred. Be sure to include where the plants received their energy, and where the plant matter is coming from.

Sample Three-dimensional Planning Tool

Bullet Point Lesson

Use this space to write a bullet point lesson. Be sure to include an observation-based introduction, student activity, and opportunity for formative assessment.

Your bullet point lesson doesn't need to be this comprehensive, but use this structure to guide your thinking.

http://phenomena.nationalgeographic.com/2016/03/09/the-earth-has-lungs-watch-them-breathe/

- *Show students the image above, and have them jot down only what they see. (3-5 minutes)*
- *Using the same image, have students now jot down what they wonder about what they see. (3-5 minutes)*
- *Have students share their observations and wonderings with a partner, and have them listen to some differences and commonalities in what they see and wonder.*
- *Have students share out their observations and wonderings as a whole class.*
- *The teacher will jot down students questions and wonderings so that it is visible to the class for the duration of the lesson/unit.*
- *Pose the question to students: What does sunlight have to do with how the tree thrived throughout the seasons? (By this time students, should have mentioned something about the presence/absence of the sun.)*

Have students draw an image of the following a) flower, b) sun, c) water, d) soil. At this time, students are just drawing the image and not using arrows or academic vocabulary words to label their drawings. This will come later after they collect additional information through their investigation and research. Have students conduct the sunlight investigation. Students will place one plant in the sunlight (on a window sill) or near a lamp if there is not a window in the classroom. Students will then place another plant in an area without visible light (a closet). Students will water both plants throughout the week and monitor the plant for several days while collecting data.

Sample Three-dimensional Planning Tool

Students will be presented with several resources in which evidence will be collected from and jotted in their notebooks. The following resources can be used:

- *YouTube Video*
  - *https://www.youtube.com/watch?v=D1Ymc311XS8*
- *PBS Learning*
  - *https://tn.pbslearningmedia.org/resource/tdc02.sci.life.stru.photosynth/photosynthesis/#.WvCJOFMvzFQ*
- *Study Jams Video*
  - *http://studyjams.scholastic.com/studyjams/jams/science/plants/photosynthesis.htm*
- *Smithsonian Article*
  - *https://ssec.si.edu/stemvisions-blog/what-photosynthesis*

Using the information from the text and/or video, have students revisit their drawings and have them use arrows and words from their resources to label their drawings. At this point, look for whether students have labeled the flow of the reactants and products from the photosynthesis. The following simulation and can be used if students are having difficulty http://www.biology.ualberta.ca/facilities/multimedia/uploads/alberta/Photo.html.
The students will revisit the data they have collected from the plant they placed in the window sill and the one they placed in a dark area. The teacher will engage the students in a discussion about the data they collected.

- *What patterns do you see in the data collected?*
- *What conclusion can you draw about what would happen to the plant if we allowed it to stay in its location for another week?*
- *Would the results would be the same if they put both plants in the light and changed another variable, such as water?*

Have students complete the formative assessment in step 7.
Revisit the picture of the tree have students use what they know about photosynthesis to answer the following question: What does sunlight have to do with how the tree thrived throughout the seasons?

TN Department of Education

Three-dimensional Planning Tool

Step 1: Select a Standard

Standard:

Step 2: Identify and Break Down Disciplinary Core Idea

A. Identify Disciplinary Core Idea and (Optional) Component Idea

Disciplinary Core Idea:

(Optional) Component Idea:

B. Break Down Disciplinary Core Idea and (Optional) Component Idea

What content could be covered within this disciplinary core idea and (optional) component idea?

C. Identify Instructional Focus

What content will be the focus of this lesson?

TN Department of Education

Three-dimensional Planning Tool

Step 3: Brainstorm Instructional Scenarios and Select One to Use

Step 4: Identify and Break Down a Science and Engineering Practice

A. Identify a Science and Engineering Practice

Which science and engineering practices lend themselves to the lesson, activity, or the disciplinary core idea?

Consider all that apply and select one for this lesson:

1. Asking questions and defining problems
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics, information and computer technology, and computational thinking
6. Constructing explanations and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

Three-dimensional Planning Tool

B. Break Down the Science and Engineering Practice
Brainstorm how you will have students demonstrate their understanding of the disciplinary core idea through the science and engineering practice. Use the task formats to guide your brainstorming.

Step 5: Identify and Break Down a Crosscutting Concept

A. Identify a Crosscutting Concept
Which crosscutting concept is related to the disciplinary core idea or science and engineering practice?

Consider all that apply and select one for this lesson:

1. Patterns
2. Cause and effect
3. Scale, proportion, and quantity
4. Systems and system models
5. Energy and matter
6. Structure and function
7. Stability and change

B. Break Down the Crosscutting Concept
Think through how students can show their understanding of the crosscutting concept. Use the question prompts to guide your thinking.

TN Department of Education

Three-dimensional Planning Tool

Step 6: Write a Three-dimensional Learning Performance

Possible Template:

"Students will
Science and Engineering Practice
in order to show
Disciplinary Core Idea
highlighting that
Crosscutting Concept."

Step 7: Write Multidimensional Questions

A. Write a Two-dimensional Question

This question should demonstrate understanding of **the content** presented in the lesson through the use of a **science and engineering practice**.

Three-dimensional Planning Tool

B. Write a Two-dimensional Question
This question should demonstrate understanding of **the content** presented in the lesson and a **crosscutting concept**.

Bullet Point Lesson

Use this space to write a bullet point lesson. Be sure to include an observation-based introduction, student activity, and opportunity for formative assessment.

TN Department of Education

Next Steps

Write down 3–5 goals for your science instruction this coming school year.

List 3–5 resources you can use to help you plan for science instruction.

Identify 3–5 people you can go to when you have questions.

Identify 3–5 people you can collaborate with to implement the new science standards.

I used to ____, but now I will

____.

Tab page front

Label: Developing and Using Models

TN Department of Education

Developing and Using Models

Tennessee Academic Standards for Science

Teacher Guide for Kindergarten

Standard
K.ESS3.1 Use a model to represent the relationships between the basic needs (shelter, food, water) of different plants and animals (including humans) and the places they live.

Tennessee Academic Standards for Science: Page 20

Three-dimensional Learning Performance for Lesson
Students will develop a model* in order to show that animals live in areas that provide them food, shelter, and water** highlighting that the types of resources they need affects which biome they inhabit. ***

Science and Engineering Practice for Lesson
*Developing and Using Models**
The goal of this three-dimensional learning performance is for students to develop a model that demonstrates how animals rely on certain natural resources within their habitats to aid in their survival. Students will be working together as a class to create a large-scale model of zoo exhibits that highlight the necessary resources in each biome that supply one species of animal food, water, and shelter. This will be an opportunity for young students to collaborate and to begin to understand how to build a model of something that exists out in the wild. By building actual models of the habitats that different animals live in, students will be able to experience each habitat, make observations about similarities and differences between the various types of animal habitats, and draw conclusions about how certain environments provide certain resources for different animals. At this grade level, models should be representations (such as pictures) of things that they see or experience directly through their senses.

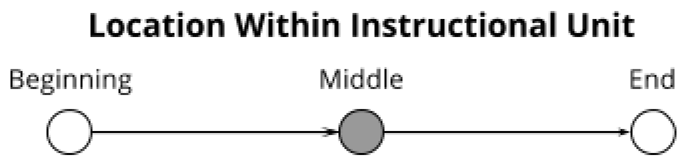
Disciplinary Core Idea for Lesson
*Earth and Space Science 3A: Earth and Human Activity***
"Living things need water, air, and resources from the land, and they try to live in places that have the things they need."

A Framework for K–12 Science Education: Page 192

Crosscutting Concept for Lesson
*Cause and Effect****
Students will begin to see the connections between the habitat an animal lives in and the resources that are provided by the environment. This is a clear cause and effect relationship: animals need certain resources (cause) which limits them to specific areas to

live in (effect). At this grade level, it is important for students to begin recognizing patterns in the types of animals that are living in certain environments.

Prior Knowledge



- Concepts that should be covered before this lesson:
    - The types of resources needed by plants
    - Habitats of plants
    - Difference between plants and animals (standard LS1.1)
    - Non-living vs. living things (standard LS1.2)
- This lesson covers portions of standard K.ESS3.1
    - Focuses only on animal environmental needs and their habitats

Materials

- *A Frog Thing* by Eric Drachman
    - If the book is not available, use this YouTube read-aloud link
- *Fish is Fish* by Leo Lionni
    - If the book is not available, use this YouTube read-aloud link
- Computer/laptop with projector and internet access
- Chart paper
- Markers and/or crayons
- Glue
- Scissors
- Two hula hoops
- A variety of butcher block paper
    - Green, blue, brown, black, red, orange
- Stuffed animals for zoo exhibits
    - Elephant, polar bear, dolphin, snake, deer
- *Ecosystems Cut-Out Cards* PDF
    - Pictures printed in color and laminated
- PDF of *Teacher Cut-Out Page*
- *Animal Habitats* PDF printout for each student
- *Informational Card Template* for Zoo exhibit – PDF included
- *Kindergarten Zoo Exhibit Rubric*
- *Zoo Tickets* (optional) - PDF included

Lesson Sequence and Instructional Notes

Teacher Introduction to Lesson Material

This is a cumulative three-dimensional learning performance, meaning that each activity the students complete will contribute to a large modeling project at the end. Throughout the lesson, students will learn about the different habitats (biomes) on Earth and the kinds of resources these habitats can give. Then, students will begin learning the types of animals that live in these specific habitats because of those resources. Practice will come in the form of a comparative reading, an anchor chart activity, cut-out activities, and a coloring-based formative assessment. The culmination of this lesson is the students building a model of a real zoo. Students will be grouped and assigned a specific habitat and animal that they have already learned about and practiced with. They will use butcher block paper, construction paper, and other resources to construct a zoo exhibit that appropriately depicts a specific animal's habitat (using stuffed animals). These groups will also have to produce an informational card (template included) about their habitat and their animal. This learning performance should be taught *after* plant habitats and needs have been discussed so that students can incorporate the proper plants into their zoo exhibits as well. The teacher can print the included zoo tickets and make this event one for families to come and enjoy. In this event, students become the "zoo educators" who teach the public about the exhibits that they made. Therefore, this lesson covers heavily the scientific practice of modeling and allows students to practice communication and collaboration. If possible, a field trip to a local zoo will enhance students' understanding of these concepts.

Student Introduction to Content

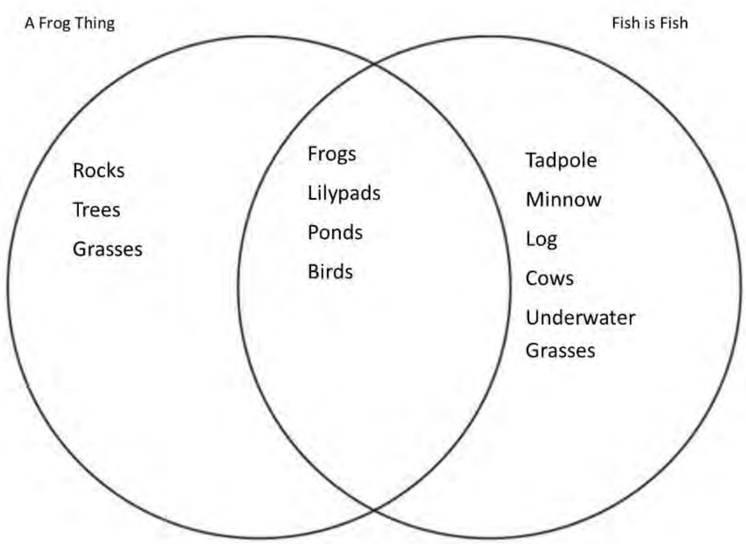
During this activity, the teacher will read two books to the class. Both books are about animals being best suited for their environment. In both stories, one character wishes they had other adaptations and body parts so they can do other things (like a frog can fly, a fish can walk). These two stories will help students see and understand that animals have to live in specific environments in order to survive and be successful.

To do this as a "comparative literature" activity, use the two hula hoops to make a Venn Diagram. The teacher will also need the teacher cut-out page. It is recommended you have these words and pictures cut out and laminated prior to the activity. Read *A Frog Thing* out loud to the class. The first time, have students just listen to the story. Read the story a second time, but this time, use the Venn diagram during the story. When students see a word or picture that should go on the Frog side of the diagram, allow a volunteer to go and place the word or picture in that hoop. Then, read the second story, *Fish is Fish,* and follow the same steps. Do not have anything in the middle just yet. After students have placed all of the words and pictures in one of the two hoops, ask them if anything should go in the middle. You can do this by asking the following guiding questions:

- “Was anything the same between both stories?”
- “What happened in each book?”
- “What was the ending like in both books?”

Students can then collaborate as a class to assign all of the words and pictures to their proper spots, either in each hula hoop or in the middle. Once the class is satisfied with their answers, correct any misplaced words and explain why their location needs to be changed. The correct answer to the Venn diagram is shown below. Before transitioning into the next portion of this learning opportunity, take this time to discuss with students why the fish realized he had to stay a fish and why the frog couldn’t keep up with his bird friend. Highlight the environmental differences between land and water and the things animals need to survive there (focus more on the resources from the environment, not so much on the body parts needed to live there).

Venn Diagram Student Responses



Biome Exploration

In order for students to become familiar with the different environments on Earth, take students on a virtual tour of five biomes. This will give them an introduction to how these different habitats can look different and contain different resources for the animals that might live there. As the teacher is showing the different areas, write the title of the biome on a separate piece of chart paper and place them around the room (this is setting up for the next activity where students will match pictures to the biomes and then match resources to them).

Google Maps: Biome Exploration Tour!
Welcome students and explain that they will be traveling the world today! Get students excited about what they may see. The teacher should instruct them that they will be touring different types of environments that animals live in (if necessary, have a quick discussion about what an "environment" is). Ask students to volunteer some ideas of what they may see on this journey. Some potential answers might be "woods," "forests," "deserts," "oceans," "rocky places," etc.

Forests:
Introduce the first environment: the forest. Ask students if they have ever been to a forest and what it looks like. Instruct students that today, they are going to the state of Nevada (if a map of the world/United States is in the classroom, show students where Nevada is). Specifically, they will be visiting the Sierra Nevada Mountain Range where there is a big forest called the Montane National Forest. Start with the 360° tour using this link. Ask students what they see, what they notice, and even if it looks familiar (Tennessee is considered a type of forest).

After the initial discussion, inform students now that they will get to "drive" through the forest. Again, have them discuss what they see and what the environment looks like. Place the "forest" chart paper up on the wall. Follow this link to "drive" through the forest.

Deserts:
The teacher should tell students about the second stop on this global tour: the desert. They will be visiting Arizona during this stop (again, if a map is present in the room, show students where Arizona is in relation to Tennessee). Specifically, they will be visiting the Sonoran Desert in Arizona. Instruct students to pay close attention to the environment and how it might look different from a forest. Repeat the same instructions and process that was used in the Forest stop.

Desert 360° View

Desert "Driving" Link

Once students have completed their discussion and comparison of the desert environment to a forest, place the "desert" chart paper up on the wall (at this time, the chart papers should be blank with only the name of the biome on the top).

Grasslands:
The next tour stop is in the grasslands. Tell students they are going to visit two different grasslands: one right here in the United States and one in Africa. Starting with the one in the United States, show students where North Dakota is located and give the same directions and follow the same process as the prior two environments. This grassland can be found in Theodore Roosevelt National Park:

Grasslands (North Dakota) 360° View

Grasslands (North Dakota) "Driving" Link

African Savanna (grassland) – Kruger National Park, South Africa

Grasslands (South Africa) 360° View

Grasslands (South Africa) "Driving" Link

Since this biome had two stops, have students talk about what they noticed was the same between both areas and what might have been different. Ask students if they think the same type of resources are available in both areas, and if there are similar animals that live in both grasslands. Hold a discussion with students about their thoughts and what they saw. Then, hang the "grasslands" chart paper up on the wall.

Arctic Tundra:
The fourth stop on the global journey is in Alaska. Explain to students that the tundra is very cold in the winter but does not always have snow in the warmer seasons. Show students where Alaska is located, then show them the Google Maps links. Again, make sure students are talking about what the environment looks like, what is has (or doesn't have), and comparing it to the other environments that they have already seen.

360° View
Tundra 360° View in summer

Tundra 360° View in winter

Tundra "Driving" Link in spring

Discuss important points (following the same pattern as the other ecosystems) with students. Then, hang the "arctic tundra" chart paper on the wall.

The final stop on this expedition is the ocean. It is difficult to get any Google Maps links with underwater focus, but inform students that you can see the ocean from the shoreline. Before showing students these places, ask them if anyone has been to the ocean and have them describe it – what did it sound like, feel like, smell like, etc. Ask students how the ocean may be very different from the environments they have already visited and ask what kind of things the ocean can give to the animals that live there (What might an ocean shelter look like? Do animals in the ocean still need water the same way that land animals do?).

Florida Keys – Key West

Hold discussion and hang the final piece of chart paper on the wall for "oceans." Students will complete an interactive activity using what they saw from these tour stops.

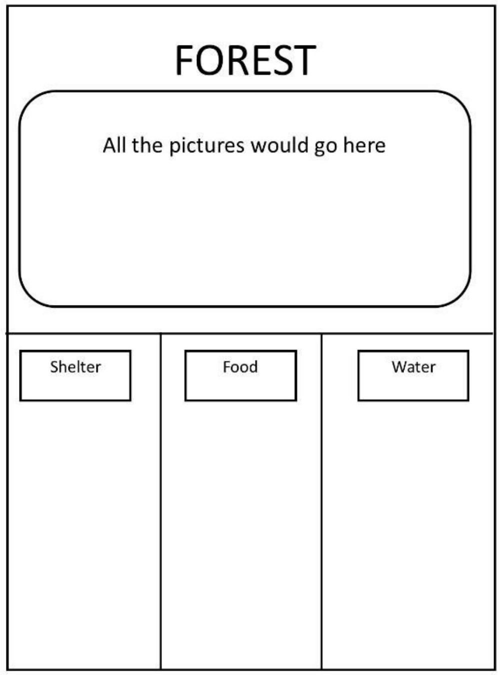
Part A of Activity
Print out (in color if possible) and laminate the *Ecosystems* pictures that are included in this learning opportunity. Place students into small groups of two to three individuals and hand students a set of cards. Ask them to first take some time to discuss what is on the cards: What do they see in the pictures? How do they compare to the tour stops we made on the global trip? Have students sort the cards into the five biomes (there will be one picture for each biome per group, totaling five total pictures for five groups). Once everyone in the class has gotten a chance to discuss the cards, ask them to come up and place them on the appropriate piece of chart paper. After the students have placed all the cards, ask them to walk around and make sure each card is on the right ecosystem.

Part B of Activity
Now students will focus on the types of resources that are available in each habitat. On the chart paper, make a table with three columns (a sample chart paper is shown below). In the first column, put "Shelter," then in the middle put "Food," and in the last column write "Water." In these columns, students should place the information cards. Each card has a picture and the term on it. The groups can be kept the same for this part of the activity. Hand each group a bundle of cards. Give them time to first decide if the card represents shelter, food, or water (sources). Once they have classified each card correctly, allow them to determine which biome the card should belong to. This can also be done as a class activity, in which each category is covered all together, and the students just determine which biome it should be placed under. (For example, the teacher would state, "What kinds of shelters would we find in each habitat?" The first card would be pulled, a discussion can take place, and a student would come up and place that shelter in one of the biomes.) Some answers are repeated (there are multiple cards for these), and some students may need help placing these resources under the proper column and biome. Below are some suggested guided questions to help students:

- What do you see in the environment?
- What is there a lot of? Or not a lot of?
- What kind of plants would you find here?

The teacher may also feel they need to complete this section using direct instruction. The method used to give this information to students should be based on the ability level of the students in the class—this section should be challenging and allow students to think critically using clues from the picture and guidance from the teacher.

Sample Anchor Chart



Correct Student Answers

Forests

Shelter	Food	Water
• Logs • Trees • Under rocks	• Berries • Leaves • Acorns	• Streams • Rivers • Ponds • Lakes

Desert

Shelter	Food	Water
• Cactus • Rocks • Underground	• Cactus • Bugs	• From food and plants (animals that live in the desert usually do not have direct access to a water source – so many of them get the water they need from their diet of either plants or animals)

Arctic Tundra

Shelter	Food	Water
• Ice • Rocks	• Fish	• Ice • Ponds

Grasslands

Shelter	Food	Water
• Underground • Small trees	• Grass • Bugs	• Lakes • Rivers

Oceans

Shelter	Food	Water
• Coral reef • Rocks • Sand	• Fish • Algae	• All around!

Animals in Their Natural Habitats

In this portion of the lesson, students will get to make observations about different animals and determine which biome they would live in based on the resources that are available. Students will cut out the pieces and place them under the correct columns in their student handouts. The pictures on the cards can also be colored. There are four animals for each environment. Students can work in small groups so they can collaborate about which animal should be placed in which environment. Encourage students to talk about what they might eat, need for shelter, or need for water to help them place the animals in the proper places.

Correct Activity Responses

Forest	Desert	Arctic Tundra	Grassland	Ocean
Deer Black ear Frog Duck	Snake Scorpion Tortoise Lizard	Polar Bear Seal Caribou Arctic Fox	Elephant Lion Bison Prairie Dog	Dolphin Shark Whale Octopus

Blank cards have been left in the PDF handout in the event the teacher wants to add additional animals.

Draw the Habitat

This activity is going to prepare students to construct their zoo exhibit. Review all material that has been covered so far, emphasizing that animals live where they can get the resources they need. Explain to them that they need to "model" the habitat that a few animals live in. They will be given a paper with an outline of the animal on it and the name of the biome on the top. Then, students will have to draw and color in the background to look like the environment it would live in. Then, they have to fill in the three squares at the bottom to indicate where they get their shelter, food, and water from in this environment. This is the first formative assessment for this unit, so students should complete this individually. The students can use the anchor charts completed earlier in the lesson for the key terms for each resource.

Teacher Evaluation Notes

Animal Pictures:

1. Deer – Forest. Three resources: Trees (shelter), Berries (food), Ponds (water)
    a. Students should draw lots of trees, rocks, and dirt for the ground
2. Snake – Desert. Three resources: rocks, mice, food
    a. Students should draw a cactus, sand, and rocky areas
3. Polar Bear – Arctic Tundra. Three resources: ice, seal, ponds
    a. Students can draw ice or snow
4. Elephant – Grassland. Three resources: trees (shade), Grass, Lakes
    a. Students should draw small trees, tall grasses, maybe even a water source
5. Dolphin – Ocean. Three resources: no shelter, fish, everywhere!
    a. Students can draw in fish, coral reefs, crabs, shells, etc

- *Full Understanding*: Students with a full understanding of this unit will be able to correctly model each habitat and correctly identify at least 13 out of 15 resources (three per ecosystem).
- *Partial Understanding*: Students with a partial understanding will be able to correctly model and draw three out of the five habitats for each animal. They may have small

mistakes in the correctly drawn habitats. Students will be able to correctly identify 10 out of the 15 resources.
- *Limited Understanding*: Students who are not comprehending the connection between the environment, resources, and the types of animals that might live there will likely only get one of the model habitats correct (oceans would be the most likely one to be answered correctly) and will have less than five of the 15 resources identified correctly.

Model That Habitat

Here is where the students get to model and construct their very own zoo! Once all students have completed the drawing formative assessment, place students into groups of three to four individuals. Assign each group a specific environment that they will be in charge of modeling. Assign five different parts of the room for set up—one for each ecosystem. Before students can start building, have them share their coloring page about the biome they were assigned. Students should be looking at any similarities or differences and come up with a general list of things, including plants, that should be included in their exhibits. Emphasize to students that the exhibit must mimic their natural habitat as much as possible, so they should think about the types of plants and nonliving things that should be included to make the animal comfortable and happy. Show each group the animal they will be using to place in their exhibit (stuffed animals needed). Allow students to brainstorm about their exhibit design. In the student handout, there is a checklist for students to use to make sure they have everything they need in their exhibit. Once the teacher has verified the checklist and the students plan (this can be communicated verbally to the teacher or drawn), then students can begin constructing their model exhibit and filling out their informational card. It may be helpful to have additional grade-appropriate books for students to look at about each animal.

A rubric has been included for formally assessing students. Once all of the exhibits have been built, invite other classes, teachers, staff, and parents to come and see the zoo! Zoo tickets have been included in this learning performance.

If a large majority of the class has never been to the zoo, use these websites below to take students on an interactive tour so they can become inspired about their exhibit. The San Diego Zoo website also offers a lot of information about animals, so some students and teachers may find it useful as a resource. Focus student attention on how the exhibits look different because they are different environments. The students may even get to see the animals interacting with their environments live!
- Tiger Exhibit (webcam)—represents forests
- Penguin Exhibit (webcam)—represents Arctic Tundra
- Giraffe Exhibit (webcam)—represents Grasslands

Informational Card Template – Example of Student Response

Environment Arctic Tundra

Animal Name Polar Bear

Our animal, the Polar bear, likes to live in the Arctic Tundra. This environment has lots of seals to eat, lots of water from Melting ice. Our Polar bear finds shelter by Making dens in the snow.

Zoo Exhibit Rubric

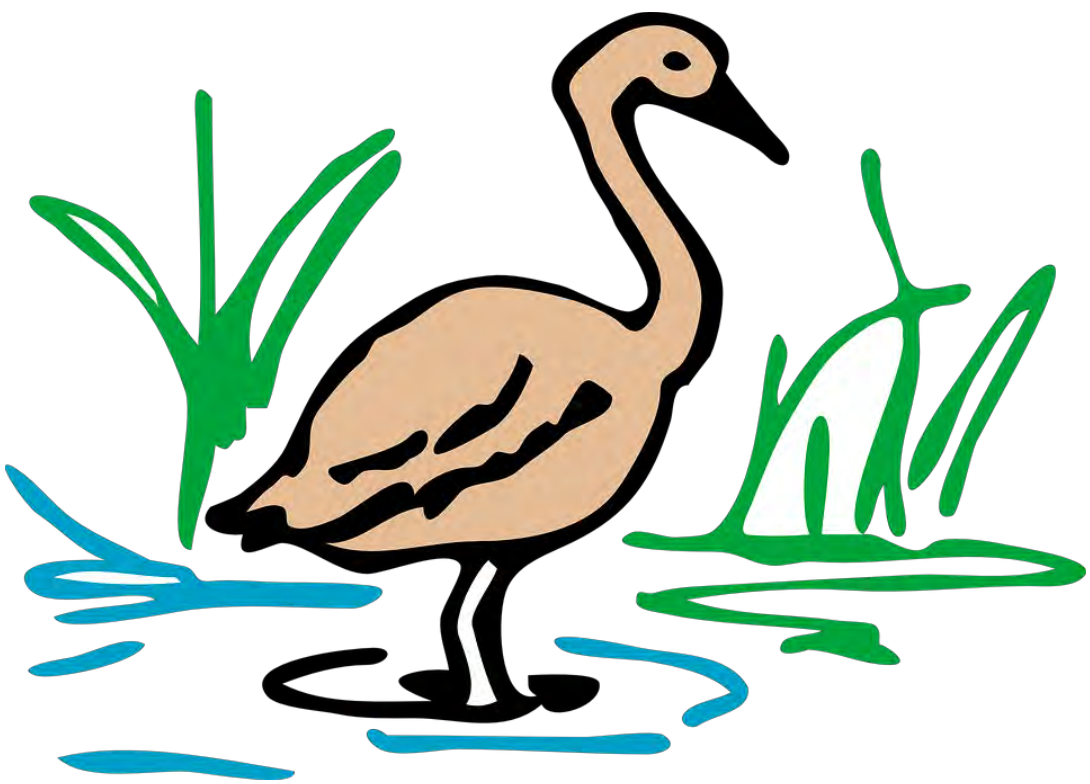
Kindergarten Zoo Exhibit Rubric

Exhibit Contains:			
The right habitat	Group did not model the correct habitat	Group modeled the correct habitat with a few mistakes	Group did model the correct habitat
Correct plants	Group did not include plants	Group did include plants but not all are the right type for the environment	Group did include plants and most or all are correct
Shelter, food, And water	Group did not identify sources for these resources	Group identified two out of the three resources	Group identified all of the resources correctly

Citations and Resources

San Diego Zoo Webcams – sdzsafairpark.org

ANIMAL HABITATS



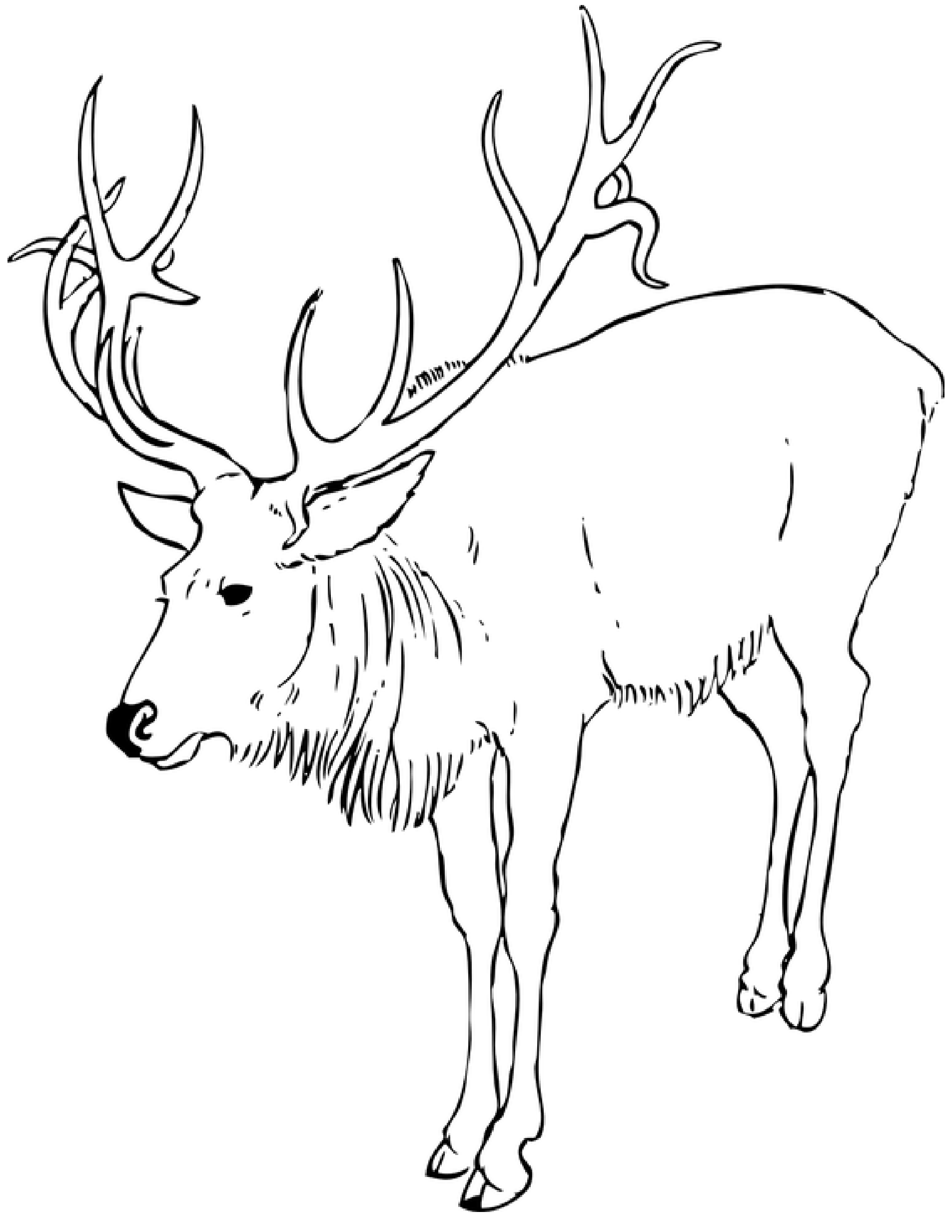
Animal Homes

Forest	Desert	Arctic Tundra

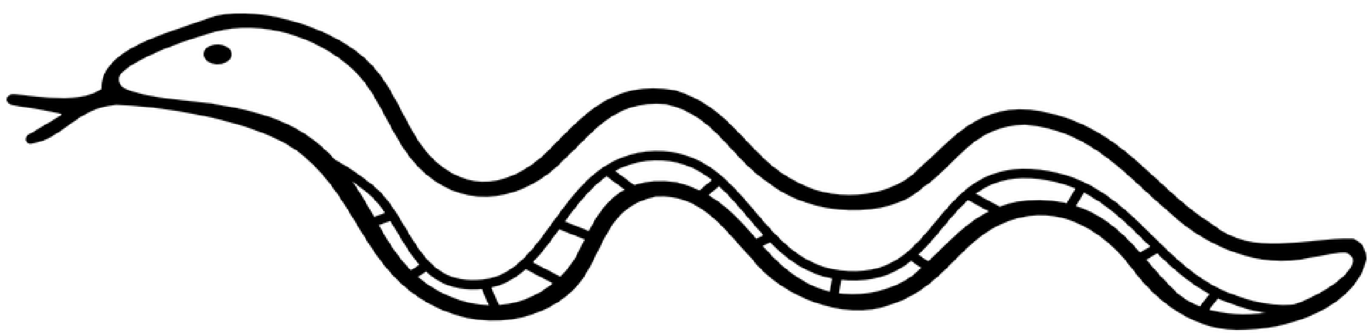
Animal Homes

Grassland	Ocean

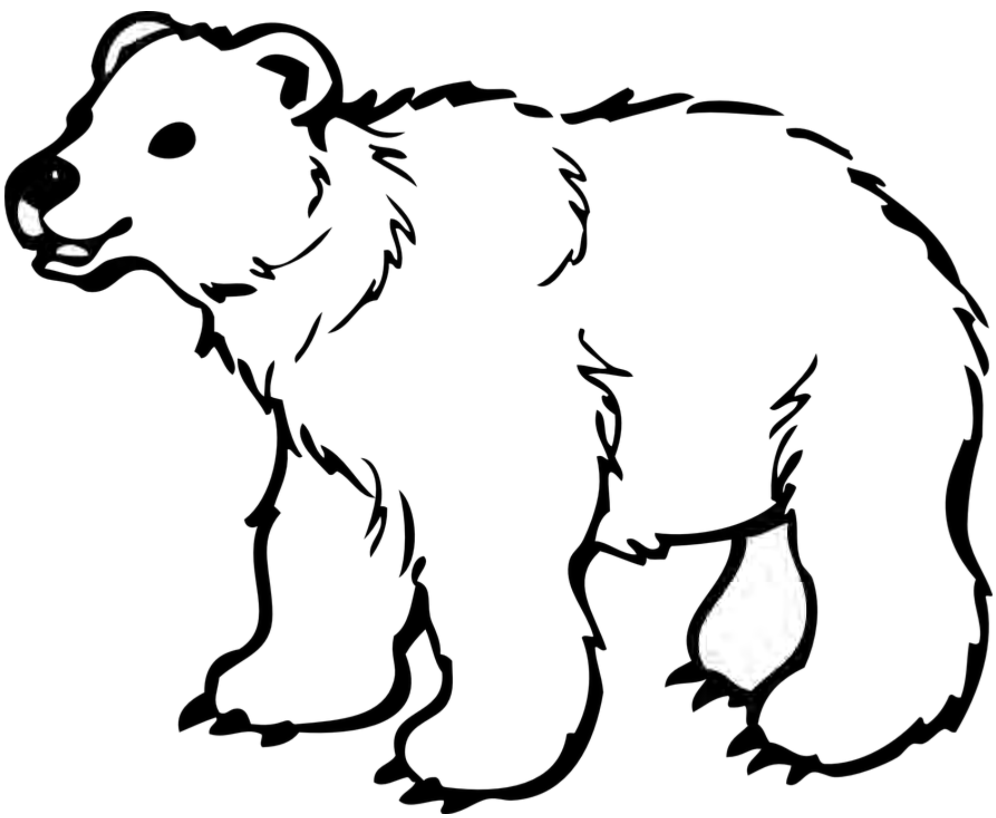
Forests



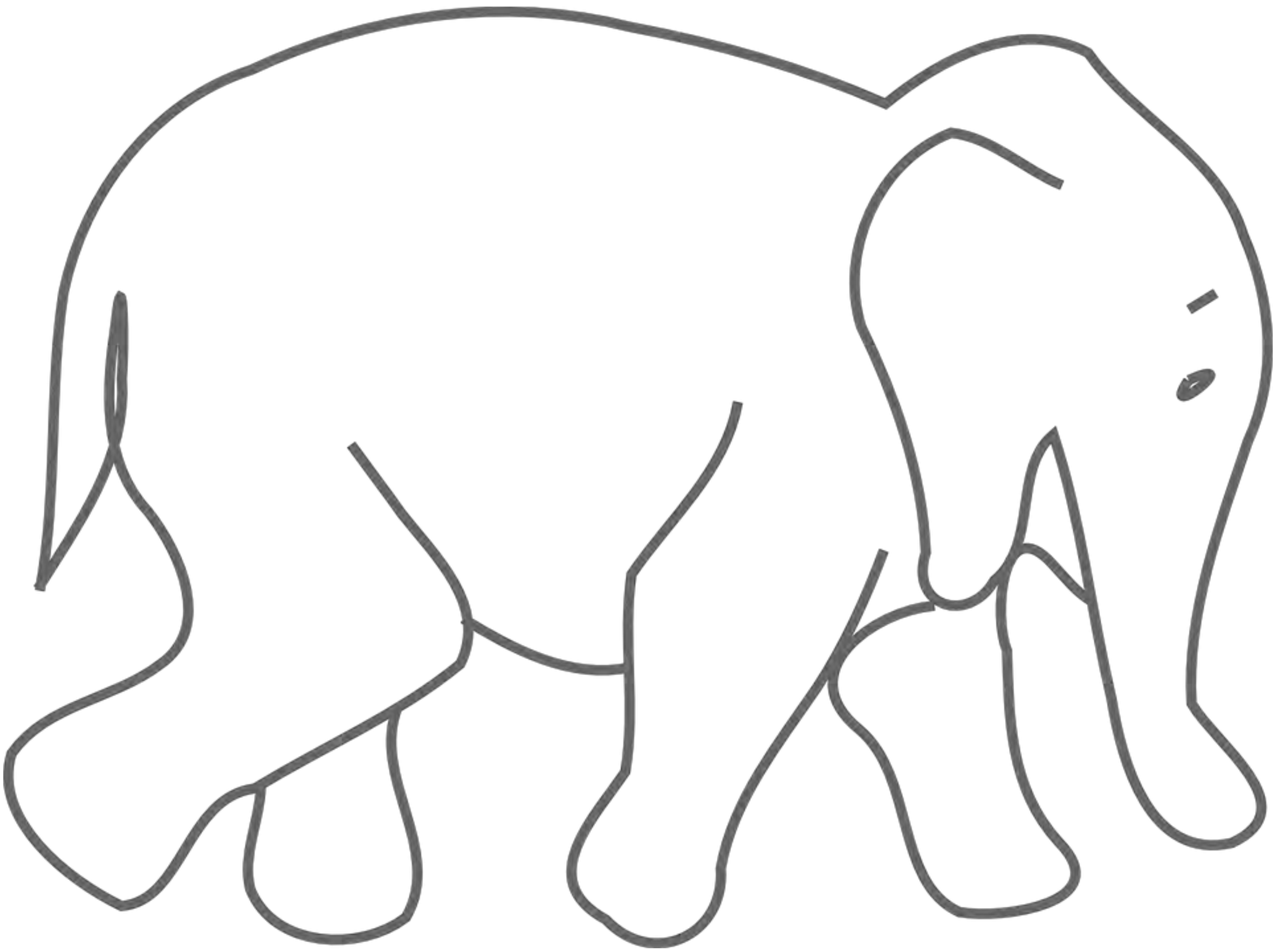
Deserts



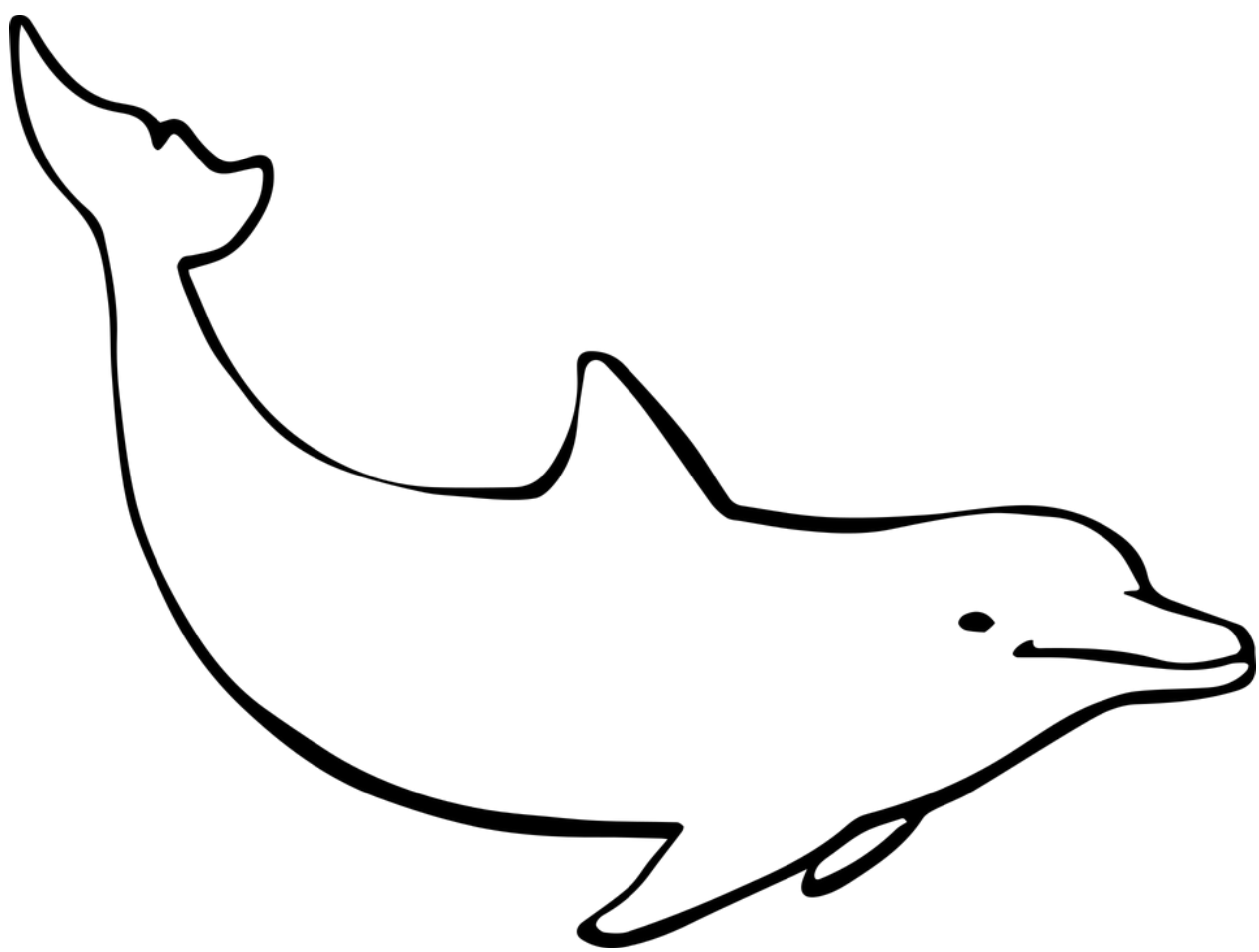
Arctic Tundra



Grassland

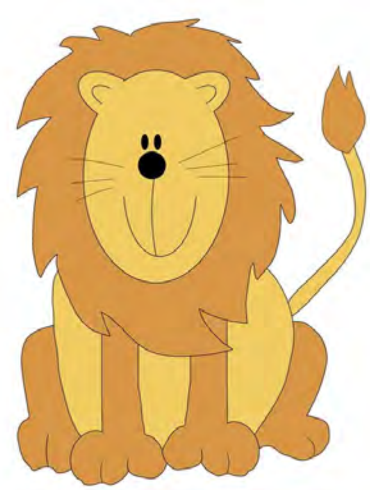


Ocean



Model a Zoo Exhibit!
Checklist

- ☐ Stuffed Animal
- ☐ Plants
- ☐ Things to play with
- ☐ Things to eat
- ☐ Things for shelter



Environment ____________________

Animal Name ____________________

Our animal, ____________________, likes to live in the

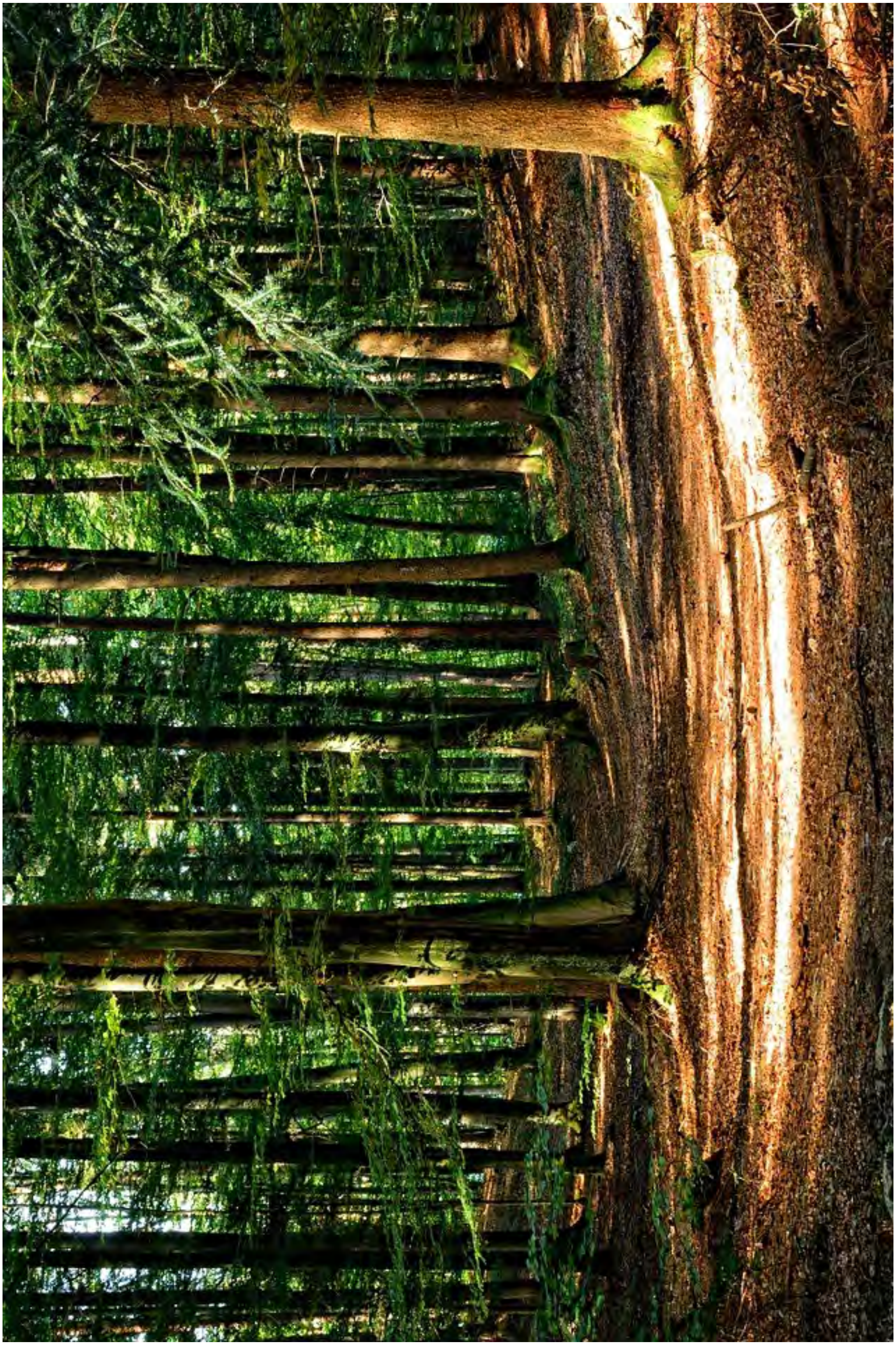
________________. This environment has lots of _______________ to

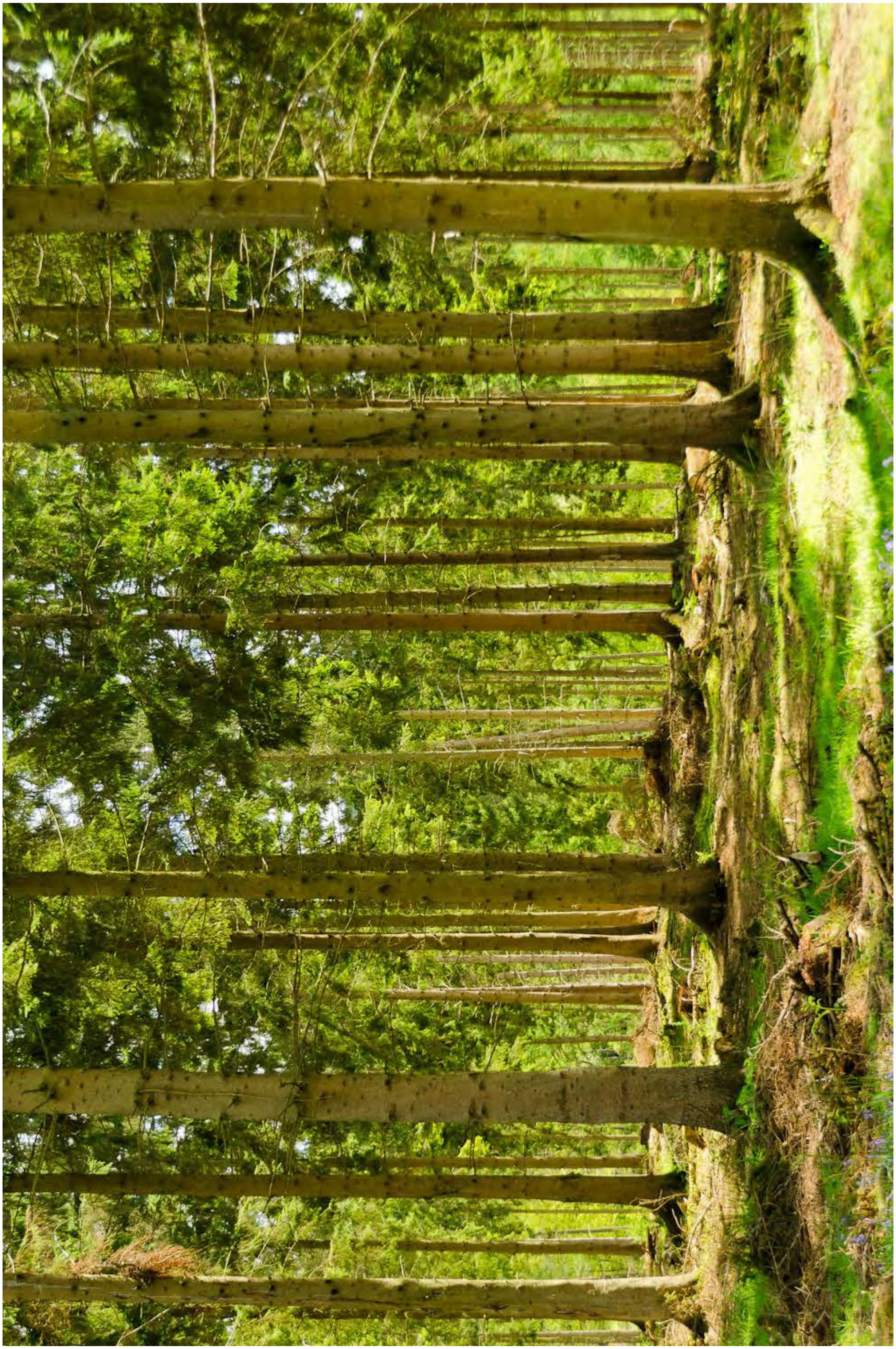
eat, lots of water from __________________. Our ______________

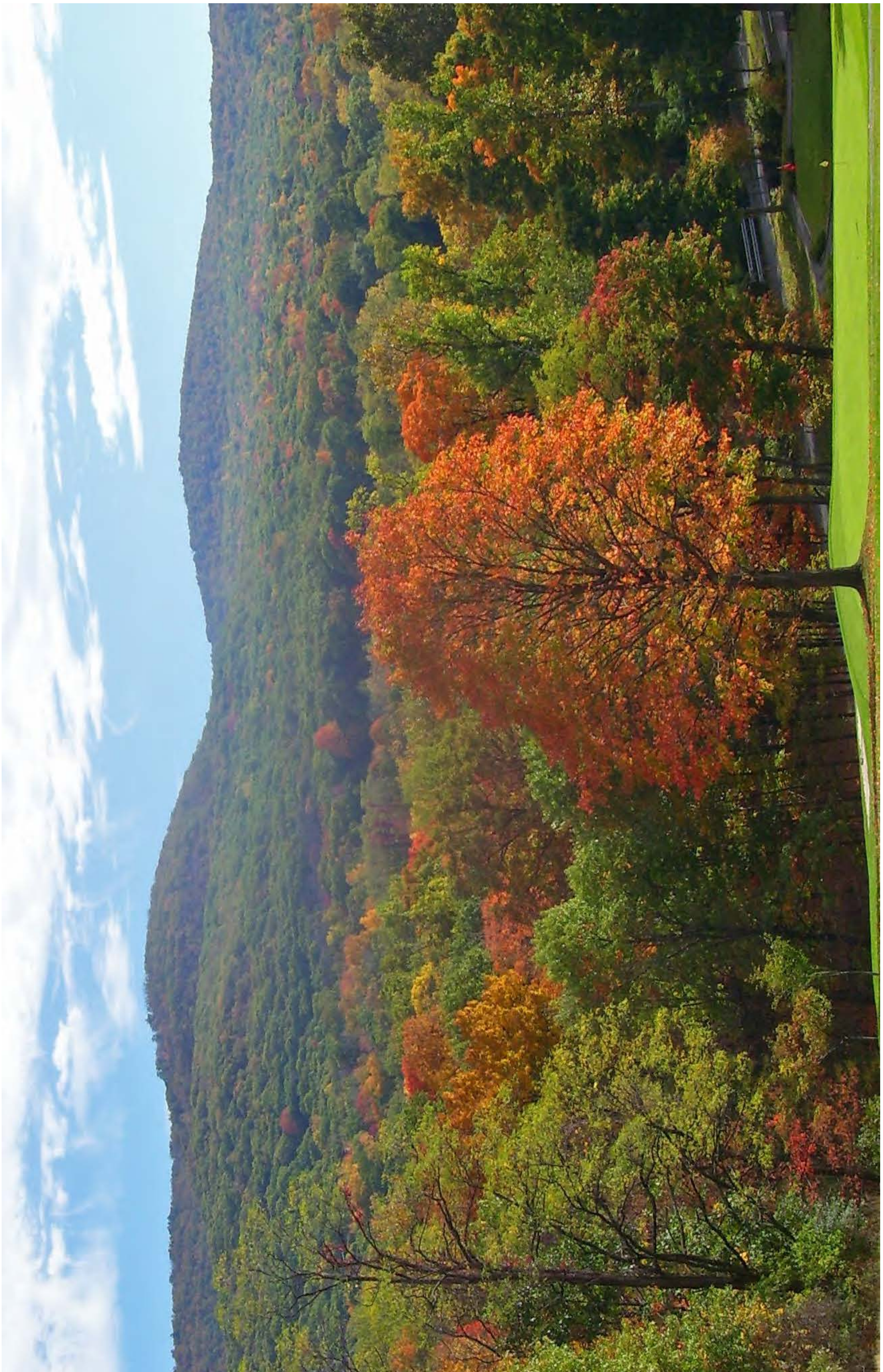
finds shelter by ___________________________.

Forests

One Picture per Group



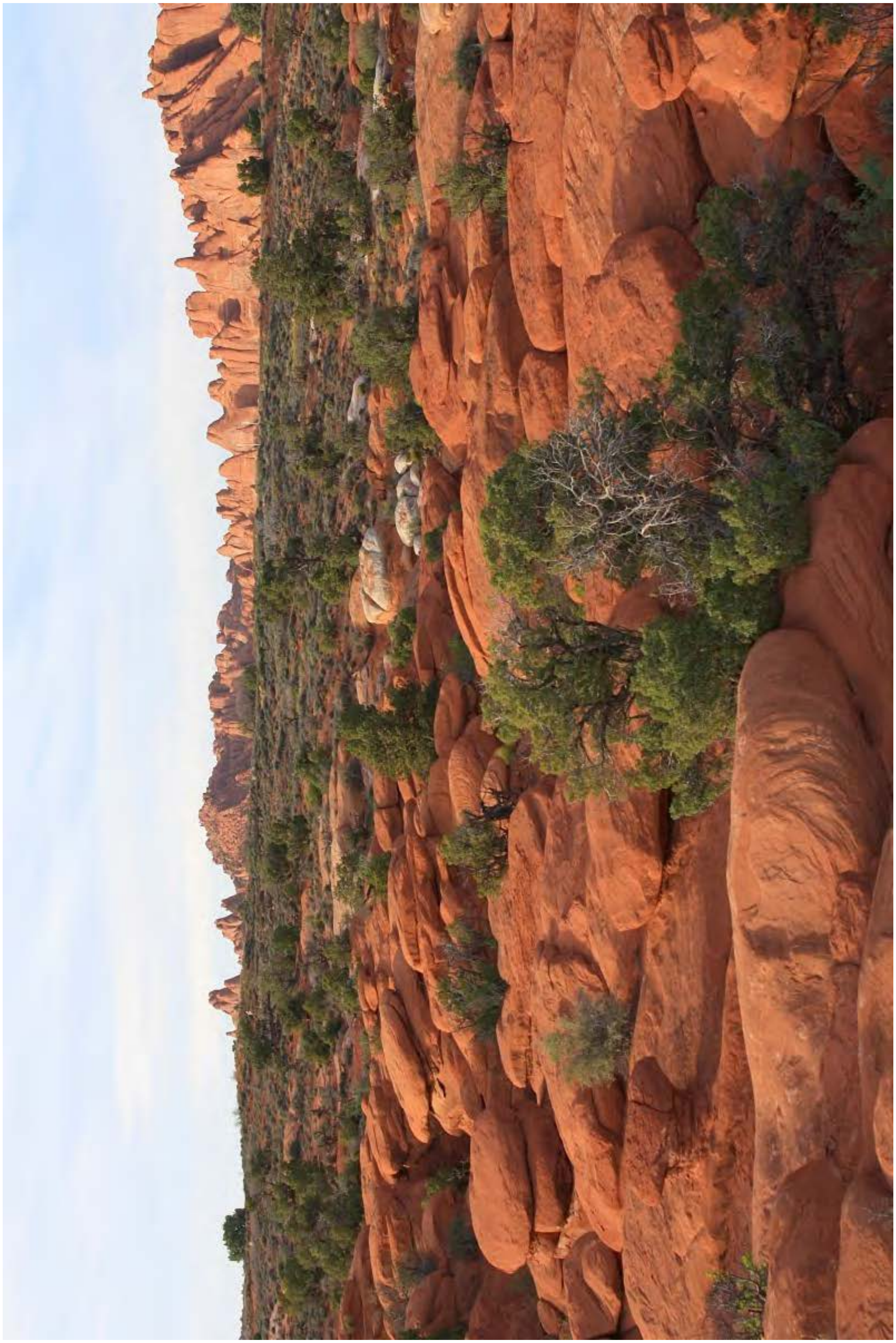




Deserts

One Picture per Group

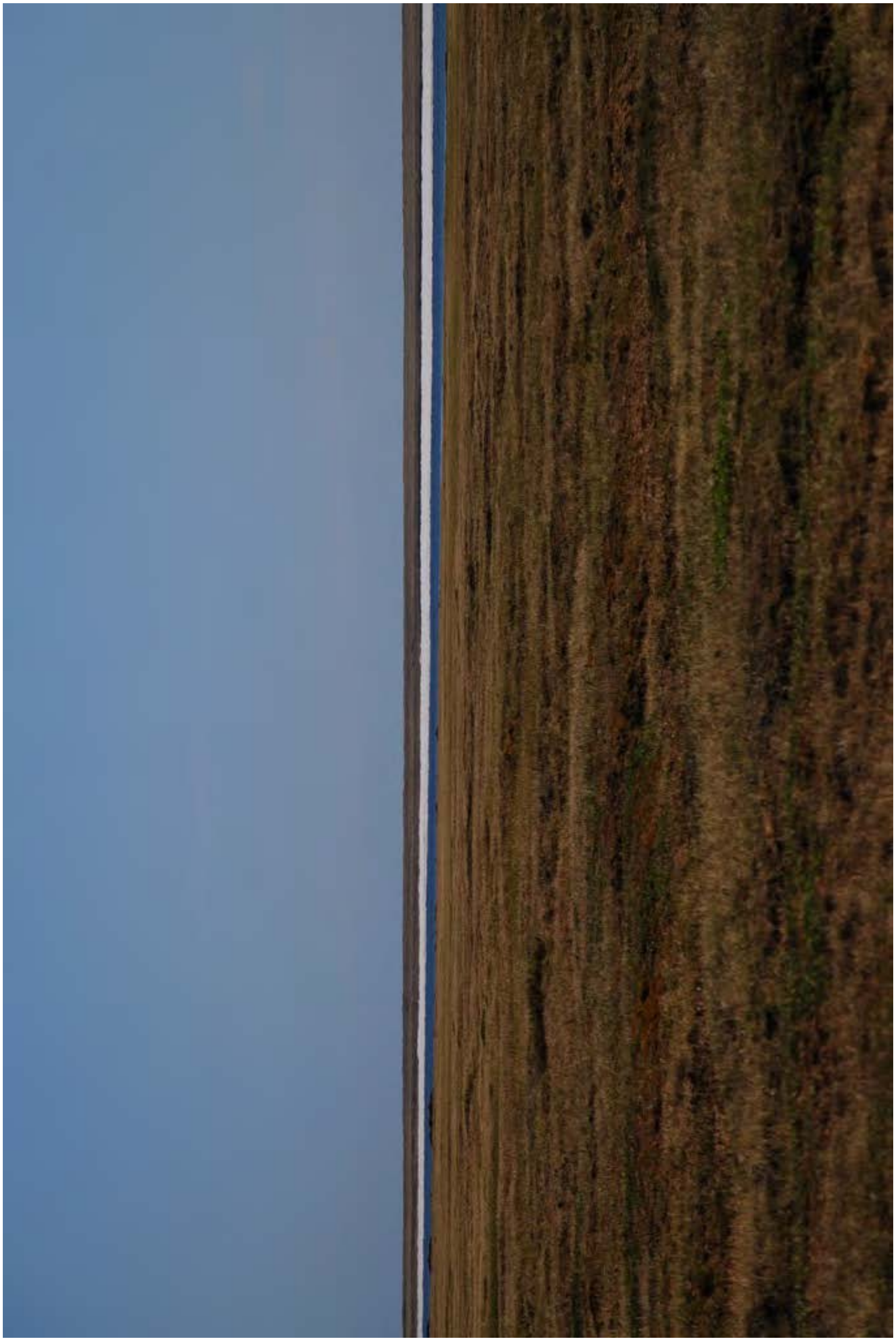
h p://maxpixel.freegreatpicture.com/Utah-Desert-Red-Rocks-Moab-Southwest-Forma on-2792148

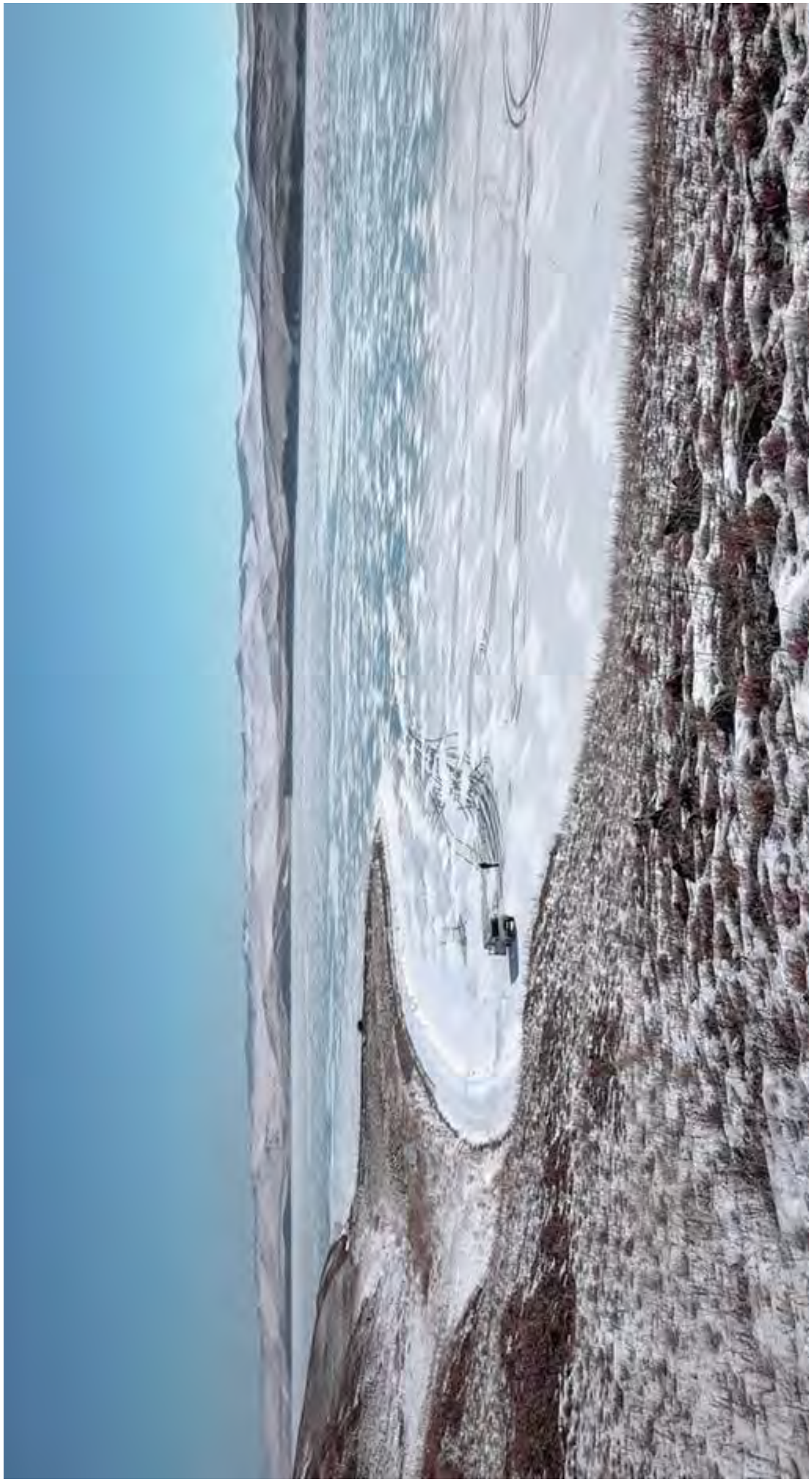


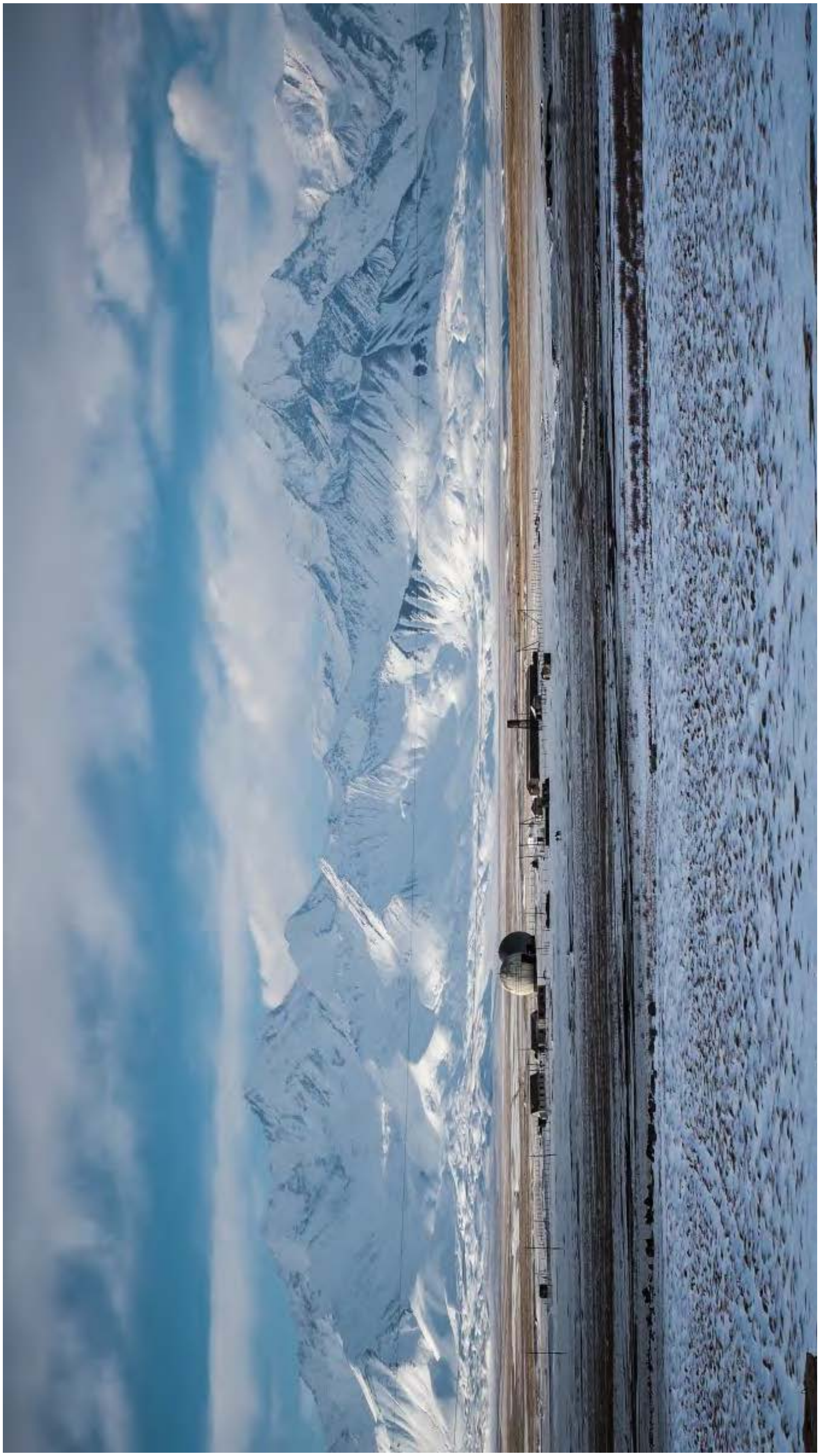
Arctic   undra

One Picture per

Group

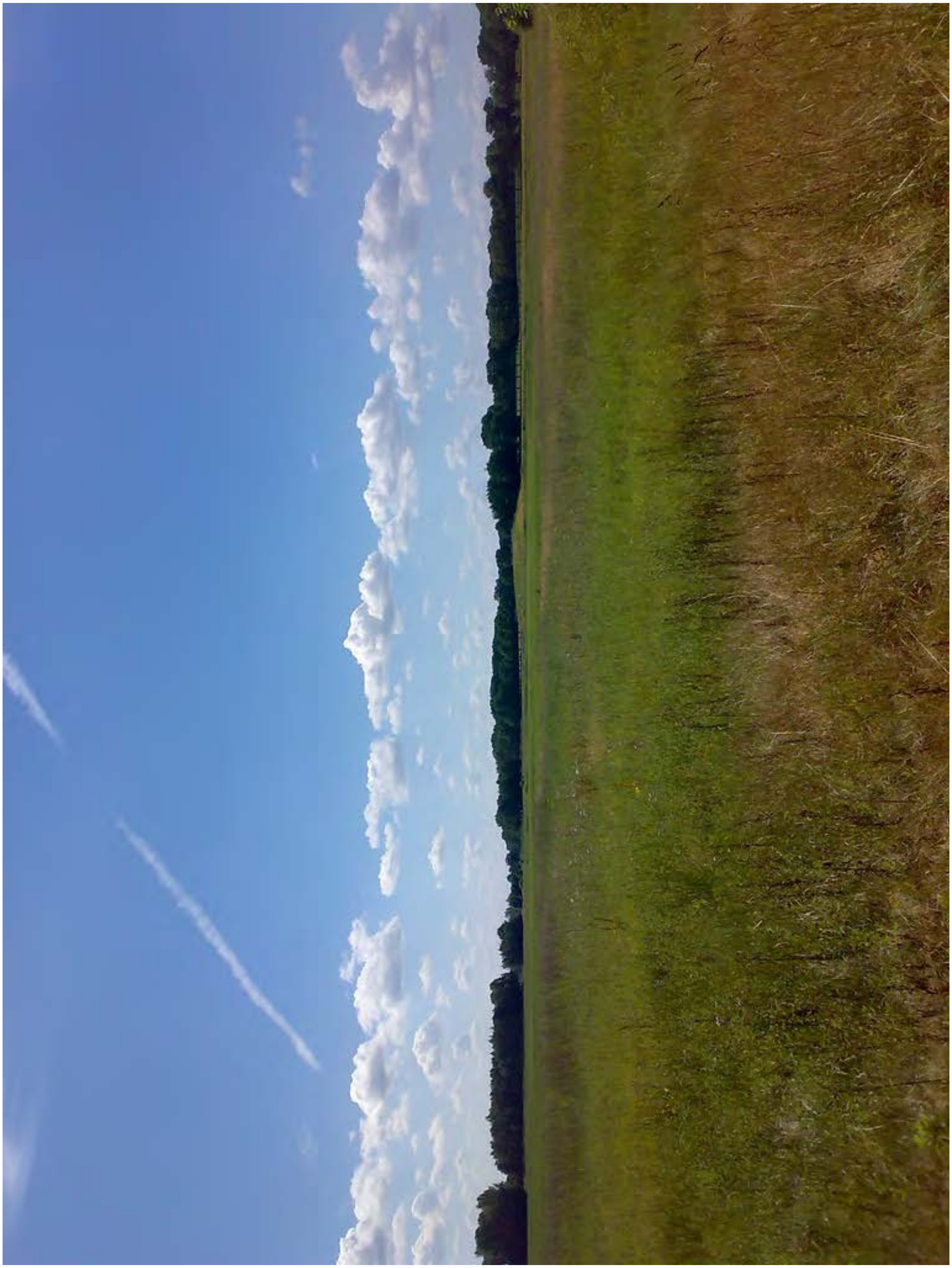


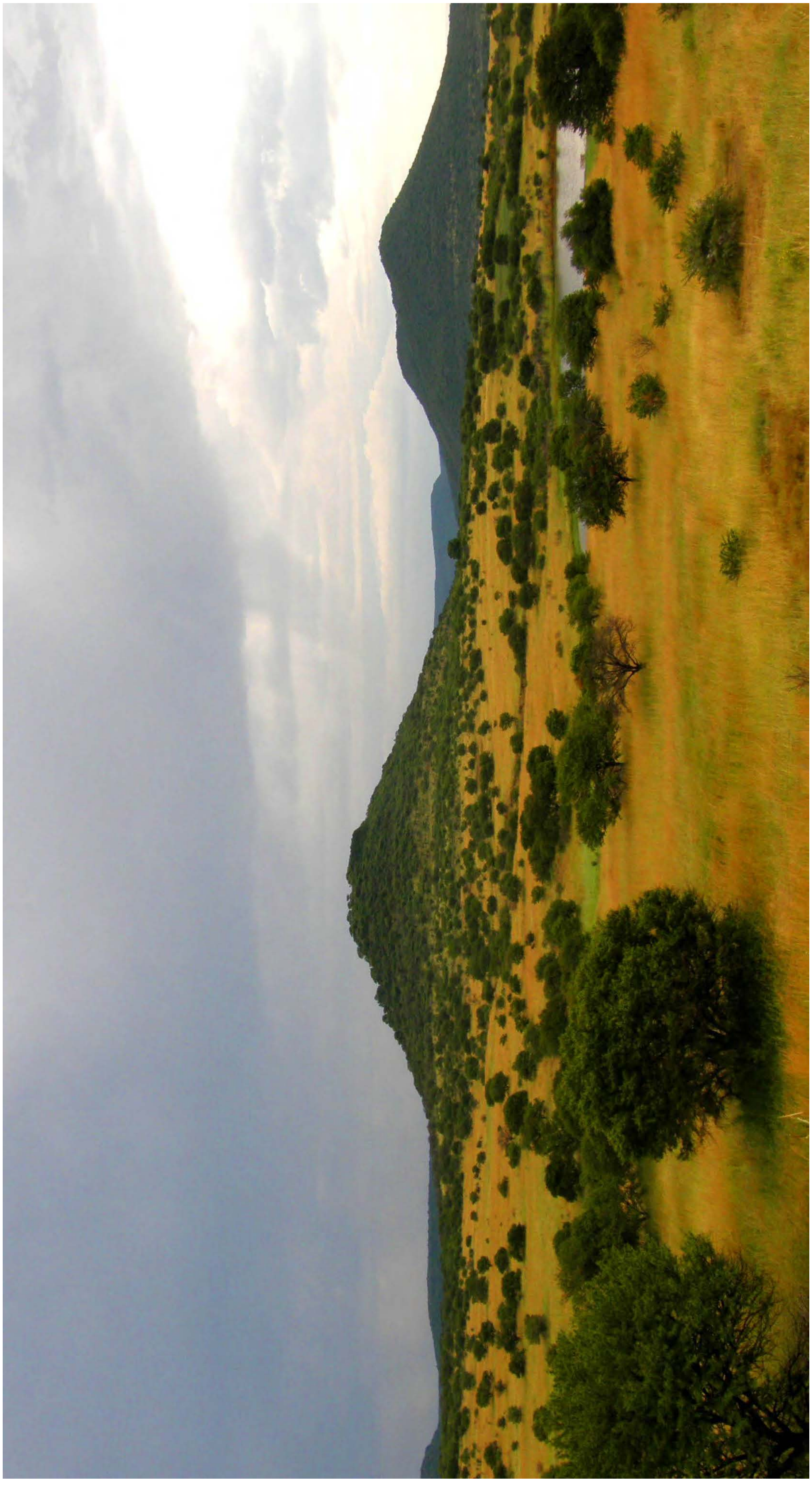


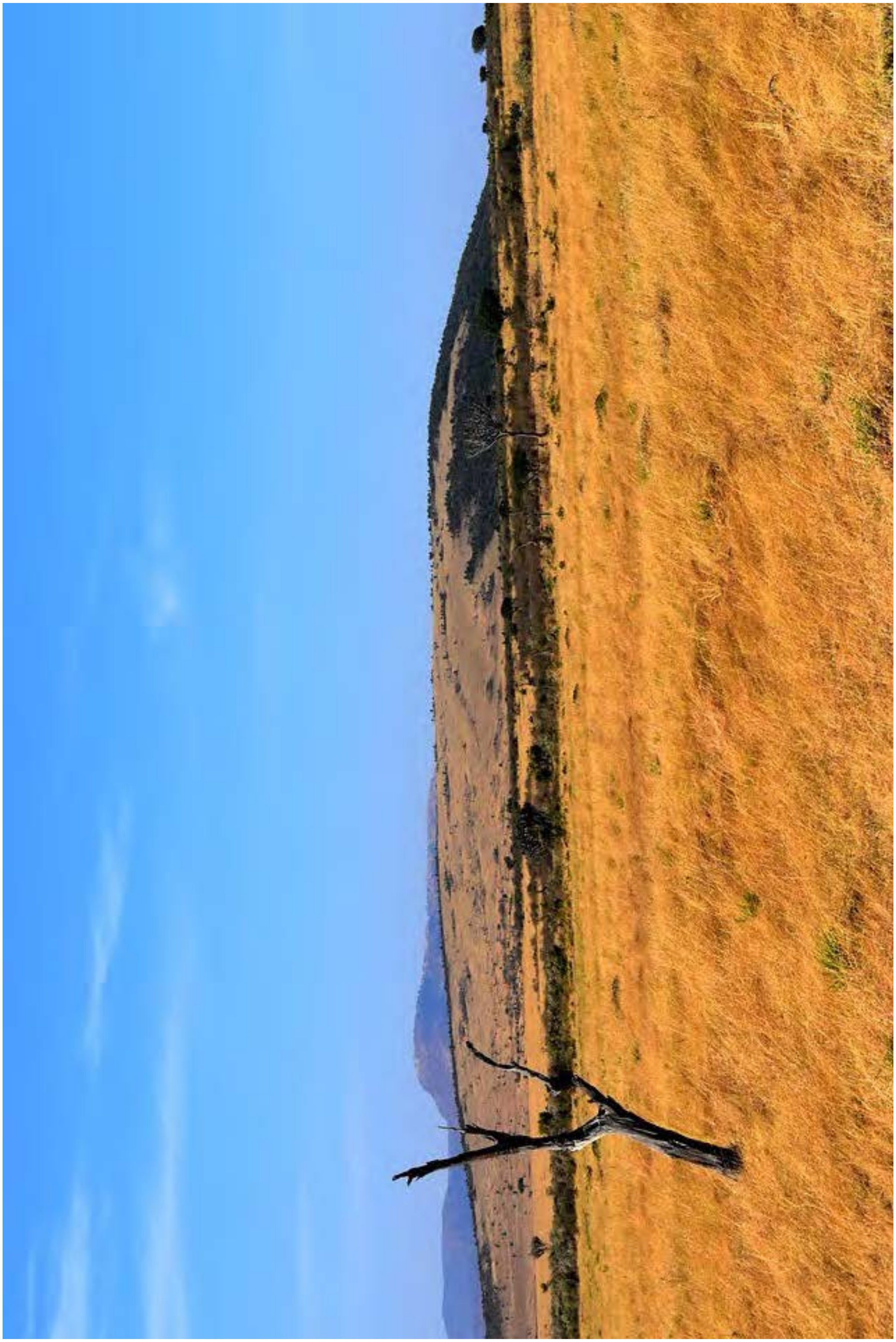


Grasslands

One Picture per Group

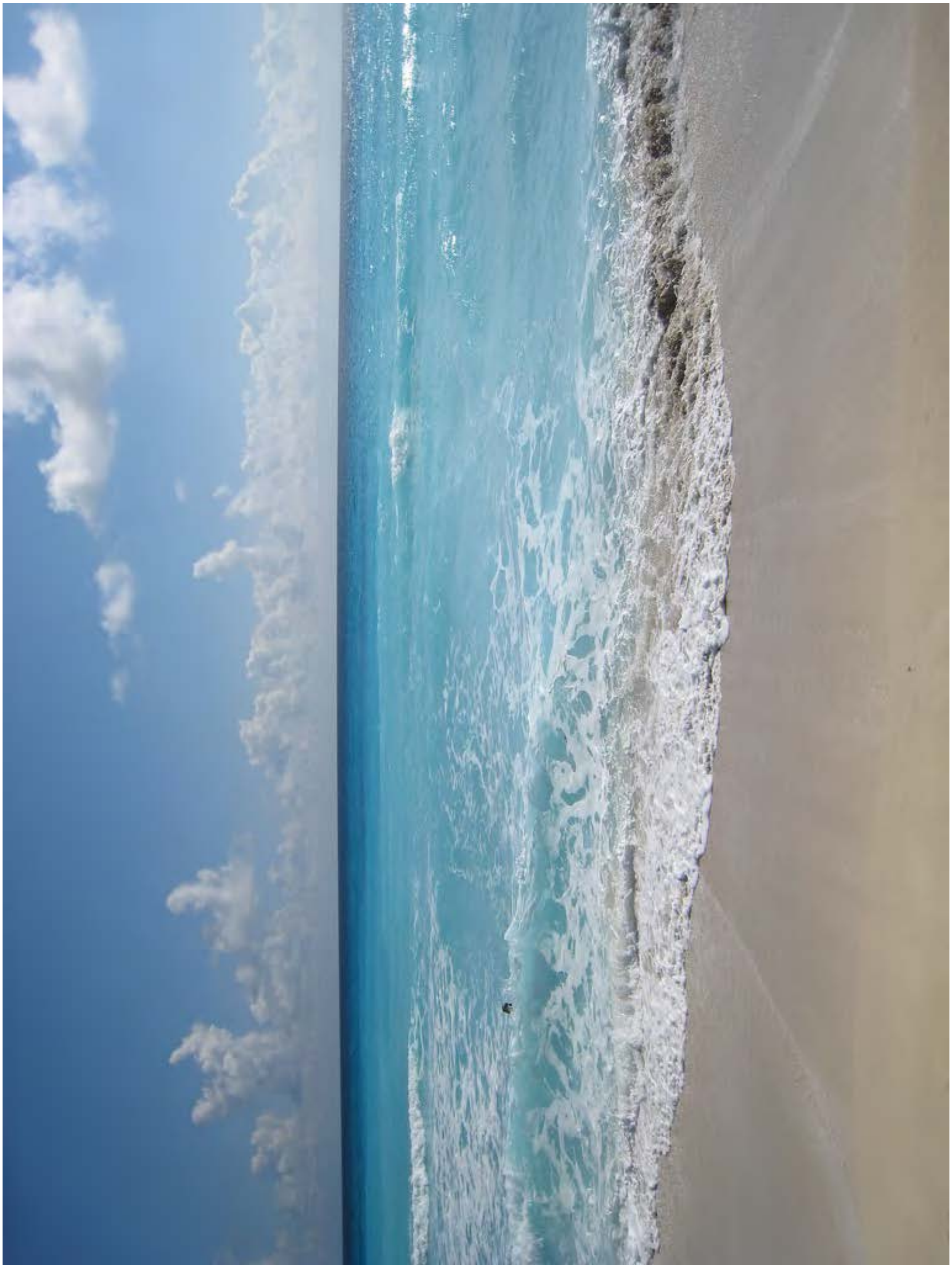


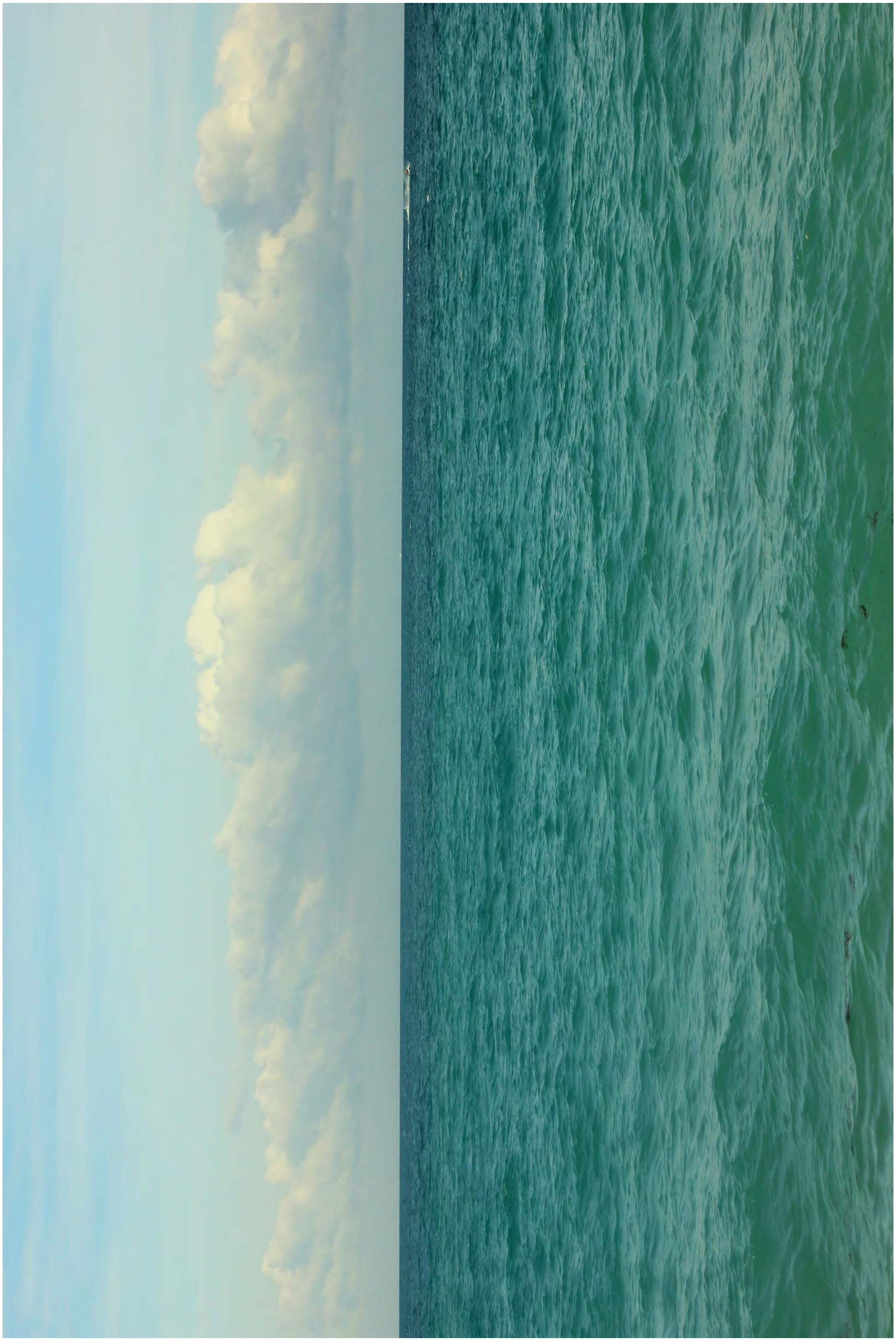


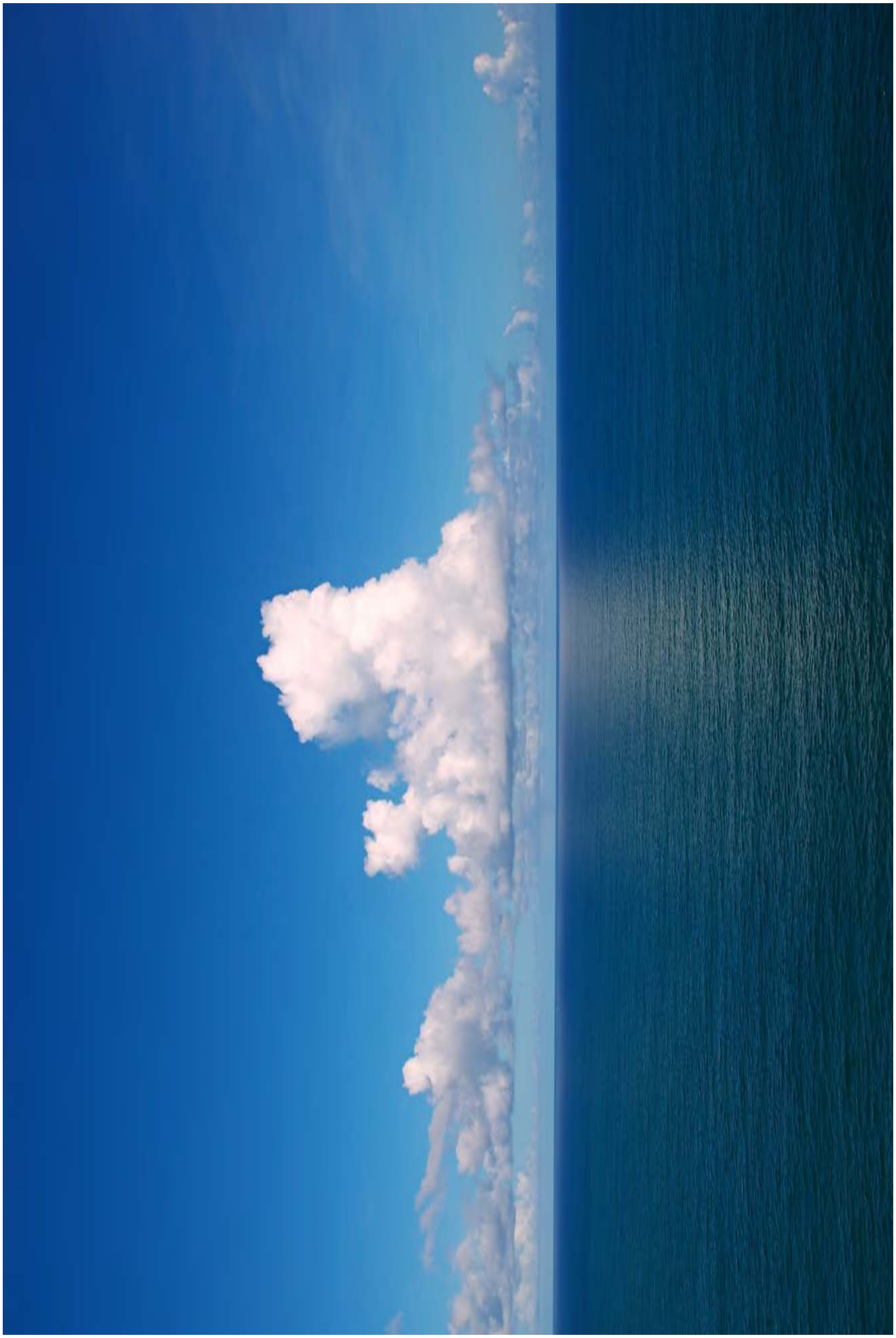


Oceans

One Picture per Group



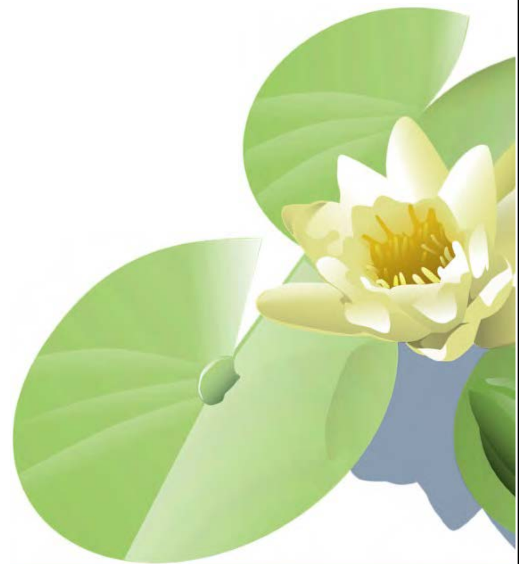




Words for Hula Hoop Venn Diagram

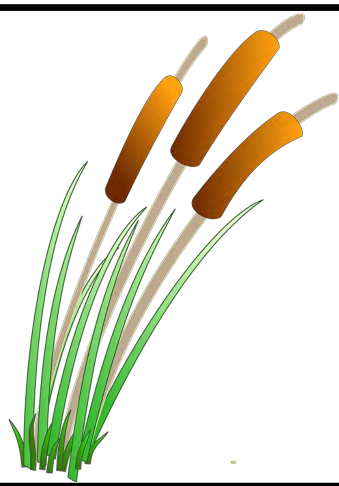
Frog

Lily Pad



Pond

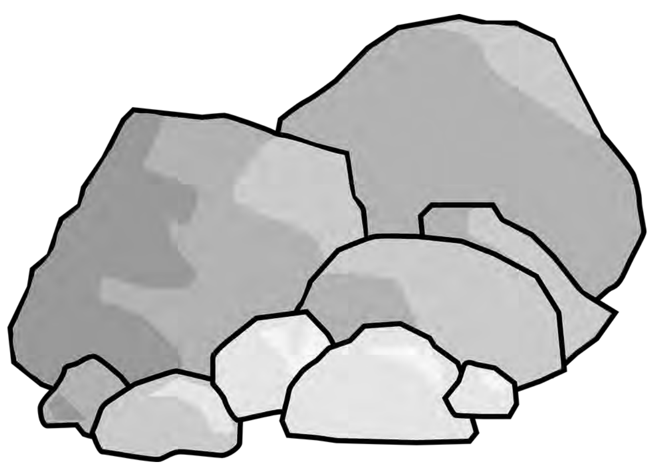
Words for Hula Hoop Venn Diagram



Cattail

Grass

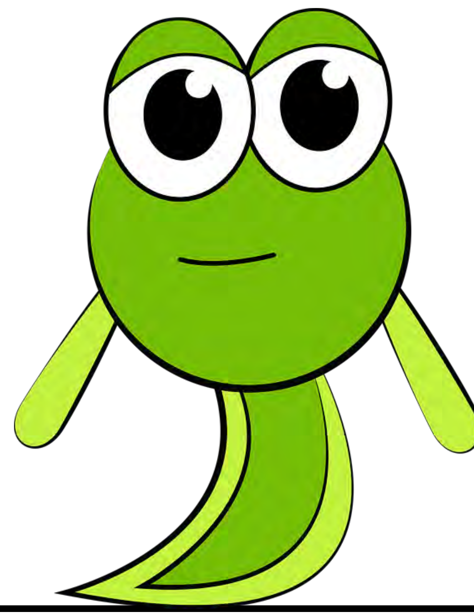
Rocks



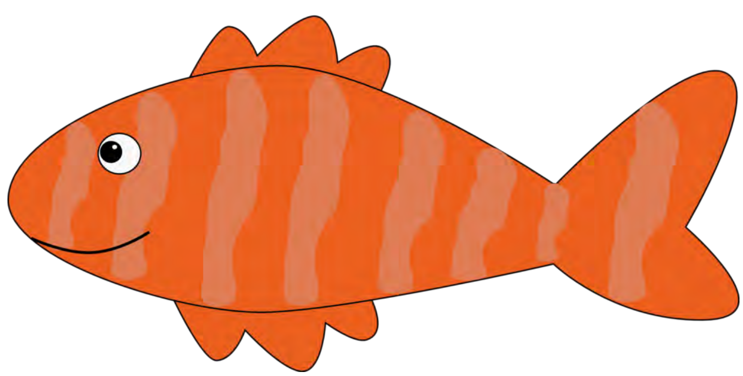
Words for Hula Hoop Venn Diagram

Trees

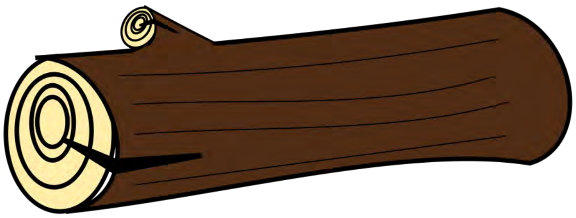
Tadpole



Minnow

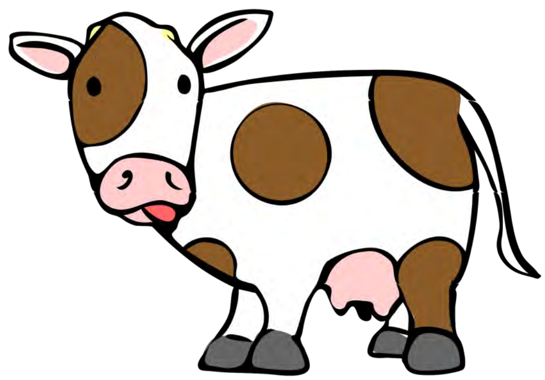


Words for Hula Hoop Venn Diagram



Log

Cows



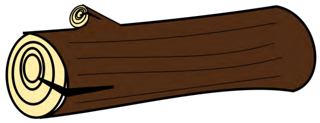
Birds

Words for Hula Hoop Venn Diagram

Underwater Plants

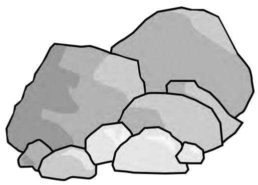
Cut-outs for Biome Anchor Charts

Logs

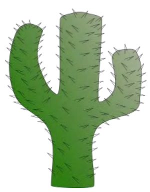


Trees

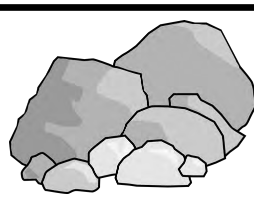
Rocks



Cactus

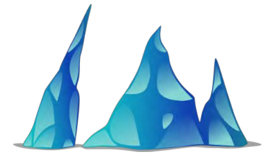


Rocks

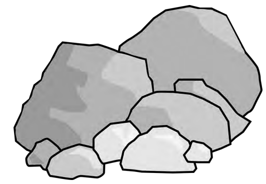


Underground

Ice



Rocks

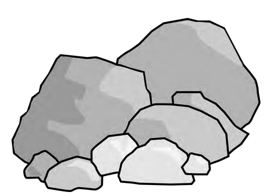


Underground

Trees

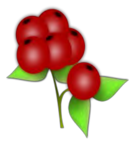
Coral Reef

Rocks

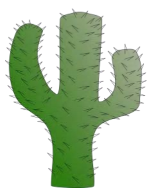


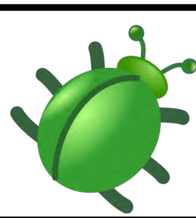
Cut-outs for Biome Anchor Charts

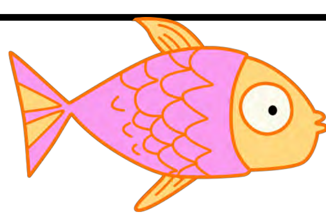
Sand 

Berries 

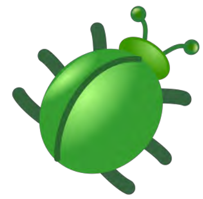
Acorns 

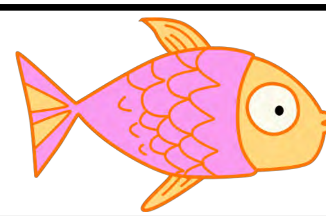
Cactus 

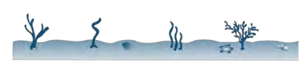
Bugs 

Fish 

Grass 

Bugs 

Fish 

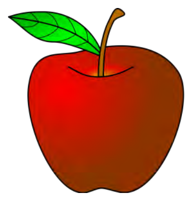
Algae 

Stream 

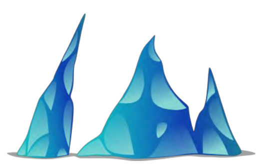
Rivers 

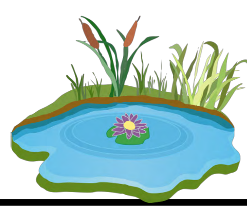
Cut-outs for Biome Anchor Charts

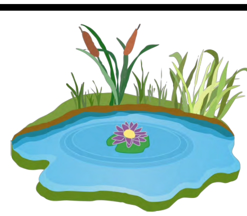
Lakes


Food


Plants


Ice


Ponds


Ponds


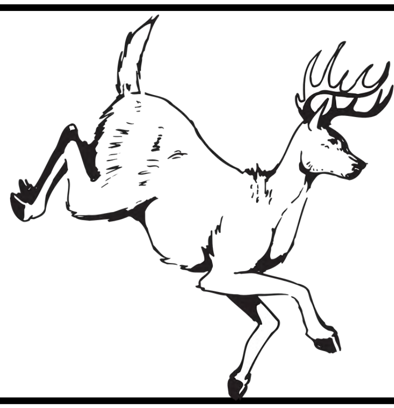
Lakes


Rivers

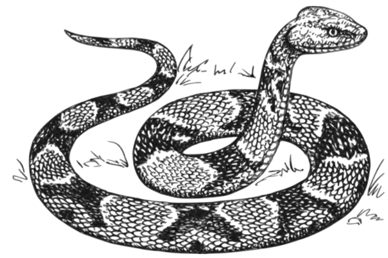

Everywhere!

Cut-outs for Student Animal Homes

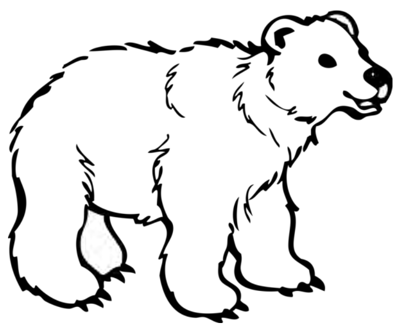
Deer



Snak

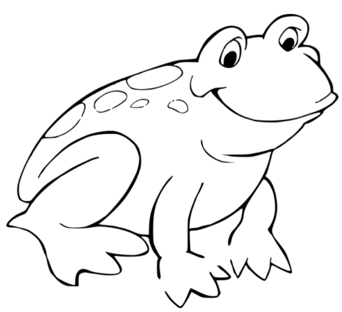


Black Bear

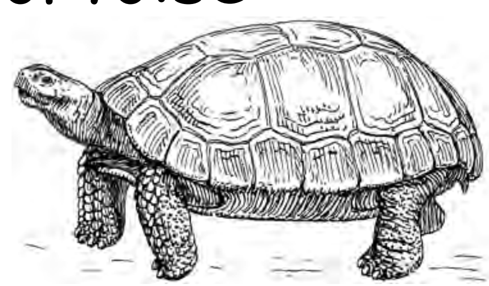


Scorpion

Frog



Tortoise



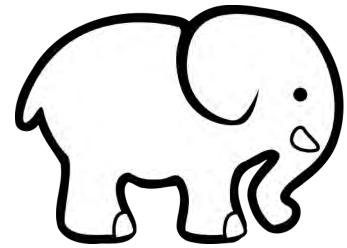
Duck

Lizard

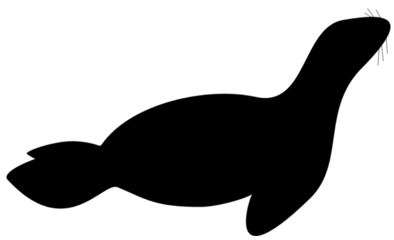
Cut-outs for Student Animal Homes

Polar Bear

Elephant



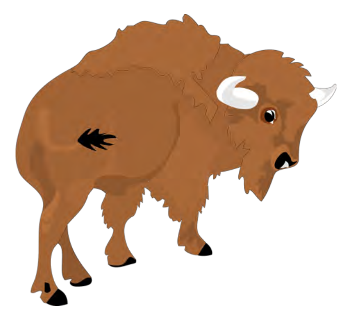
Seal



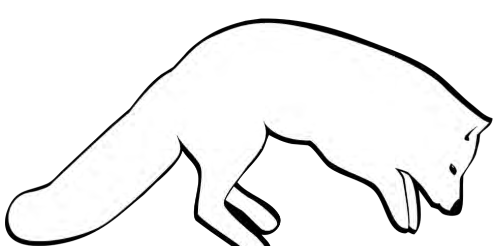
Lion

Caribou

Bison



Arctic Fox

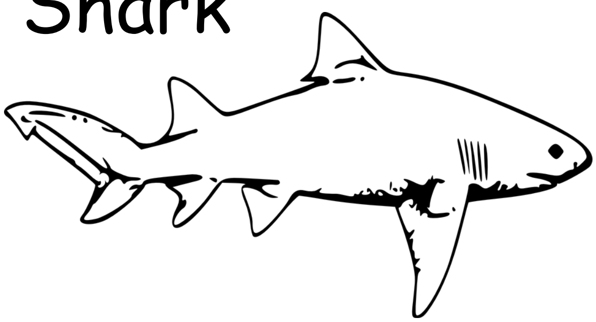


Prairie Dog

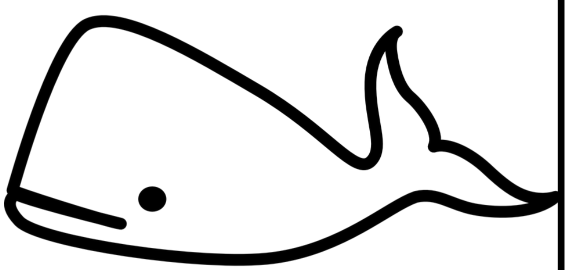
Cut-outs for Student Animal Homes

Dolphin

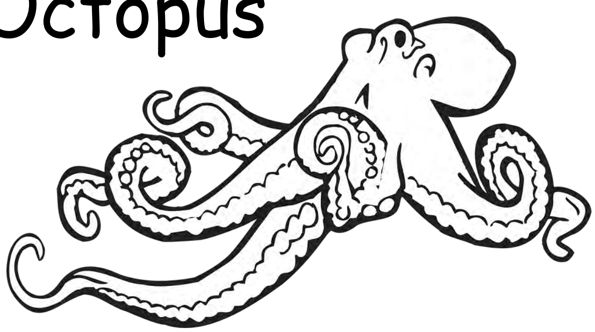
Shark



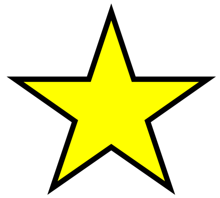
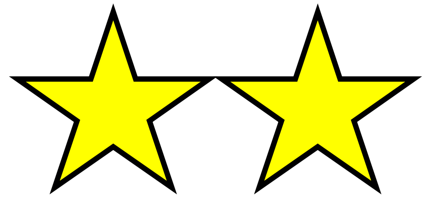
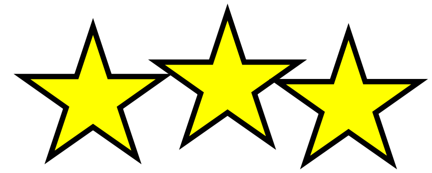
Whale



Octopus



Kindergarten Zoo Exhibit Rubric

Exhibit Contains:			
The right habitat			
Correct plants			
Shelter, food, And water			

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ADMIT ONE

To the Classroom Zoo Event

674286

Brought to you by the Kindergarten Zoological Society

Tab page front

Label: Using Mathematics and Computational Thinking

TN Department of Education

Using Mathematics and Computational Thinking

Tennessee Academic Standards for Science

Teacher Guide for Kindergarten

Standard

K.ESS2.1 Analyze and interpret weather data (precipitation, wind, temperature, cloud cover) to describe weather patterns that occur over time (hourly, daily) using simple graphs, pictorial weather symbols, and tools (thermometer, rain gauge).

Tennessee Academic Standards for Science: Page 19

Three-dimensional Learning Performance for Lesson

Students will fill out a temperature and weather chart based on observations made over several days* in order to show that weather patterns occur and can be tracked over time** highlighting the patterns of weather processes which may in turn be predicted.***

Science and Engineering Practice for Lesson

*Using Mathematics and Computational Thinking**

Students use information obtained from daily observations about 1) temperature and 2) cloud cover to fill out a weather chart. Though students are not yet expected to read a number line on an analog thermometer precisely, the teacher can establish general parameters of "cold, cool, comfortable/cozy, warm, hot" and relate those terms to general areas of a thermometer. The "Materials" section on the next page contains a link to a color-coded template that can be used to help relate areas of an analog thermometer to the relative terms "cold, cool, comfortable/cozy, warm, hot." The template includes the temperature thresholds for each relative term in case students are using digital thermometers. Alternatively, if using analog thermometers, the teacher can create a simple modification by using clear tape to affix colored pieces of paper to the students' thermometers in order to relate each area of the thermometer to one of the relative terms.

Disciplinary Core Idea for Lesson

Earth and Space Science 2: Earth's Systems **

"Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time. People measure these conditions to describe and record the weather and to notice patterns over time."

A Framework for K–12 Science Education: Page 188

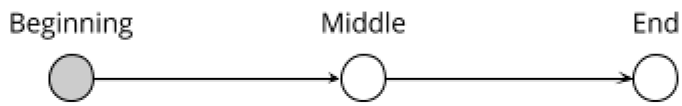
Crosscutting Concept for Lesson

*Patterns****

Students recognize that various patterns may emerge in weather data, which can be subsequently used to make more accurate predictions of future weather conditions.

Prior Knowledge

Location Within Instructional Unit



- Concepts taught prior to this lesson:
    - Making a prediction is like making a guess with a good reason
    - Weather occurs outside in nature every day
    - Our understanding of weather is aligned with two primary factors
        - Conditions - cloudy, partly cloudy, sunny
        - Temperature - hot, warm, cool, cold
- Concepts still need to be taught after this lesson:
    - The impact of precipitation on temperature
    - Measuring precipitation in general terms using tools such as a rain gauge
    - Weather changes hourly throughout a day (usually cooler in the early morning and warmer in the early afternoon)

Materials

- Three digital thermometers
    - One kept in classroom (room temperature)
    - One kept in a warmer or cooler location than classroom prior to the lesson (e.g. inside a cold refrigerator at school or outside the classroom on a warm day)
    - One kept outside the classroom in a pre-selected location where students will be able to observe the weather (such as right outside the classroom or hallway, or near the school playground)
- *Daily Weather Record Sheets*
- *What Will the Weather Be* by Lynda DeWitt, or another suitable read-aloud related to the weather (optional)
- *The Kindergarten Thermometer*: Modified thermometers for students (Instructions for modification)
- "Weather 101 for Kids" YouTube video (optional)
- "Be a Weather Watcher" YouTube video (optional)

Lesson Sequence Outline

1. Review making predictions → A prediction is a guess with a good reason.
2. Discuss how you notice that the weather sometimes changes and sometimes stays the same. Pose the question to the class, "How can we observe and predict the weather?"
3. Discuss meteorologists and what they do → Meteorologists observe weather and make predictions using weather tools.

4. Segue to how students will behave like meteorologists over next five days and use a weather tool to make weather observations.
5. Model how to use a thermometer.
    A. Prior to the lesson, set one thermometer in another location at the school such as inside a school refrigerator, and set one thermometer outside so it is already displaying the ambient temperature when students go outside for their observation activity.
6. Model how to observe the weather (clouds and temperature) and record it on the record sheet.
7. Let students observe the weather and fill out their record sheet for Monday/Day 1.
8. Closure - Connect back to predictions about weather and the work of meteorologists. Each day the students will act like a meteorologist making observations about weather and making predictions about tomorrow's weather.

Instructional Notes

To begin the lesson, the teacher reviews with students what a prediction is and identifies a prediction as making a guess with a good reason. The teacher may model how they use reasoning to make their prediction using an example such as, "Last week, the cafeteria served pizza on Friday. I predict the cafeteria will serve pizza again this Friday, because they served it on Friday last week, and come to think of it, the week before that, they also served pizza on Friday." The teacher then calls on a student volunteer or two to share a prediction that they have about something and the reason for that prediction (e.g., "I predict I will be a bus rider this Tuesday, because every Tuesday I ride the bus home").

Next, the teacher connects the idea of making predictions with weather by saying, "I notice that the weather sometimes changes, and sometimes it stays the same. Weather can be hard to predict!" The teacher then writes the question, "How can we observe and predict the weather?" prominently on the board. This question will drive the remainder of the lesson and activity.

Once the question has been posed to students, the teacher may accept some responses if students have some ideas about how they can observe and predict the weather. If students do not bring up an experience about watching a meteorologist on TV, then the teacher can pose the question, "Has anyone ever seen a person on TV talk about the weather?" After students have a chance to respond, the teacher follows up by explaining, "That person has a special job and is called a *meteorologist*. A meteorologist is in charge of observing the weather and predicting the weather for future days so that we can be prepared for good or bad weather. Starting today, and for each day this week, *we* will get to be meteorologists!"

In order to provide additional information on what a meteorologist does, the teacher can share a read-aloud such as *What Will the Weather Be* by Lynda DeWitt, or another suitable read-aloud story related to weather. Alternatively, the teacher can show one of the suggested online videos such as “Weather 101 for Kids” or “Be a Weather Watcher.” The “Weather 101 for Kids” video features an actual meteorologist explaining what his job is like to a young viewing audience, and the “Be a Weather Watcher” video explains how to observe weather and provides an overview of the observation activity that students will be doing in a few moments. Regardless of which resource(s) the teacher uses, a quick review should follow to ensure that students understand that a meteorologist is someone who observes and predicts the weather.

At this point in the lesson, the teacher should clarify that in order to REALLY work like a meteorologist, we have to use a TOOL to help us make accurate weather observations. The teacher displays a thermometer which has been stored in the classroom and shows the room temperature. The teacher demonstrates to students how to look at thermometer and observe the position of the liquid to determine roughly if the temperature is “cold, cool, comfortable/cozy, warm, or hot.”* If the modified thermometers have been created, the teacher can explain the meaning of the color coding. In this case, the thermometer will most likely show a "comfortable/cozy” reading if the classroom has been kept at a typical room temperature. At the same time, students can be introduced to the concept that we use numbers to keep track of temperature. The teacher can demonstrate the collection of the first data set which would include the analog reading based on color and an accompanying digital reading where students record the number shown on the digital thermometer.

**Note:*

- *Specific temperature readings from a number line are not expected at this grade level. It is sufficient that students identify whether the thermometer is showing a temperature that is roughly considered “cold, cool, comfortable/cozy, warm, or hot” based on the approximate position of the liquid in the thermometer.*
- *If using digital thermometers: Teachers may opt to adapt this lesson using Fahrenheit scale. Celsius was selected because most of the numbers written will be closer to the 1-20 range that students write, and all numbers written will be less than 100. If Fahrenheit is selected, be deliberate in the selection of temperatures to measure so that none will exceed 100 degrees Fahrenheit. The use of a digital thermometer provides a scaffold to record temperatures greater than 20 degrees Celsius.*

The teacher then informs students that they have stored another thermometer in a different location at school with a different ambient temperature (e.g., in a school refrigerator). The teacher first asks students to predict if the thermometer will show a “cold, cool, comfortable/cozy, warm, or hot” temperature, and what reason they have for making their prediction. For example, a student may respond, “I predict the thermometer in the fridge will be cold, because when I open my fridge at home it is always cold inside!”

Once students have made predictions, the teacher retrieves the second thermometer from its stored location and demonstrates how it is displaying a different temperature from the first thermometer. It is important that the demonstration happens quickly enough that the second thermometer does not acclimate to the classroom temperature and show an identical reading. A reading of a digital thermometer can be taken at the same time to complete the modeling of a second data piece.

After the teacher has demonstrated to students how a thermometer can be used to tell us if it is “cold, cool, comfortable/cozy, warm, or hot” outside, the teacher explains that now students will get to be the meteorologists. The teacher will set expectations for student behavior by reminding students that when they go outside they are doing so as meteorologists, which means that they are observing the weather and not playing or running around during this time.

The teacher gives each student a clipboard and a copy of the *Daily Weather Record Sheet* (starting with the day of the week that this lesson is). The teacher goes over the sheet with students and makes sure they understand that they are observing four things about the weather each day.

1. Is the sky cloudy, partly cloudy, or sunny?
2. Is there precipitation (rain)?
3. According to the thermometer, is the temperature “cold, cool, comfortable/cozy, warm, or hot?”
4. What is the digital thermometer reading?

Students also make one prediction each day on their record sheet about what they think the weather will be like the following day. Ideally, students are basing their predictions on how the weather is behaving today. For example, a student may predict, “I predict the weather tomorrow will be cloudy and warm because today it was cloudy and warm.”

For the activity, the teacher may choose to provide students with their own thermometers if supplies are handy. If not, the teacher can also keep track of the one class thermometer that is stored outside and can display it for students outside so that they can record whether it shows a “cold, cool, warm, or hot” day on their record sheets. Time spent outside should be enough so that every student is able to observe the weather according to the parameters mentioned above. Once every student has had a chance to observe the weather, students line back up and return to the classroom for the lesson closure.

Once back in the classroom, the teacher asks students to share what they observed about the weather, what predictions they have about tomorrow’s weather, and what reasons they have for making their prediction. The teacher then collects or has students store their *Daily Weather Record Sheets* in the classroom so they are ready to make more observations using the remaining sheets for future days. The goal is to do this observation activity for five days so students can begin to see if their data supports weather that is easy to predict or really difficult to predict.

Engaging with the Practice
The data collected during investigation provides an opportunity to engage with multiple standards within the Counting and Cardinality domain. Students should count the number of temperatures recorded within each of the five given temperature ranges (K.CC.A.4a,b,c) and record these numbers on their data sheet. (K.CC.A.3). If the data collection takes place over an extended period of time, students will have data samples large enough to compare the number of temperatures in each range (K.CC.A.6).

**Note: Because temperatures will be scattered, there should be fewer than 10 temperatures per range. This will limit the number of temperatures that can be collected. Collecting temperatures at different times each day is poor investigative practice but will lead to a wider variety of sampled temperatures if desired for emphasis on the math component of this lesson. A similar approach to gather larger data sets would include multiple thermometers placed: indoors by a window, indoors away from a window, outdoors in the sun, outdoors in the shade.*

Student Responses and Formative Assessment
As students turn in their *Daily Weather Record Sheets*, they should be demonstrating an understanding of the following:

- Observing if it is cloudy, partly cloudy, or sunny outside
- Observing if there is rain (or other precipitation) present that day
- Analyzing a thermometer in order to gather some approximate data regarding if the temperature is "cold, cool, comfortable/cozy, warm, or hot" outside
- Using that data to establish the basis for a prediction for the following day's weather in terms of cloudy/partly cloudy/sunny and "cold/cool/comfortable/cozy/warm/hot."
- Comparing two numbers of items in two different groups of less than ten items

Citations and Resources

Image of thermometers showing different temperatures retrieved from
https://pixabay.com/en/thermometer-temperature-measure-1917500/

Image of cloudy symbol retrieved from
https://pixabay.com/en/clouds-cloudy-overcast-weather-98536/

Image of partly cloudy symbol retrieved from
https://en.wikipedia.org/wiki/File:Weather-few-clouds.svg
Image of sunny symbol retrieved from
https://commons.wikimedia.org/wiki/File:Soleil_wiki.jpg

Name ____

Our Daily Weather

This week is in the month of ________________________.

Monday: The weather was: (Circle one)

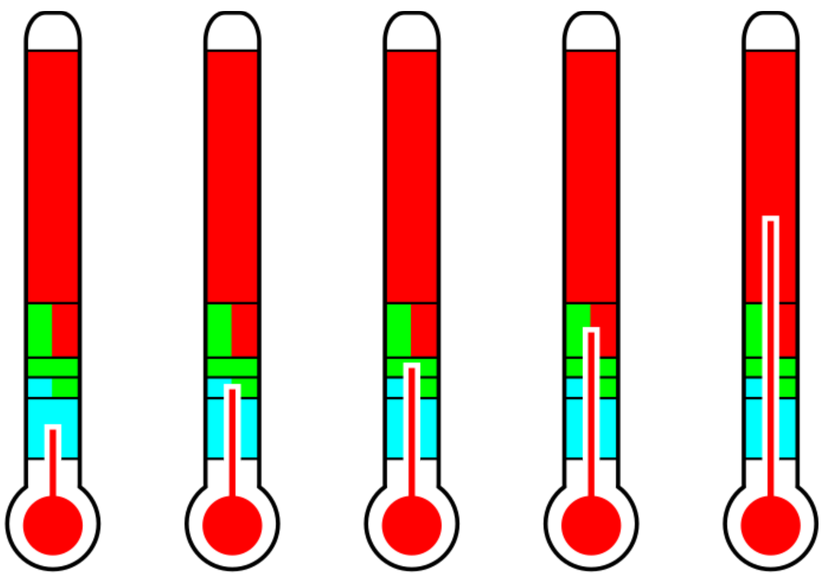
Sunny

Partly Cloudy

Cloudy

Did it rain today? Yes No

The temperature was: (Circle one)



COLD COOL COZY WARM HOT

I predict the weather tomorrow will be _______________ and _______________.

Name ____

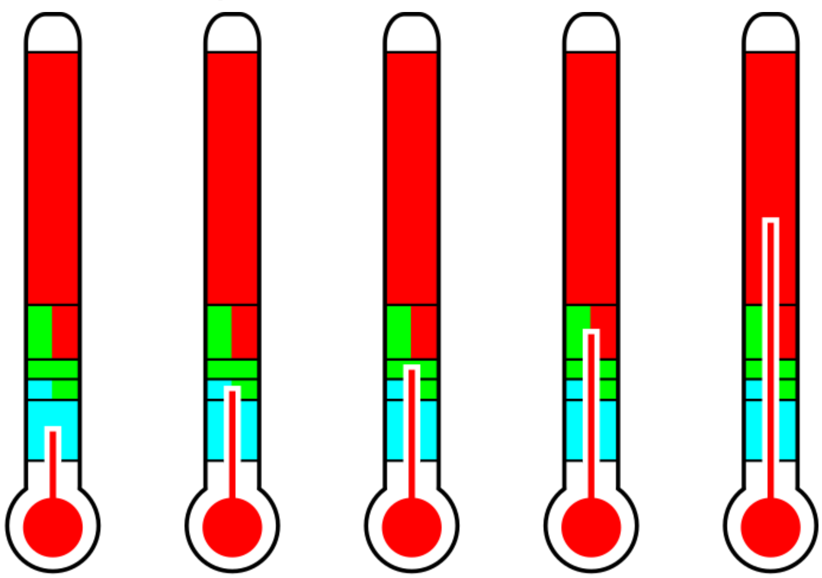
Tuesday: The weather was: (Circle one)

Sunny Partly Cloudy Cloudy

Did it rain today? Yes No

The temperature was: (Circle one)



COLD COOL COZY WARM HOT

I predict the weather tomorrow will be ______________

and ______________.

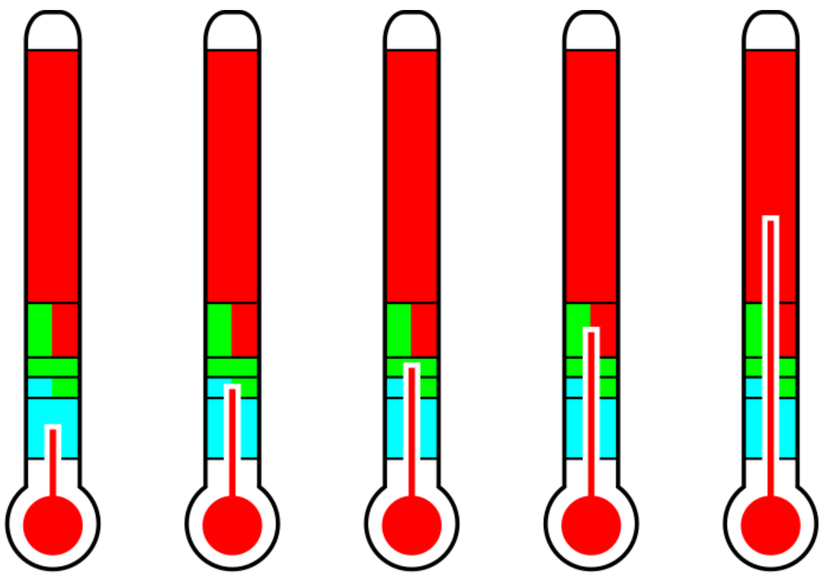
Name ______________________________________

Wednesday: The weather was: (Circle one)

Sunny Partly Cloudy Cloudy

Did it rain today? Yes No

The temperature was: (Circle one)



COLD COOL COZY WARM HOT

I predict the weather tomorrow will be _______________

and ________________.

Name ______________________________________

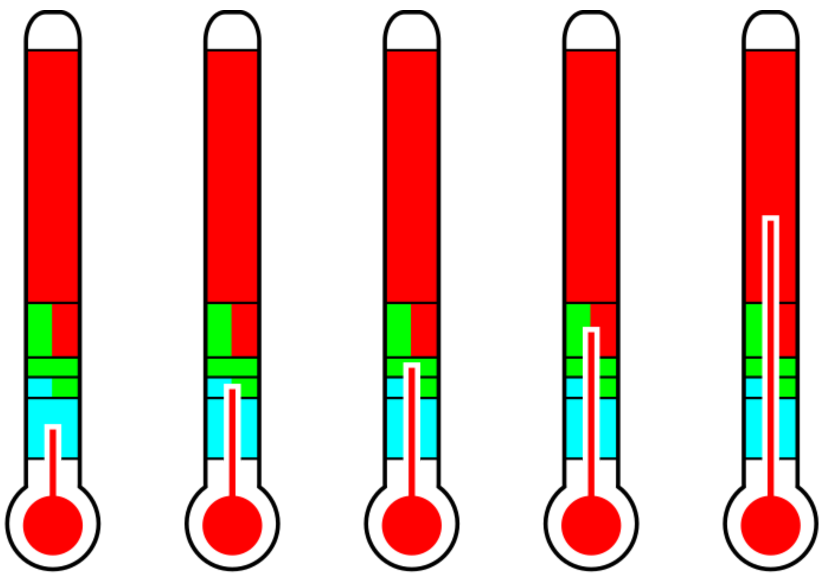
Thursday: The weather was: (Circle one)

Sunny | Partly Cloudy | Cloudy

Did it rain today? Yes No

The temperature was: (Circle one)



COLD COOL COZY WARM HOT

I predict the weather tomorrow will be _______________

and ________________.

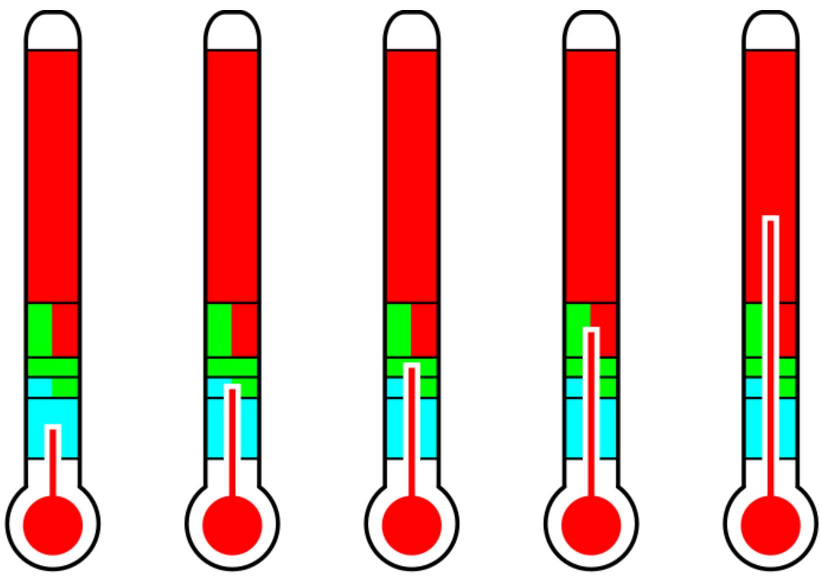
Name ____

Friday: The weather was: (Circle one)

Sunny Partly Cloudy Cloudy

Did it rain today? Yes No

The temperature was: (Circle one)



COLD COOL COZY WARM HOT

I predict the weather tomorrow will be ________________

and _________________.

Name ____

Our Weekly Weather Review

Use the weather data you collected this week to answer the following questions.

1. How many sunny days?

2. How many partly cloudy days?

3. How many cloudy days this week?

4. If next week's weather is the same as this week, what kind of days do you think we will have the most?

Sunny

Partly Cloudy

Cloudy

Name ____

5. Count the number of cold temperatures: ______

6. Count the number of cool temperatures: ______

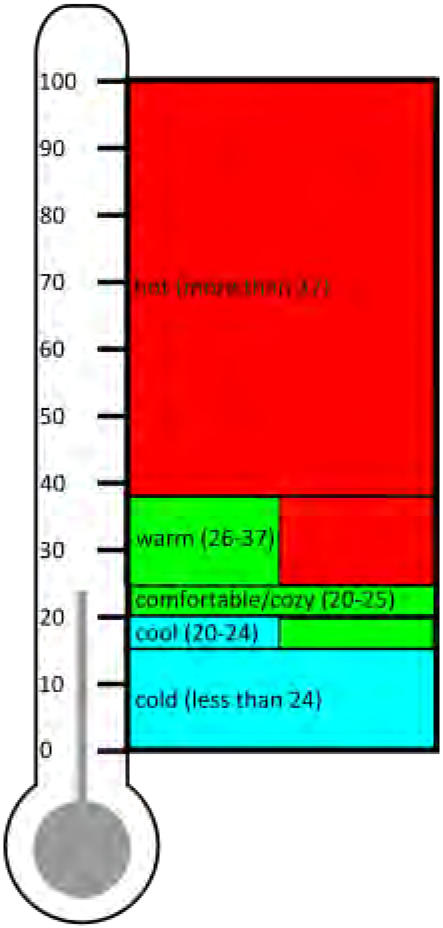
7. Count the number of cozy temperatures: ______

8. Count the number of warm temperatures: ______

9. Count the number of hot temperatures: ______

10. Circle the group with the most temperatures:

Cold Cool Comfortable/Cozy Warm Hot



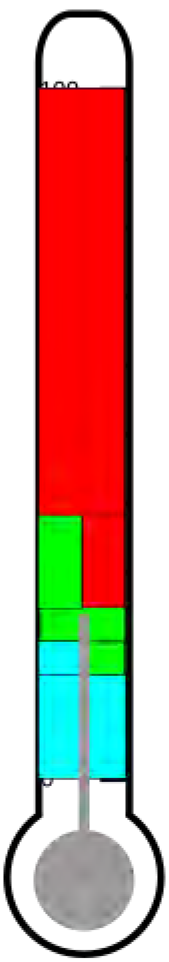
The Kindergarten Thermometer

These modifications are intended for a thermometer calibrated on the Celsius scale. Though students are less likely to encounter these temperatures in daily life, the mathematical scale is more appropriate to grade-level number fluency expectations, and this scale is standard in future scientific work.

The numbers shown on the thermometer are not needed and that portion of the thermometer surface can be covered with a color coded scale.

To apply color to the thermometer, nail polish can be used on the surface of the thermometers. Alternatively, strips of paper can be placed onto a strip of packaging/invisible tape which is then wrapped around the thermometer.

Be careful to leave a portion of the thermometer without paint so that the thermometer can still be read. Masking tape can be placed over a portion of the thermometer where the temperature will be read before painting the thermometer to ensure that it remains paint-free.



Tab page front

Label: Engaging in Argument from Evidence

TN Department of Education

Engaging in Argument from Evidence

Tennessee Academic Standards for Science

Teacher Guide for Kindergarten

Standard
K.LS1.1 Use information from observations to identify differences between plants and animals (locomotion, obtainment of food, and take in of air/gases).

Tennessee Academic Standards for Science: Page 19

Three-dimensional Learning Performance for Lesson
Students will engage in argument from evidence[*] in order to show that plants and animals have different characteristics[**] highlighting that the different structures of plants and animals are used to perform different functions. [***]

Science and Engineering Practice for Lesson
Engage in Argument from Evidence[*]
The goal of this three-dimensional learning performance is for students to understand the difference between a plant and an animal. For this grade-level, engaging in an argument from evidence may be a verbal discussion with another student or a teacher about the traits of a plant versus the traits of an animal. This practice can also be accomplished by sorting activities of pictures of plants and animals and students classifying them into the appropriate groups. Students will be practicing a foundational skill of making observations and using those observations as evidence for defending or refuting a claim.

Disciplinary Core Idea for Lesson
Life Science 1: From Molecules to Organisms: Structures and Processes[**]
"All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place and seek, find and take in food, water and air. Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive, grow, and produce more plants."

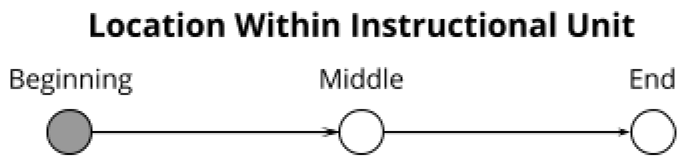
A Framework for K–12 Science Education: Page 144

Understanding that something is living or non-living is the foundational precursor for the information that will be presented in first grade (plants) and second grade (animals).

Crosscutting Concept for Lesson
Structure and Function[***]
The crosscutting concept of structure and function is prevalent throughout this lesson. Students will analyze the structures of plants and animals when determining when classifying various organisms. Connections should be made between the structure of a

physical part of an organism and what it is used for. This will help students differentiate between plants (leaves, roots, stems) and animals (limbs, eyes, mouths, etc.).

Prior Knowledge



- Concepts that should be covered before this lesson:
  - None, this is likely the first lesson for this standard
- This lesson covers portions of standard K.LS1.1
  - Focuses only on plants and plant structures

Materials

- Glass mason jars, or strong clear plastic cups
- Potting soil
- Seeds of a fast-growing plant, such as a bean plant
- *Plant the Tiny Seed* by Christie Matheson
  - If the book is not available, use this YouTube read-aloud link
- Computer/laptop with projector and internet access
- *Plant Parts Matching Game*
- Chart paper
- Markers
- Glue
- "Life Cycle of Plants" diagram
- Additional suggested books available for student access (optional):
  - *The Tiny Seed* by Eric Carle
  - *From Seed to Plant* by Gail Gibbons
- Play-Doh (optional)
  - Specifically, green, brown, and pink colors
- *Is It a Plant? Sorting Cards*—one set per pair/group
  - Recommended to be printed in color and laminated
- *My Plant Journal* PDF printout for each student

Lesson Sequence and Instructional Notes

Student Introduction to Content

Start this lesson by introducing the concept of plants to students. An anchor chart will be used to document the students' ideas about what plants are, where they are found, and even what they do. Begin a discussion by asking students if they have ever seen a plant. Write the student responses on types of plants under the appropriate category (see the diagram below). Students will likely respond with things like “trees, flowers, bush, etc.” If a student gives an incorrect response, correct the misconception appropriately. Once students have given examples of plants, then ask students the following questions. Again, document the responses on the anchor chart, being sure to correct any incorrect answers or confusion. An additional column was left for any questions that students may have that require a more in-depth answer.

- What do all plants have in common?
- What do all plants need?
- How do plants get their food?

Any time students come up with a good, scientific inquiry or observational question about plants (such as – what do flowers do?) write it on a Post-it Note and place it on the questions column.

After the anchor chart has been completed, have students fill out the first page of their plant journal. They should draw a picture of a plant in the box, and then write what a plant means to them. If students in the classroom can’t write, allow them to draw another picture instead.

Sample Anchor Chart and Student Responses:

Examples of plants	All plants have...	All plants need...	Plants get their food...	Questions we have
Trees Flowers Rose Bush Lettuce Broccoli	Leaves Roots Stems Green	Water Sunlight	From the Sun	

Student Journal Expectations: Page 2

For this page in the student journal, students with a good understanding of what a plant is should be able to draw any example of a plant, be it a tree or a flower. Students who are capable of written expression should be able to copy any of the words from the anchor chart into their journal. They can choose what to include for the written part. They may want to write “plants make food from the sun” or “plants have leaves” or “a tree is a plant.” Any of these are appropriate responses. If a student is still struggling with writing, the teacher can choose to have the student draw an additional picture or copy directly from a written statement that the teacher gives them.

Acting out a Story

During this activity, the teacher will read a book out loud to the class, titled *Plant the Tiny Seed* by Christie Matheson. The book highlights the life cycle of plants and the interactions of plants with the environment. Students can act out this book as the teacher reads. The first time, the teacher should read and teach the students the hand motions that go along with the book. Then, the teacher can read the book a second time with students acting out each of the motions. The third time the teacher reads the book, the students can be filling out the third page of their plant journal where they get to draw two things they learned from the book and write a short explanation.

Suggestion Book Motions:

- “There’s magic in this tiny seed, press it down and count to three.” Have students hold out their hands like they have a seed in them and then have them press their hands down on the floor or their desks. Have the students count to three out loud.
- “Plant another one, and then one more, press it down and count to four.” Have students repeat the above actions two more times but then count to four out loud.
- “Wiggle your fingers to add some water.” Have students wiggle their fingers over where they pushed the seeds down.
- “Rub the sun to make it hotter.” Have students rub their hands together quickly.
- “Tap the cloud and wish for rain.” Have students clap their hands once and say, “please rain!”
- “Clap to find the sun again.” Have students clap again.
- “Find the worm.” Have students point to the worm from where they are seated.
- “Shoo away the hungry snail.” Students should make a gentle “shooing” motion with their hands while saying, “shoo snail!”
- “Tell the little bud goodnight.” Have students bend down to where they pushed down their seeds and whisper, “goodnight.”
- “Now point to the purple flower.” Have students point to the flower.
- “Tap the cloud again.” Students clap once.
- “Touch the blossoms gently, please.” Students can act out what they think a flower looks like.
  - Students may stand and put the arms up and move them side to side, like they were blowing in the wind.
- “Now jiggle the plants to scatter the seeds.” Have students hold their arms straight out and shake them.
- “Close your eyes, wave your hands in the air.” Students can close their eyes, wave their hands in the air.

Student Journal Expectations: Page 3
For this page in the student journal, students will be able to draw two things that they learned from the book. Then, they can write what they learned (that matches the picture) right next to the picture. For example, a student might draw a cloud raining in the first box and write “plants need rain” for the explanation. Then, they may draw a flower in the second box and say “plants grow flowers” for their explanation. Students can choose any part of the book that they learned something from to draw for this portion of their journal.

Plant Life Cycles

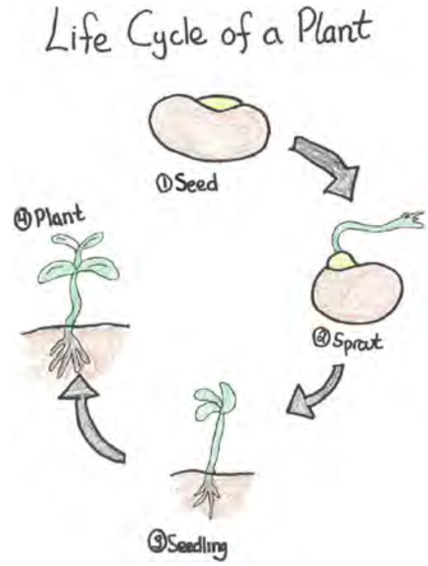
In the reference document for this standard, a special mention is made to plant and animal life cycles and growth and development. Since this portion of the lesson only focuses on plants, only the plant life cycle should be covered here.

During this portion of the lesson, the teacher will teach the four main parts of a plant life cycle to students. The four main stages are: seed, sprout, seedling, plant. There are three main sections to this portion of the learning performance: students will first receive direct instruction on the life cycle of a plant. Then, students will watch a video of a seed sprouting. Then, students will model the life cycles with Play-Doh. It is also an option to read the Eric Carle book *From Seed to Plant* at this time in the learning performance. Students will be able to use the information from the book as well as the book they read prior to this portion to answer the questions. When it comes time to write something in their journals, they will cut out and paste, in the proper order, the three different stages of plant development.

Direct Instruction
Place a diagram of a plant with the life cycle stages labeled on the board, either via a drawing or a diagram on the computer (a suggestion for a drawing has been included at the end of this section). Ask students where they think plants come from. When they have given their responses, direct student attention to stage 1: seed. At this time, pass around some seeds (you can use the same seeds you will be planting in the next section—just make sure you get them back!). Ask students to describe the seed as they pass it around. Then, ask students what you should do with the seeds. When they respond, “plant them in the dirt,” transition to the next stage.

Ask the students, “After the seeds are planted, what happens?” Students should be able to respond correctly that the seed will sprout, and a small plant will start growing. Inform students that this is called a “sprout.” Explain to students that the plant will continue to grow until it breaks the through the dirt and once it comes out of the dirt it is called a “seedling.”

Finally, ask the students what they think the final stage of a plant life cycle is. Students should correctly respond with “plant” or an adult plant or full-grown plant. Direct students to pay attention to the difference between stage two and stage three. Ask students how they would be able to tell if a plant was in one of those two stages. Use their responses to have a classroom discussion.



Video

Play this video entitled "Plant Life Cycle of a Bean Seed." This is a 40-second video that shows a time-lapse of a growing bean seed. Pause the video at the four stages that were discussed during direct instruction and ask students what stage of development is being shown. Watch it as many times as needed for students to see the cycle.

Pause at 6 seconds = Stage 1 - Seed
Pause at 9 seconds = Stage 2 – Sprout
Pause at 15 seconds = Stage 3 - Seedling
Pause at 25 seconds = Stage 4 – Plant

Afterwards, show this video.

Students can either compare and contrast the videos, or they can then identify more so on their own the parts of the life cycle in the video. Students can watch the video and instruct the teacher when to pause the video at the points that each stage is being demonstrated.

Modeling with Play-Doh (optional)

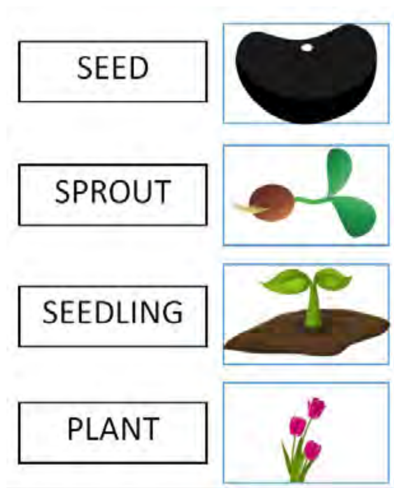
During this section, allow students to model the four different life cycle stages of a plant. Place students into groups of three to four students and encourage them to follow what is on the board and make their own life cycle diagram. Students should be able to correctly model each stage with the Play-Doh and verbally confirm the names of the four stages to the teacher. Give students about 25-30 minutes to complete this activity. Once students are done, allow them to walk around the room to view everyone else's models. They can also place labels on each stage made out of toothpicks and Post-it Notes if the teacher desires.

Formative Assessment

Student Journal Expectations: Page 4

For this page in the student journal, students will match the name of the stage with the appropriate picture and place the pictures in the correct order of the life cycles. Students should complete this individually so the teacher may formally asses each students understanding of the life cycle. The cut-outs for this portion are included in this learning performance. Students should also color in the pictures. Inform the class not to glue the pictures or labels down until the teacher has checked their order.

Correct Student Responses:



Planting Seeds

**Note: Depending on the time that is going to be allotted to this portion, the teacher may want to start with this so that the seedling journal can be kept for the duration of this learning performance. It is recommended to use clear cups or jars so that students can see the roots. When a solid pot is used, students will not be able to observe the roots growing, or even the seedling sprouting.*

In this portion of the lesson, students will get to make observations about growing plants. Students will get to help plant a seed and place it in a window (if a window is not available, it may be best to purchase a growing light, so the plants may receive the necessary nutrients). Have one jar or sturdy cup for every four students. Place students into groups of four. Give each group one bean seed, the cup or jar, a small amount of potting soil, and a small cup with water. Together as a class, prepare the growing cups. First, place about a cup or two of potting soil in the jars (the amount of soil may vary based on the size of the jars or cups that are being used). Then, remind students about the hand motions from the book that was read earlier. Have students “push” down the seed into the jar and cover it back up with soil. Then, allow them to water the seed until the soil has been well saturated.

Leave the pots in the window for 10-14 days. The student journals go up to ten days, but an additional page can be added if extra time is needed. Everyday, students should be given time to go and view the plants and document what is happening in their journals. Students can document the progress of the plant by drawing a picture of what it looks like every day. There is also additional space under the “day” portion to write the stage of the life cycle that the plant is in for each day.

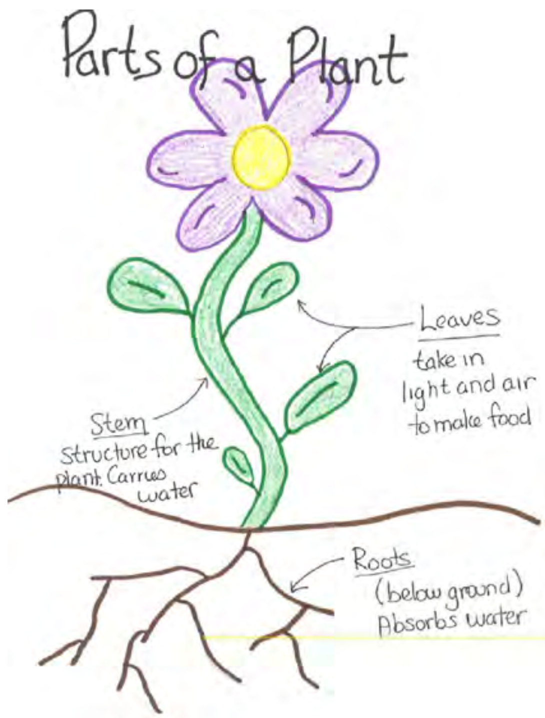
Parts of a Plant

Now that students understand how a plant grows (this will be useful for the next standard, K.LS1.1, for determining living vs. non-living things), they will begin to understand what makes a plant a plant, and not an animal. Students will learn three main parts of a plant (a fourth, the flower, can be added if the teacher deems it appropriate for each class. However, since not every plant has a flower, this may cause confusion). A picture is included below as a suggestion for a chart for students to see. It is important to emphasize that almost all plants have three main structures, roots, leaves, and stems. These structures are not shared by animals. When explaining these structures to students, emphasize the need for food and water.

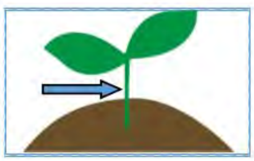
- The leaves absorb light and air for plants to make their own food.
- The stem helps to give the plant structure (support) and transport water from the roots to the leaves.
- The roots absorb water and nutrients from the soil.

As the teacher is going through this information, students can be copying the terms “leaves, roots, and stem” into page 7 of their journal.

Once students are familiar with the terms and functions of the parts of a plant, then students can practice matching the part to the function. On page 8 of their journals is a matching portion. Students need to cut out the structures and the functions and match them appropriately in their journal. For this activity, students can be paired up and work together to match the structure and function on their desk prior to gluing it down in their journals. When students have the terms correctly matched, then they can place it in their journals.



Correct Student Responses



STEM

LEAVES

ROOTS

After students have correctly matched the parts of a plant, now they must use this information as evidence to engage in an argument when classifying plants from other things. Use the *Is It a Plant? Sorting Cards* PDF for this portion (some of these pictures can be used in later learning performances that address the remaining parts of this standard, specifically classifying animal vs. plants). Keep students within the same pair and have them identify all of the plants that are within the cards. Students should be discussing with their partner why a plant is identified as such and not as something else. They will use their knowledge of plant life cycles and the structures of a plant in order to classify them properly. They are engaging in argument by using observational evidence to support their ideas while collaborating with another student. Some of the cards are tricky, as they do not obviously demonstrate the three parts of a plant. Guide students through these tougher pictures by asking them the following questions:

- How do you think it gets food?
- How do you think it grows?
- Is there anything on the picture that looks like a [leaf, stem, roots]?

Nature Walk

One of the most important ways for students to make connections between what they are learning in school and their everyday life is to be able to apply their knowledge outside of school. Taking students on a nature walk will allow them to practice their new skill of classifying plants. The nature walk can be through the school courtyard, just around the school, or on a greenway/nature trail, depending on what is available around the school. Pages 9, 10 and 11 in their student plant journals are meant for students to record the plants they find outside the school. Students can draw a picture of the plant they found and write a short description of what it looks like, the parts it has, and anything they find interesting about the plant. From each student, collect one of their journal pages to display on a “plants around our school” wall. Try to chose different plants so that many different types of plants are represented on the wall. Allow students to view their peers work and give positive feedback. Tailor the discussions of these plants to focus on identifying the structures that were found on each plant (students can pick up on the patterns that each plant has similar structures).

Suggestions for “Plants Around Our School” Wall
For this bulletin board, try to combine the life cycle of plant visuals with structures of plants visuals, mixed in with the student work. This will be a good way to allow students to see the broad connections between all of the activities they have participated in.

Formative Assessment
My Plant Journal: Pages 12, 13 and 14

The formative assessment for this portion of the standard focuses on the student’s ability to identify the structures that define a plant, and the ability to separate a plant from other organisms or objects. The final page of the journal is a summary page where students can put all of the evidence they have learned in this learning performance into one location.

Teacher Evaluation
My Plant Journal: Page 12
For this page, students will identify the structures that classify a plant. They will be able to look at the picture in the journal and identify the parts of the plant by circling the correct answers.

- *Full Understanding:* Students who have a complete understanding about the parts of a plant will be able to correctly circle stem, leaves, and roots.
- *Partial Understanding:* Students who have a partial understanding of plants will be able to circle two items correctly and may circle an additional trait that is not relevant to plants.
- *Limited Understanding:* Students who have a limited understanding may only be able to correctly identify one characteristic that defines a plant or may not circle any of the choices correctly.

My Plant Journal: Page 13
Here, students will demonstrate an understanding of what a plant is. They will be able to distinguish a plant from other animals and other objects by correctly circling all of the plants on the page.

- *Full Understanding:* Students that have a complete understanding of what a plant is will be able to correctly identify the four plants on their journal page. They will also not circle any items that are not classified as a plant.
- *Partial Understanding:* Students that have a partial understanding will be able to correctly identify at least three of the plants on the page but may also circle an incorrect object.
- *Limited Understanding:* Students who have a limited understanding will circle only two or less objects that are plants and will likely circle two or more incorrect pictures.

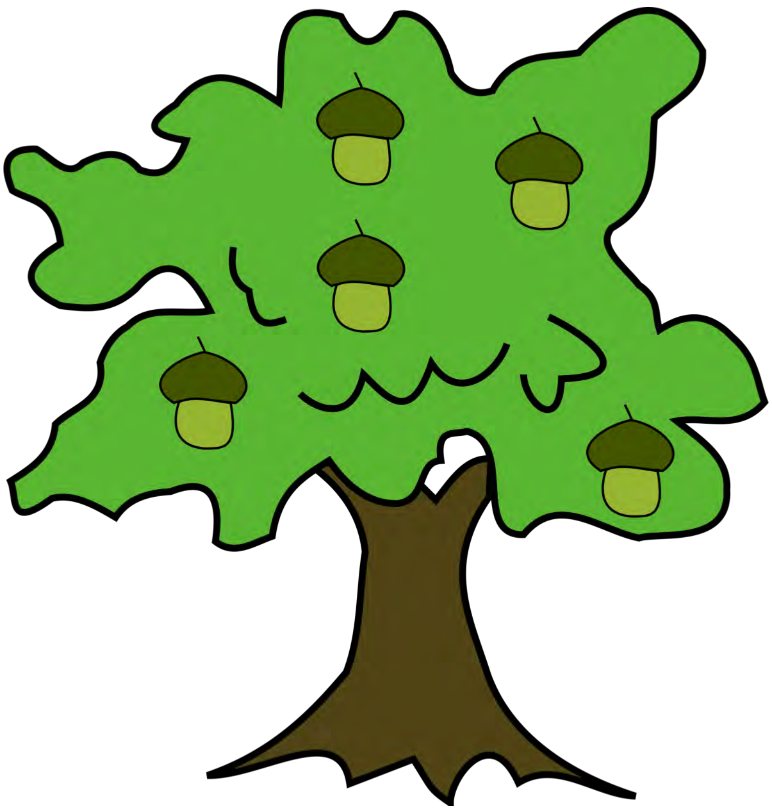
My Plant Journal: Page 14
On the final page of their journal, students will have the ability to practice their writing skills and give a general summary of the entire learning performance. This is an entry-level skill for practicing in engaging in argument. Students are essentially summarizing their evidence for classifying plants as plants, and not animals or nonliving things. In order to practice engaging in conversation, the teacher can have students pair share their responses for this page, so they may collaborate and practice verbally identifying their evidence for their ideas.

In each box, students should write something they learned about each of the main points about plants. In the first box, students should write about what a plant does; in the second box, students should write something about the life cycle of plants; and in the final box, students should summarize what structures all plants have.

- *Full Understanding*: Students who fully understood the entire learning performance will be able to include the following information in each box (not limited to these responses).
    - Box 1: Plants grow, plants make their own food
    - Box 2: Plants start as seeds and grow into plants
    - Box 31: Plants have stems, leaves, and roots

- *Partial Understanding*: Students who only partially understood this learning performance may be able to summarize only two of the three main ideas appropriately.
- *Limited Understanding:* Students who did not understand this learning performance may not be able to summarize any of the sections from this learning performance. If the student is unable to write, offer to allow them to draw a picture for each box instead. If students still cannot complete this part of the learning performance, they may need additional assistance and practice before receiving a grade.

MY PLANT JOURNAL



Name: ____________________________

A plant is . . .

From the Book

The Life Cycle of Plants

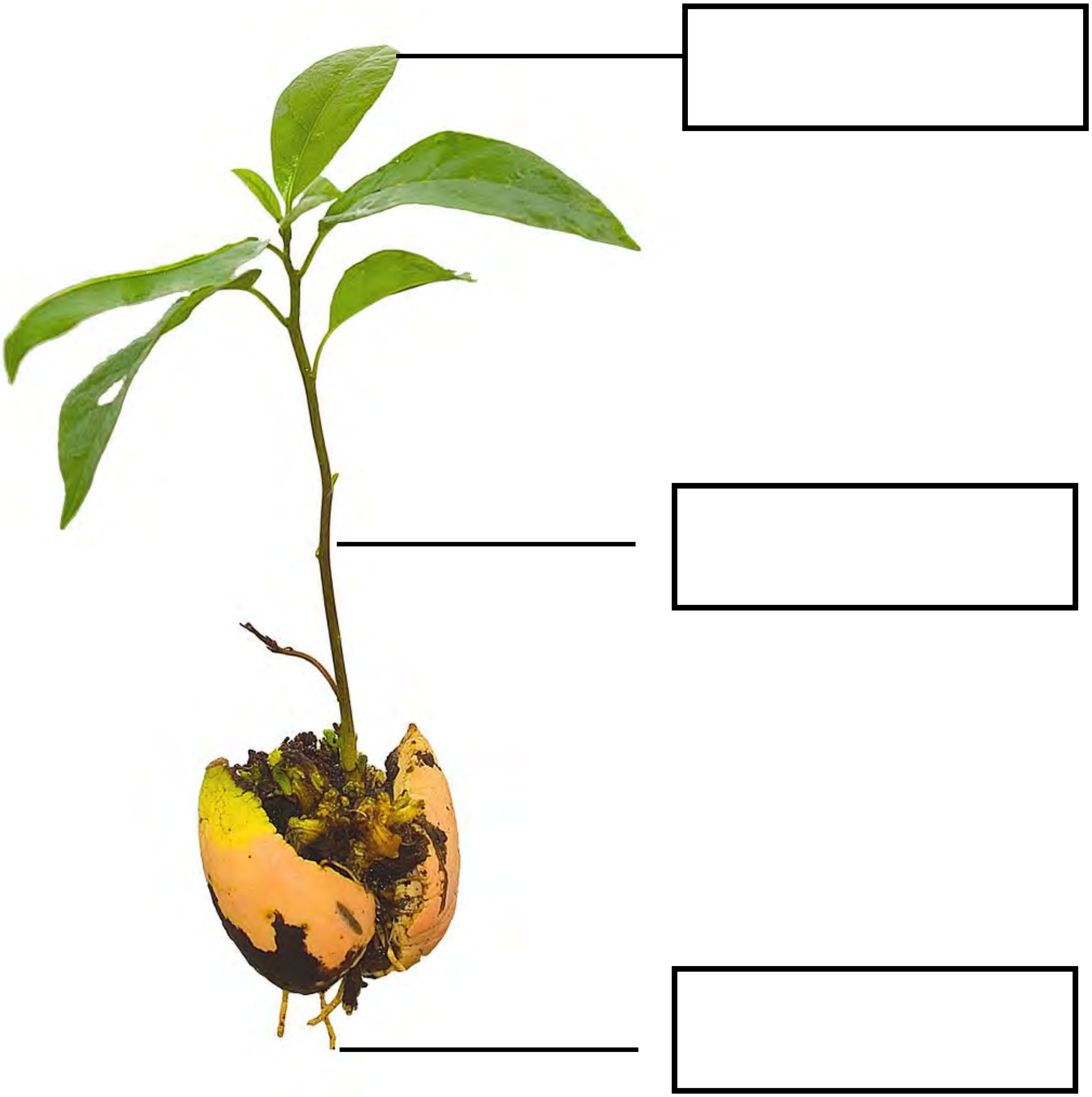
My Seed Observations

DAY 1	
DAY 2	
DAY 3	
DAY 4	
DAY 5	

My Seed Observations

DAY 6	
DAY 7	
DAY 8	
DAY 9	
DAY 10	

Parts of a Plant



Part	Purpose

Nature Walk

The plants I saw...

Nature Walk

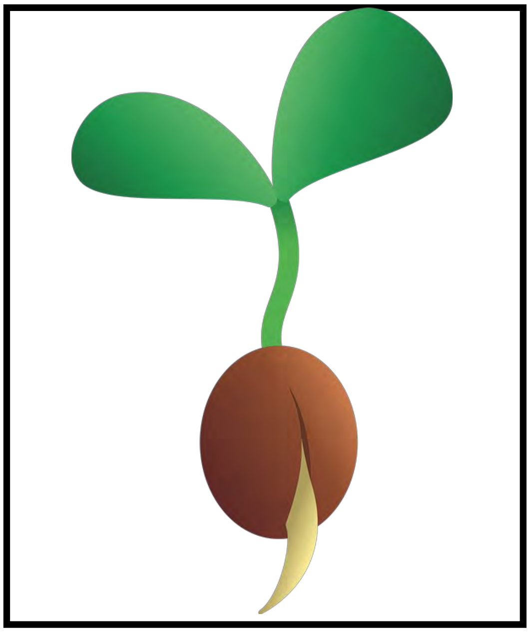
The plants I saw...

Nature Walk

The plants I saw...

What I Learned

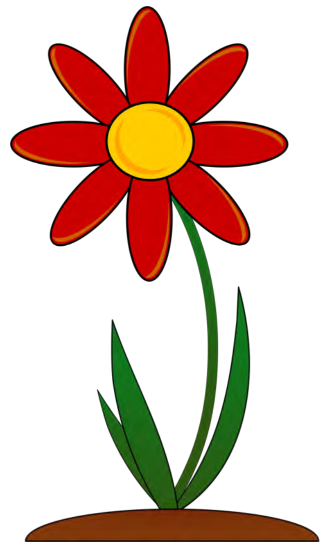
This is a plant because it has ...

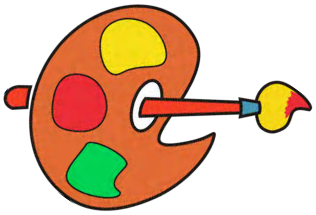


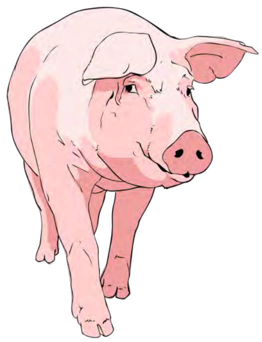
A Stem	Feet
Hands	Leaves
Roots	Eyes

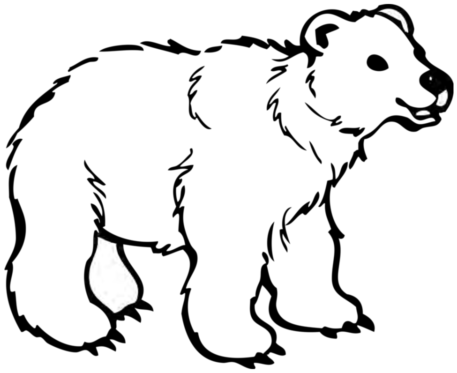
What I Learned

Circle the plants!





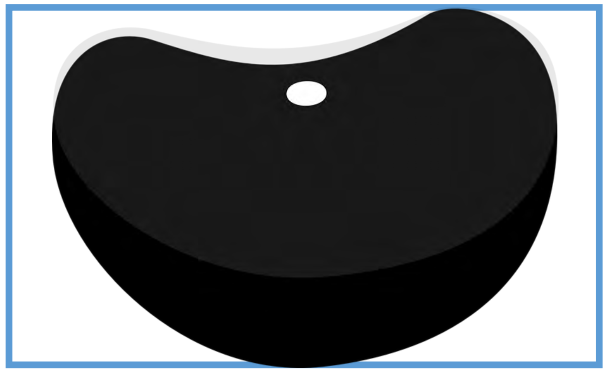




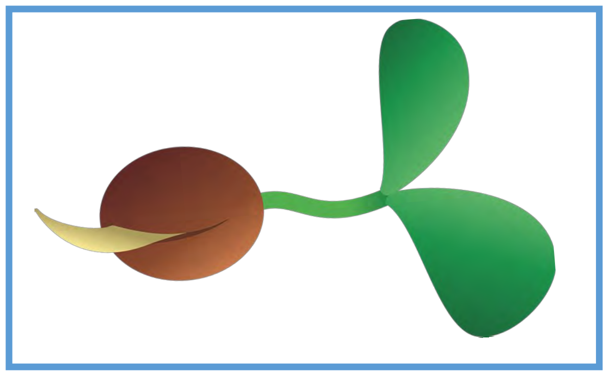
My Summary

For teacher use—cut-out portio for life cycle of plants journal page

SEED



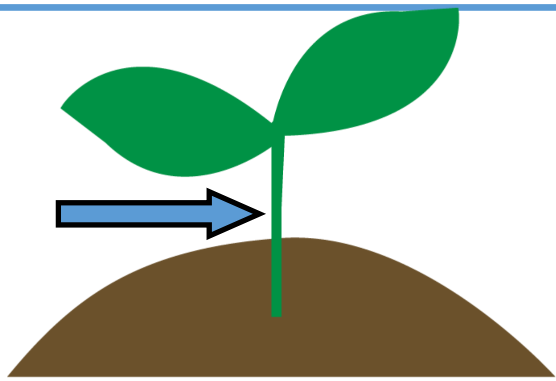
SPROUT



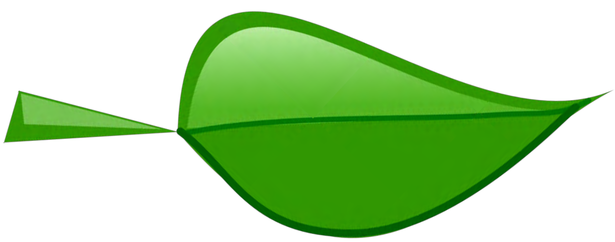
SEEDLING

PLANT

Parts and purposes of a plant cutout page



STEM

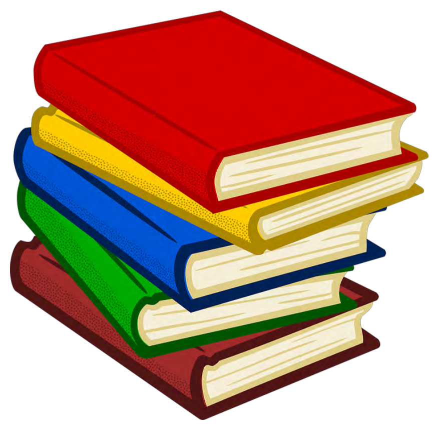


LEAVES

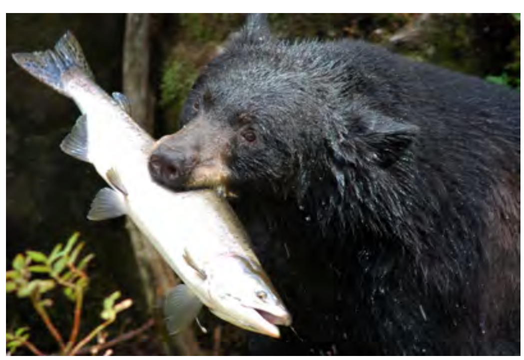
ROOTS






GETBK.ORG



Tab page front

Label: Analyzing and Interpreting Data

TN Department of Education

Analyzing and Interpreting Data

Tennessee Academic Standards for Science

Teacher Guide for Kindergarten

Standard
K.LS1.2 Recognize differences between living organisms and nonliving materials and sort them into groups by observable characteristics.

Tennessee Academic Standards for Science: Page 19

Three-dimensional Learning Performance for Lesson
Students will analyze and interpret data[*] in order to show that living and nonliving things can be classified into different groups[**] highlighting that living and nonliving things have patterns of observable characteristics. [***]

Science and Engineering Practice for Lesson
Analyze and interpret data[*]
The goal of this three-dimensional learning performance is for students to understand the difference between living organisms and nonliving objects. Students will be able to classify various things into one of these two categories by recognizing simple patterns of physical characteristics. At this grade level, data is mainly going to be pictures or representations of examples, and analyzing and interpreting data will be primarily accomplished through sorting and grouping activities.

Disciplinary Core Idea for Lesson
Life Science 1: From Molecules to Organisms: Structures and Processes[**]
"All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place and seek, find and take in food, water and air. Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive, grow, and produce more plants."

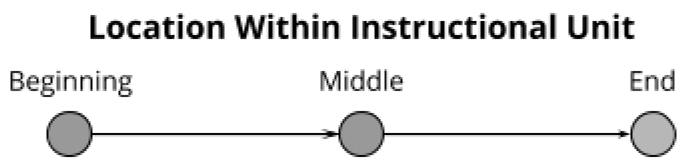
A Framework for K–12 Science Education: Page 144

Understanding that something is living or nonliving is the foundational precursor for the information that will be presented in first grade (plants) and second grade (animals).

Crosscutting Concept for Lesson
Patterns[***]
By practicing classification through sorting, students will begin to identify the basic patterns that are exhibited between living organisms and be able to identify different patterns in nonliving objects. Understanding that all living things share certain characteristics

establishes a foundation of identification and classification that students will use throughout the remainder of their science education.

Prior Knowledge



- Concepts that should be covered before this lesson:
    - Differences between plants and animals (K.LS1.1)
- This lesson covers all portions of standard K.LS1.2
    - Focuses on classifying living and nonliving things by sorting

Materials

- Chart paper
- Markers
- Crayons
- Glue
- Scissors
- *Do You Know Which Ones Will Grow?* by Susan A. Shea
    - If the book is not available, use this YouTube read-aloud link
- Computer/laptop with projector and internet access
- *Group Sorting Activity Pictures* (PDF included)
- *Formative Assessment Sorting Cards* (PDF included)
- Additional suggested books available for student access (optional):
    - *I Am a Living Thing* by Bobbie Kalman
    - *What's Alive?* by Kathleen Weidner Zoehfield
    - *Living or Non-Living?* by Kelli Hicks

Lesson Sequence and Instructional Notes

Student Introduction

Start this lesson by introducing students to the concepts of living vs. nonliving. First, ask students if they are alive. When they reply, "yes," ask students to volunteer some other ideas of things they think are living. Then, ask students to try to name a few things that are not alive. After a few students have volunteered answers, begin asking students what makes something alive. If students are struggling to give answers, help them by asking the following guiding questions: "What is something that all living things have?" "How can you tell if something is alive or nonliving?" (There is a potential for students to confuse dead with nonliving – explain to students that in order for something to die, it had to be living at some point). Put chart paper up on the board. Write the following question: “How do we know it is alive?” As students make suggestions on how to determine if something is alive, write it up on the chart paper on the left hand side (a completed example of the chart paper is shown toward the bottom of this section).

Potential Student Responses:
- It has eyes
- It moves
- It eats
- It has ears
- It talks
- It has hands
- It has a heart
- It can breathe

There may be others that your class will come up with. Use your best judgement to determine whether or not it should be written on the chart paper.

Once a list has been generated and students feel that everything that should be up on the chart is there, begin dwindling the characteristics down. Ultimately, this list is going to be what defines a living thing, so the most important five traits of a living thing should be represented. A living thing:
1. Grows,
2. Moves by itself,*
3. Needs food,**
4. Breathes (exchanges gases with the surrounding environment), and
5. Reproduces

*Students will struggle understanding that plants move, especially on their own. This is a grade-level appropriate version of the actual statement, which is “responds to environmental stimuli.” In the activity below, when students approach the tree and asks if it moves, explain to students how trees can bend towards the light, they can adjust their root systems, etc.
*Food is used as a grade-appropriate descriptor for acquiring energy.

To dwindle the list, start with something that is definitely living, that students will not argue against, like a kitten. Write “kitten” in the first column. Have students discuss each characteristic to determine if it meets the criteria of living. Place a checkmark in the box if it does, place an “X” in the box if it doesn’t. If it does not have that trait, you can also cross out that suggestion. Then, name another organism, like a butterfly. Repeat the process that was done with the kitten. Finally, name a difficult organism that some students may not know is a living thing, like a tree (this is where the teacher will have to explain some instances—trees “breathe” by absorbing gases, they move slowly toward light, they reproduce through seeds, etc). Continue to cross suggestions off the list until you are left with the core five characteristics of living things that were listed above. Explain to students that these traits are ones that are shared with all living things and ones that are not shown by nonliving things. To prove this, show them a nonliving object, such as a tissue box. Go through the list and ask students if any of the remaining five traits can be applied to the tissue box. Correct any misconceptions if they arise.

Note: Once a suggestion receives an "X," you can cross it out so it is not a part of the discussion anymore. The below chart is just a suggested scenario, but notice it lacks all five characteristics. It is important to make sure all five characteristics are on the original chart before the teacher begins to eliminate traits.

Sample Chart from Student Suggestions

HOW DO WE KNOW IT'S ALIVE?

Trait	Kitten	Butterfly	Tree
It can talk	✗	✗	✗
It has ears	✓	✗	✗
It can eat	✓	✓	✓
It has eyes	✓	✓	✗
It can move	✓	✗	✓

Reading Time

During this activity, the teacher will read a book out loud to the class titled *Do You Know Which Ones Will Grow?* by Susan A. Shea. The book highlights one of the characteristics of living things, that they must grow and development over the organism's lifetime. The teacher can decide the best method of reading this book out to the students based on their already established routine for activities similar to this. It is recommended that as the teacher is reading the book, students are following along with the cut and paste activity. The book asks about a variety of living or nonliving objects and if they can grow. The student handout has a T-chart with a simple YES side and a NO side. The objects in the book are included in the cut-out page. Students can answer each question posed in the book by pasting the animals and objects into the appropriate columns, answering the question of does it grow. A YouTube link where this book is being read aloud has been included in the materials section of this guide in the event that the book can not be obtained.

Once the book has been read and students have had time to place the objects in the appropriate corner or column, go over each one. Refer back to the original characteristics chart if there is any discrepancy between student answers and correct answers. Always challenge student thinking by asking questions to elicit correct responses: “Does it need food?” “Does it move on its own?”

Skills Practice

During this portion of the learning performance, students will begin to recognize the pattern (crosscutting concept) that is present when identifying an object as living or nonliving. Be sure to leave the chart from the first portion of this lesson up on the board or in a visible location so students can continue to look back at the five main characteristics that define a living organism. For this portion of the lesson, students will practice determining whether or not something is alive. They can work in a small group so they can practice discussing their ideas and sources of evidence. It is recommended that the teacher prints the supplied pictures out in color and laminates them for continued use. These pictures are just suggestions and can be supplemented with additional examples, depending on classroom size.

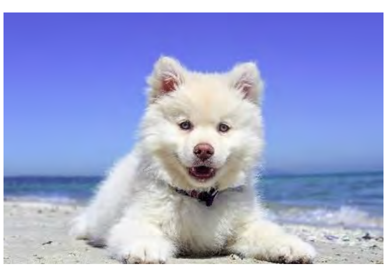
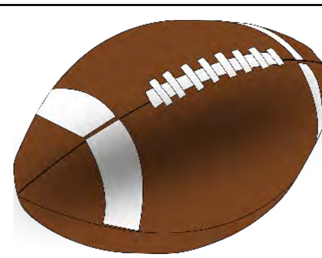
Split students up into groups of two or three. The teacher will then hand each group one or two cards (depending on classroom size), preferably one picture of a living thing and one picture of a nonliving object (for students that may be able to work at a higher level, hand out two pictures at random so that they may receive two living things or two nonliving things). Students will then have to classify these pictures using the observational patterns that they have been exposed to in the prior activities. On the whiteboard or on chart paper, make a T-Chart. Label one side “Living” and the other side “Nonliving.” Once students have classified the pictures, allow them to come up to the chart and place their pictures in the proper column. Do not correct students who are placing cards in the wrong location. Once all students have placed their cards, then have a classroom discussion focusing on the evidence for their placement. For example, if a student properly classified the rock as nonliving, ask that group why they placed it there and what their evidence was. If a group misplaced a card, ask another group if they agree, why or why not, and what evidence do they see that could help change the classification. For example, if a group placed a rock in the living category, ask the class if it follows the five characteristics: "Does it move on its own?" "Does it grow?" Then, the group can come back up and fix the location of the picture to the proper column.

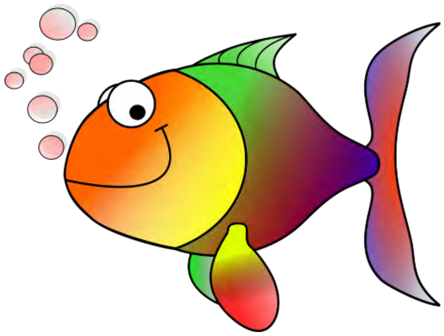
Formative Assessment Scenario #1 – Classifying pictures

Task: Present students with recorded observations of the natural world, then ask them to describe a pattern or relationship that they can infer from the observations. (STEM teaching tool #30)

The task presented above is for the practice of analyzing and interpreting data. Since kindergarten students may not be able to read and write, working and sorting pictures is a prime way to assess student comprehension of this standard. Have students work alone so that the teacher can see which students understand this content and which students may need additional guided practice and help. The sheet that students will be placing the cards on is included in the student handout. It is recommended to give each child their own set of cards and for the cards to be printed in color and laminated.

Correct Student Responses

Living Things	Nonliving Objects
	
	

Formative Assessment Scenario #2 – Drawing

For the final assessment of student understanding, ask students to draw a new example of a living thing—something that the class has not yet talked about. Have them draw and color their living thing on the student assessment handout. Once they are done coloring, ask each student to look at the bulleted list below the picture. The teacher should help the student read each bullet (each bullet is a characteristic of living organisms). If the picture meets that bullet, then let the students put a check mark next to it. Do this for all five bullet points. Make sure each picture meets all five requirements and has all five check marks. Once the students are done, display their artwork in the classroom or hallway.

Teacher Evaluation Notes

Drawing Assessment:

- *Full Understanding:* A student with a full understanding of patterns of characteristics of living and nonliving things will be able to draw a living organism that was not previously discussed, like a bird, bush, shark, or hamster. They will also be able to answer verbally whether or not their organism meets each check mark.
- *Partial Understanding:* Students with a partial understanding may be able to appropriately draw a living organism, but they may not be able to verbally answer the check mark questions with confidence.

- *Limited Understanding:* Students with a limited understanding may draw a nonliving object instead of a living organism, and they will not be able to verbally answer the check mark questions.

Citations and Resources

Additional books for this topic:
I Am a Living Thing by Bobbie Kalman.
Living or Non-Living? (My Science Library) by Kelli Hicks
What's Alive? by Kathleen Weidner Zoehfield
What Do Living Things Need? (Science Readers: Content and Literacy) by Elizabeth Austen

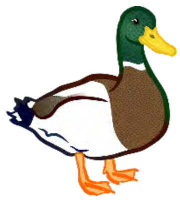
Does it grow?

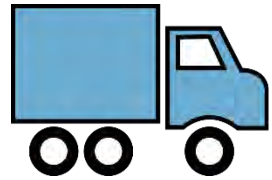
To be done during the book reading

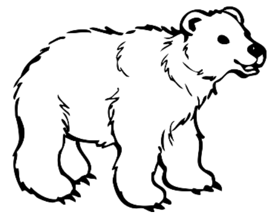
Directions: Paste the objects from the book into one of the columns. If you think it grows, place it in the “Yes” side. If you don’t think it grows, but it on the “No” side.

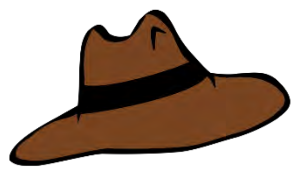
YES	NO

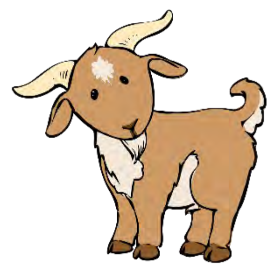
Does it grow? – Cut-out page

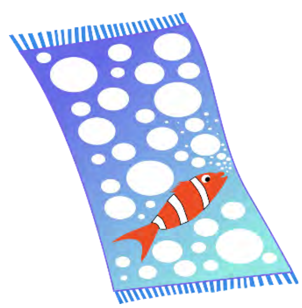


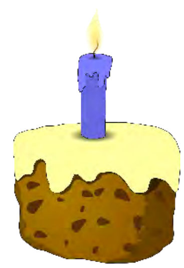


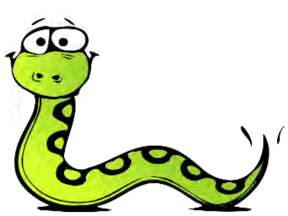


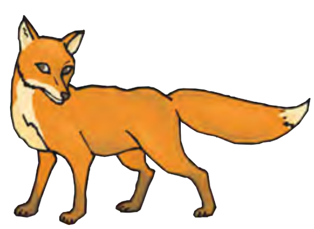












Sorting pictures

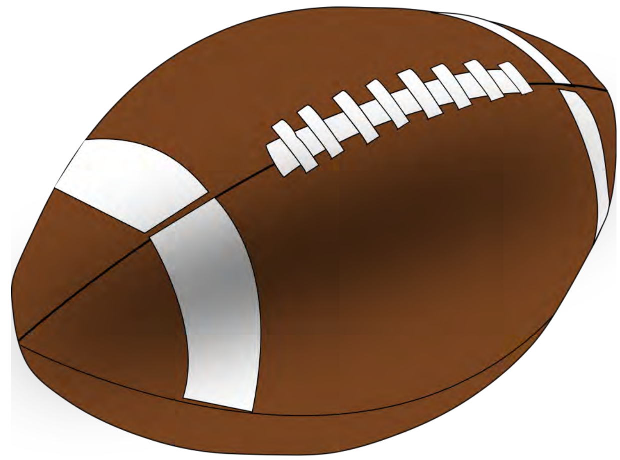
LIVING THINGS	NONLIVING OBJECTS

Drawing task

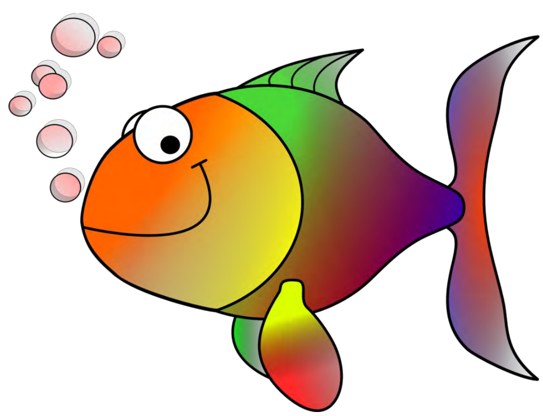
Does your drawing:

- Grow?
- Move?
- Eat?
- Reproduce?
- Breathe?



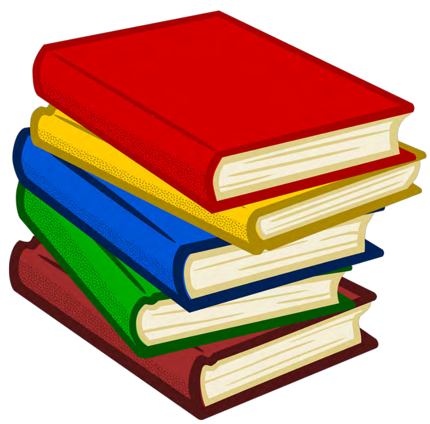












Pink Pearl
MALAYSIA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MILK
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Tab page front

Label: Obtaining, Evaluating, and Communicating Information

TN Department of Education

Obtaining, Evaluating, and Communicating Information

Tennessee Academic Standards for Science

Teacher Guide for Kindergarten

Standard
K.LS1.3 Explain how humans use their five senses in making scientific findings.

Tennessee Academic Standards for Science: Page 19

Three-dimensional Learning Performance for Lesson
Students will combine information from across texts and from a hands-on experience[*] in order to show that humans can use their five senses to make scientific findings[**] highlighting the structure and function of human sensory organs.[***]

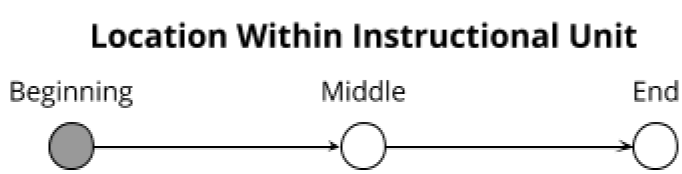
Science and Engineering Practice for Lesson
Obtaining, Evaluating, and Communicating Information[*]
Students receive direct instructional content from a read-aloud regarding the five senses as well as from a related video. Students then make sense of the information by applying their senses to make their own scientific findings in an exploration activity. Students ultimately communicate their findings and how they used their senses to make observations by sketching their experience and labeling which sense they used.

Disciplinary Core Idea for Lesson
Life Science 1: From Molecules to Organisms: Structures and Processes[**]
"Animals have body parts that capture and convey different kinds of information needed for growth and survival—for example, eyes for light, ears for sounds, and skin for temperature or touch."

A Framework for K–12 Science Education: Page 149

Crosscutting Concept for Lesson
Structure and Function[***]
Students investigate the world around them by using their senses, which are possible as a result of specific parts of the body.

Prior Knowledge



- Concepts taught prior to this lesson:
    - None; this lesson begins the unit of study.

- This lesson covers the following portions of the standard:
    - Using four of the five senses to observe the world around them (the sense of taste is not explored during the lesson)
    - Describing how they used their senses to make an observation (e.g., "I smelled a flower with my nose")

Materials

- Clipboards
- Pencils
- *5 Senses Observation Record Sheet*
- *5 Senses Labels Sheet*
- *5 Senses Matching Formative Assessment Sheet*
- Grade-appropriate read-aloud text about the five senses
    - Ex: *The 5 Senses* by Nuria Roca
- Link to YouTube video "The Five Senses | The Dr. Binocs Show"

Lesson Sequence and Instructional Notes

Obtaining Information

The teacher begins the lesson by having students use their senses to identify some different objects and their features. For example, a teacher could bring in a flower from the playground as one of their objects and ask students questions about it such as, "What color is it?" "Is it hard or soft?" "How does it smell?" "What does it look like?" "What does it sound like?" As students respond with their observations, the teacher records their responses on the board. These responses can be referred back to later in this lesson once students receive instructional content about the five senses from the read-aloud and/or video.

The teacher continues by asking students, "What are some ways that you might notice something?" The teacher can add, "For example, how might you notice that an apple is round? Or shiny? Or that it makes a crunch when you first bite into it? How do you notice that some apples are sweet, and some are tart?" The teacher encourages students to generate additional ideas for how they might notice something. The idea is to help students generate thinking around two concepts:

1. That there are a lot of things that we can notice!
2. Noticing things involves more than just seeing them (e.g., we can notice we are near the ocean by the smell of the salt air, the sound of crashing waves, and the feeling of sand if we are on a beach).

After this initial brief discussion, the teacher informs students that they will learn more about all the different ways they can notice something. They will start with a read-aloud book, *The 5 Senses*, and then watch a video called “The Five Senses” on YouTube. After the video, students will have a chance to go on an exploration search to notice something using one of their senses.*

**Note: Use of taste is generally discouraged for kindergarten students to use for science activities, as the risk of germs, allergies, or potentially toxic material is significant.*

The teacher then guides students through the read-aloud, *The 5 Senses.* While reading the book, the teacher stops each time a new sense is referenced and asks the class “How could I be a scientist and use this sense to notice something?” After students offer a few appropriate responses, the teacher continues reading the story. Once the story is finished, the teacher briefly reviews the five senses with students.

Students are then shown a five-minute instructional video “The Five Senses” (link provided under the “Materials” section and here). After watching the video, the teacher asks students if they can recite the five senses and what they are used for (e.g., “We use our eyes to see, ears to hear,” etc.). The teacher at this time explains that the act of noticing something is called “observing something” or “making an observation,” and that we as scientists make observations all the time about the world around us.

The teacher then tells students that they will have the chance to explore something and make observations using one of their senses (excluding taste). The teacher displays the *5 Senses Observation Record Sheet* and the *5 Senses Label Sheet* and models for students how to use one of the senses to make an observation about something. To do this, the teacher chooses an object and has students help them describe it using their senses. “What does it look like? What does it sound like? What does it feel like? What does it smell like?” are all questions that can be asked. Once students help describe the object, the teacher sketches it quickly on their *Record Sheet* and glues a label to show which sense(s) they used to help make their observation. Once the teacher models and students understand what to do, the students get a clipboard and pencil so they can move about and record their observations.

The teacher can choose to do the student observation activity either in the classroom, on the playground, or at another school setting such as the cafeteria. Moving to a different location often helps students identify “new” or different smells in addition to the other senses.

Evaluating Information

Once students have a clipboard, pencil, and their Senses Observation Record Sheet then they are ready to begin exploring their setting and recording their observations. A suggestion is to have several printed copies of the *5 Senses Labels Sheets* so that the students can take a copy and cut-out and glue the labels of the senses they used. During this activity time, the teacher is moving around to monitor students and assist as needed.

This activity can last as little or as long as students are engaged, but a suggested timeframe is to allow between 5-10 minutes.

Communicating Information

Students sketch the object that they observe using their pencils and clipboards, and they glue a “senses label” to identify which sense or senses they were using to make their observation.

Once the activity is complete, the students gather back on the carpet along with their clipboards and share what sense they used and what they observed. After they share, they can turn in their record sheets to the teacher who can check them for accuracy and later arrange for them to be sent home with the student.

As a final formative assessment for this lesson, students complete a *5 Senses Matching Sheet* to demonstrate their understanding of structure and function as it relates to the senses. The teacher can use this assessment sheet to take note of which students are correctly identifying the five senses. Due to the nature of a matching format, it is entirely possible that students have a correct idea of the senses but are showing them being used a different way on the matching sheet (e.g., “Touch” matched with “Roses” because the student has experienced how a rose petal feels soft). For this reason, consider briefly conferencing with students who matched different senses to objects to ascertain why they marked those senses.

Name______________________________

Draw a picture of something that you observed with your senses:

I observed ______________________________

Glue the sense you used to observe your object:

I used my sense to:

Name: ______________________________

Match each picture with the best sense:
Use each sense only one time!

 Taste

Teddy Bear 

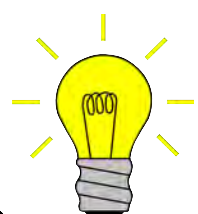
 Hear

Cake 

 See

Roses 

 Smell

Lightbulb 

 Touch

Tweeting bird 

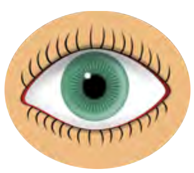

See


Hear


Taste


Smell


Touch


See


Hear


Taste


Smell


Touch

Tab page front

Label: Asking Questions and Defining Problems

Asking Questions and Defining Problems

Tennessee Academic Standards for Science

Teacher Guide for Kindergarten

Standard
K.LS3.1 Make observations to describe that young plants and animals resemble their parents.

Tennessee Academic Standards for Science: Page 19

Three-dimensional Learning Performance for Lesson
Students will ask descriptive questions after observing photographs of young organisms and their parents* in order to show that young plants and animals resemble their parents** highlighting the patterns of features used to determine if creatures are related based on similarities and differences.***

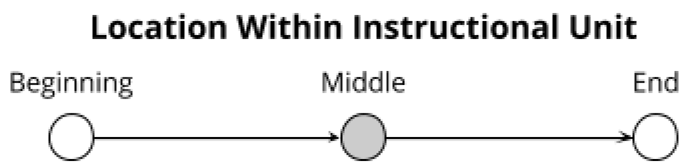
Science and Engineering Practice for Lesson
*Asking Questions**
Students will be shown images of young animals and plants and then images of parent animals and plants, with the purpose of asking and refining scientific questions about the images. Initially, students will most likely ask broad questions, such as “Why do some animals look different as babies?” The teacher will then guide students to make more careful observations and notice particular features that could be evidence of a relationship between a young animal and their parent. The goal is to have students generate a more scientific line of questioning. For example, one student may be guided to ask, “Why does a baby chick have yellow feathers, but a grown-up chicken has brown/black/white feathers?” While another student may ask, “Why are their feathers different colors but their mouths/beaks look similar?” By refining their questions to focus more on similar and different features, students make more refined observations about which features provide evidence that young plants and animals resemble their parents.

Disciplinary Core Idea for Lesson
Life Science 3: Heredity **
“Organisms have characteristics that can be similar or different. Young animals are very much, but not exactly, like their parents and also resemble other animals of the same kind. Plants also are very much, but not exactly, like their parents and resemble other plants of the same kind.”

A Framework for K–12 Science Education: Page 158

Crosscutting Concept for Lesson
*Patterns****
Students observe that plants and animals of a certain species display a pattern of similar features or characteristics. These patterns are typically even more similar when observing organisms that are part of the same family.

Prior Knowledge



- Concepts taught prior to this lesson:
    - We use our senses to notice things, such as features on a plant or animal
    - Young animals often resemble their parents
        - We determine this by looking for how similar their features are to each other

Materials
- *Tree Detective Sheet*
- *Animal Matching Cards*
- "Animal Parents and Kids" YouTube slideshow
- Image of Mature Pine Tree
- Image of Pine Tree Sapling
- Image of Detective (Cartoon)
- Image of Kid Detective
- Optional "Detective" Lens (hand lens) for students

Lesson Sequence Outline

1. Review that young animals often resemble their parents
2. Complete matching animal activity
3. Guide students to ask a similar question about plants (e.g., "Do young plants resemble their plant parents?" or "Do all living things resemble their parents?")
4. Discuss how a detective is a special kind of policeman that investigates things to get all the possible clues, which they then use to solve a case or answer a question
5. Set up students for activity by having them get their 'detective lens' out so they can think like a detective
6. Have students engage with the *Tree Detective Sheet* and collect for formative assessment

Instructional Notes

The teacher begins the lesson by reviewing from a previous lesson with students that young animals often resemble their parents. To do this, the teacher (re)plays the YouTube slideshow "Animal Parents and Kids," and pauses the video at each slide so that they can call on students to identify similar features that provide evidence that these animals are related. For example, students may say "The parent porcupine and baby porcupine both have spiky backs!" or "The puppy has the same color brown fur as its parent." A focus for this part of the lesson is to have students generate evidence that describes how the animals are similar, rather than just declaring "They look the same!"

Once the slideshow is over, the teacher will have students demonstrate their understanding of animals and their parents by having them match the parent animal with its kid using the *Animal Matching Cards*. The cards should be copied, cut out ahead of time, and laminated if possible. Students can work in pairs to match their cards. Whenever a student matches animals together, they should describe evidence for why they think those animals are related. For example, the student may say, "I think the cat and the kitten are related because they have the same grey colored fur." Again, the focus for this activity is to have students work on identifying specific features that are similar between animals.

After students have completed the *Animal Matching Cards* activity, the teacher gathers students back together and tells them a story. In the story, the teacher was out walking in nature when they noticed a big pine tree. The teacher displays the Image of Mature Pine Tree to students so that they can understand what the tree looks like. Then, the teacher continues saying that during that same walk, they noticed another tree that looks similar in some ways, but different in other ways. The teacher displays the Image of Pine Tree Sapling to students and asks students if they notice what is similar about these two pictures. As students offer suggestions, such as, "They both have pine needles!" the teacher pretends to do some deep thinking before saying to students, "You guys are noticing some really interesting similarities between these two trees. Hearing all your thoughts is causing me to have some questions about these trees now. Does anyone else have a question or is maybe wondering something about these two trees?" From here, the teacher guides students to ask questions about the trees with the goal of having students wonder if the trees could possibly be related.*

**Note: The goal of having students ask questions about the trees is to hopefully have a student ask if the two trees are possibly related, like the animals in the matching game and on the slideshow. Students may require some scaffolding to arrive at this question, so the teacher can guide the class to ask these sorts of questions by suggesting things like "I notice several of you are asking questions about how one tree is little and one tree is really big. When we looked at animals and their parents on the slideshow earlier, was one of them always big and one of them always little? (Yes!) What could this mean about the big tree and the little tree then? Are you saying that they could be related?"*

Once students are primed to examine if the trees are possibly related to each other, the teacher tells students, “Trees can be harder to figure out than animals. This is because trees in some ways are very different than animals, but if we go searching for clues very carefully, we might find some evidence that helps us find out the real answer.” The teacher then displays the Image of Detective (Cartoon) and asks students if they know what a detective does. If they do not know, the teacher explains that a detective is someone who looks very carefully for clues to help them solve something. The teacher explains that a detective is usually shown with a hand-lens because they use tools to help them look for clues. The teacher emphasizes that most importantly, though, a detective uses those clues to ask “Detective Questions.” These are questions related to the mystery that the detective is trying to solve. The teacher can give an example of this to students, such as “For example, when I was walking on the nature trail the other day and saw those two trees I thought to myself ‘I noticed those two trees look like a parent tree and a baby tree because they have the same type of needle-leaves, but one was really big and the other one was really small. I wonder if these trees are related like the animals we saw earlier?’”
The teacher can model this further by working with the class to point out any other similarities that they notice that might be evidence that two trees are related. Some similarities include: The leaves appear the same, they both have leaves growing from a branch, they both are growing up out of the ground, they both have green leaves and a brown trunk, etc. This may need to go on for a few minutes to give students a chance to notice and describe similarities between the two trees.

When students are ready to move on, the teacher informs them that for this next activity, the students will need to become detectives to solve the mystery of whether the following trees could be related. In order to do this, they must look for evidence (similar features) in the pictures on the activity sheet they will receive. This means they will need to use their “Detective Hand-lens” to make careful observations of some images of trees and determine how the trees are similar. The teacher can display the Image of Kid Detective to help solidify this point. In order to work as “tree detectives,” the students will each receive a copy of the *Tree Detective Sheet* as well as an optional hand-lens. Students will need to use the sheet to do the following:

1. Page 1
    - A. Look closely at two images of trees to notice how they are similar and how they are different
        - i. Students can use their ‘detective hand-lens’ to help them focus on the images and hone in on specific features of the trees
    - B. Describe one or two ways that the trees are similar
    - C. Describe one or two ways that the trees are different
2. Page 2
    - A. Use the images of two “mystery” plants to notice how they are similar and how they are different
    - B.Formulate their own “detective question” about the two plants
        - i. Examples:

1. Are the plants related?
2. Will the smaller/"baby" plant grow up to be like the bigger/"parent" plant?
3. Will the "arms"/branches on the smaller plant grow?
4. Do the plants have the same parts?

As students are working, the teacher is monitoring students and assisting as needed. Once finished, the teacher can collect the sheets to look over student responses as a formative assessment of student understanding.

Student Responses and Formative Assessment

Young Birch/Mature Birch observations:

- Similarities include: trunks are both white-ish, both types of trees grow out of the ground, both trees have leaves, etc.

- Differences include: Young birch trunks are more skinny than mature birch trunks, mature birch has more leaves than young birch, mature birch trunks form a 'Y' shape and young birch trunks go up in a straight line, etc.

Mystery Desert Plants
The images are of a young Saguaro cactus and a mature Saguaro cactus.
Students should notice how similar the two plants appear in the pictures. The branches on the young Saguaro will develop over time to look more like the mature Saguaro.
As students are deciding on a 'detective' question related to these plants, they should choose the question that asks if the plants come from the same family based on their similarities.

Citations and Resources

Image of Pine Tree:
https://www.flickr.com/photos/forestfortrees/4359236961

Image of Pine Tree Sapling:
https://www.flickr.com/photos/96713863@N00/1290126678/

Image of Detective (Cartoon):
https://pixabay.com/en/inspector-man-detective-male-160143/

Image of Kid Detective:
https://pixabay.com/en/detective-magnifying-glass-viewing-788592/

Animal Matching Cards
Image of Goat:
https://pixabay.com/en/goat-billy-goat-cute-goat-2644998/

Image of Kid:
https://commons.wikimedia.org/wiki/File:Hausziege_04.jpg

Image of Deer:
https://pixnio.com/fauna-animals/deers/deer-female-in-wild

Image of Fawn:
https://www.flickr.com/photos/slopjop/828388505

Image of Kangaroo:
https://en.wikipedia.org/wiki/File:Kangaroo-in-flight_cropped.jpg

Image of Joey:
https://commons.wikimedia.org/wiki/File:Macropus_rufogriseus_rufogriseus_Joey_1.jpg

Image of Cat:
https://pxhere.com/en/photo/986828

Image of Kitten:
https://pixabay.com/en/cat-tomcat-kitty-kitten-2866167/

Image of Duck:
https://commons.wikimedia.org/wiki/File:White_domesticated_duck,_stretching.jpg

Image of Duckling:
https://pxhere.com/en/photo/994760

Image of Dog:
https://pixabay.com/en/dog-labrador-light-brown-pet-1210559/

Image of Puppy:
https://commons.wikimedia.org/wiki/File:Too-cute-doggone-it-video-playlist.jpg

Tree Detective Sheet
Image of Mature Birch Tree retrieved from:
https://pixabay.com/en/nature-outdoors-woods-birch-tree-3070475/

Image of Young Birch Tree retrieved from:

https://commons.wikimedia.org/wiki/File:Birch_forest_with_birds_nest_Gullmarsskogen.jpg

Image of Walnut Tree retrieved from:
https://www.flickr.com/photos/brighton/4621671958

Image of Young Saguaro Cactus retrieved from:
https://www.nps.gov/tont/learn/nature/saguaro.htm

Image of Mature Saguaro Cactus retrieved from:
https://www.nps.gov/orpi/learn/nature/saguaro-cactus.htm

Name ________________________

Tree Detectives

Young Birch Tree and Mature Birch Tree

Young Birch Mature Birch

Compare the pictures of the two types of trees above. What is the same between them? What is different?

One or two things that are the same	One or two things that are different

Name: ____

Mystery Desert Plants

Take a look at the plants in the two pictures above.

As a "Tree Detective," you look carefully at the plants to see what is the same and what is different. What is a "detective" question that you could ask to find out more about these plants?
(Circle One)

- These plants look almost the same. Could they be from the same family?

- The desert is very hot. Is the desert my favorite place to visit?

goat

kid

deer

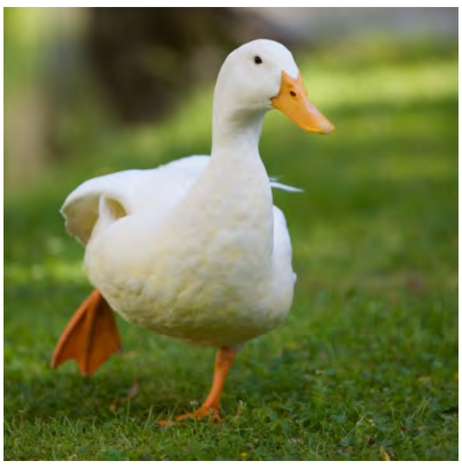
fawn

kangaroo

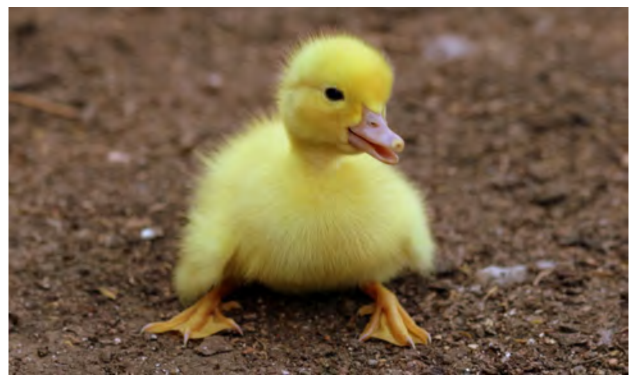
joey

cat

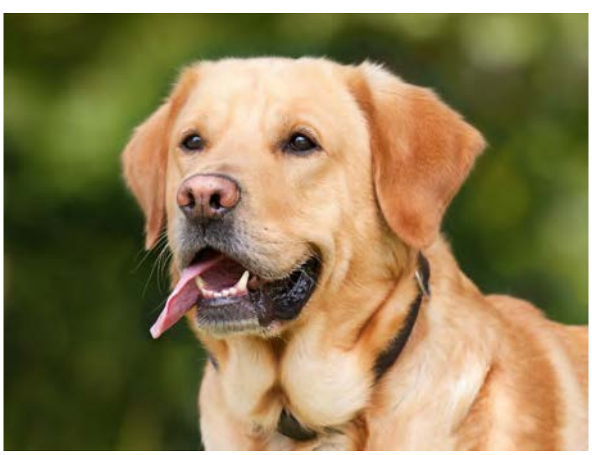
kitten



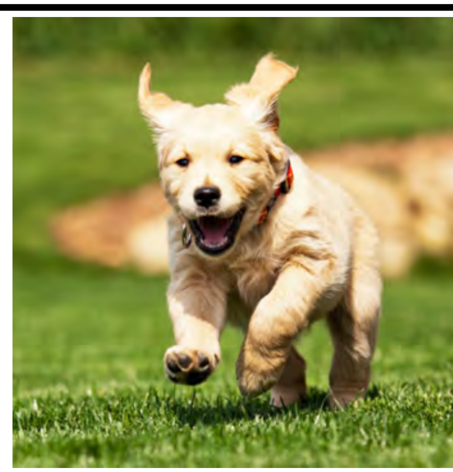
duck



duckling



dog



puppy

Tab page front

Label: Planning and Carrying Out Investigations

Planning and Carrying Out Investigations

Tennessee Academic Standards for Science

Teacher Guide for Kindergarten

Standard
K.PS1.1 Plan and conduct an investigation to describe and classify different kinds of materials including wood, plastic, metal, cloth, and paper by their observable properties (color, texture, hardness, and flexibility) and whether they are natural or human-made.

Tennessee Academic Standards for Science: Page 19

Three-dimensional Learning Performance for Lesson
Students will investigate different kinds of objects and materials* in order to show that materials can be sorted and classified by their observable properties** highlighting the patterns that exist between materials and their properties.***

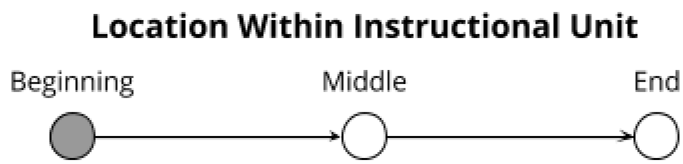
Science and Engineering Practice for Lesson
*Plan and Carry Out Investigations**
Students investigate materials by using a variety of senses (excluding taste). They use the information gathered by their senses to classify/sort the materials according to different parameters that they and/or the teacher establish.

Disciplinary Core Idea for Lesson
*Physical Science 1: Matter and Its Interactions***
"Matter can be described and classified by its observable properties (e.g., visual, aural, textural), by its uses, and by whether it occurs naturally or is manufactured."

A Framework for K–12 Science Education: Page 108

Crosscutting Concept for Lesson
*Structure and Function****
Students recognize, classify, and record objects and/or materials according to their physical properties. The driving question for this investigation is "Why do people use different materials to make things?"

Prior Knowledge



- This lesson covers portions of standard K.PS1.1:
  - Objects have basic properties that can be identified
  - These properties include color, firmness (hard/soft), and texture (rough/smooth)
  - Objects are considered similar or different from each other based on whether they share similar properties, and by observing this, we can establish patterns between objects

- Components of standard K.PS1.1 that require further development:
  - Objects are either human-made or found naturally, and usually this can be determined by examining an object's properties

Materials
- Objects and Materials (YouTube Video)
- *Object Record Sheet* (Print in color if possible so students can identify color words more easily)
- *Driving Question Assessment Sheet*
- *Material Cards* (Teacher Version/Large Version and Student Version/Small Version)
- *Group Object Sorting T-Chart*
- Construction paper
- Chart paper, or overhead projector (for teacher use w/*Object Record Sheet*)
- 5 sets of the following objects for "hands-on" examples and small group activity:*
  - At least one soft object (e.g., gloves, socks, stuffed animals, blankets, plastic baggies, paperback books)
  - At least one hard object (e.g., pencils, crayons, markers, firm plastic such as a milk jug, hardback books)
  - At least one smooth object (e.g., some book covers, non-crinkled sheet of aluminum foil, some toys, markers, surface of desks or tiled floor, leather goods, wax paper)
  - At least one rough object (e.g., sandpaper/grains of sand or salt, crinkled sheet of aluminum foil, bricks, certain types of rocks, certain bark that covers twigs or sticks, blacktop pavement, carpeted floor)

Note: Teachers are encouraged to use everyday items found in the classroom or on the school grounds to build the five sets of objects for this learning objective.* ***It is strongly encouraged to include at least one object made from the following materials: wood, plastic, leather,*

metal, and glass (classroom windows can be used for glass). These materials will be used specifically with the whole-group activity.

Lesson Sequence and Instructional Notes

Teacher-led discussion and investigation set-up
The teacher begins the lesson by asking students if they have ever noticed how certain objects always seem to be made from the same kinds of materials. Some examples could include how windows seem to always be made from glass, forks and knives in the cafeteria are always made from plastic, and nails always seem to be made from metal. The teacher asks students for any additional examples that they can think of that involve objects made from a certain kind of material. While students are responding, the teacher can write some responses on the board or on chart paper to record student thinking. After a couple minutes of this, the teacher should ask students the driving question: "Why do people use different materials to make things?" This question should also be written on the board as it will drive the investigation for this lesson.

After writing this question, the teacher will structure the format of the investigation for students which is as follows:*

1. Watch a brief video to provide some more information about this driving question
2. Participate in a whole-group, teacher-led session to identify and sort materials according to one or more properties
3. Participate in a small-group activity to sort objects that they receive according to one or more properties
4. Participate in an individual activity to identify the properties of one object

**Note: This investigation may need to be split up over one or more class sessions depending on time and pacing. If it does, it may help to just focus on the steps of the investigation that will be covered in that particular session rather than list all four steps.*

Once students understand the structure of the activity, remind them that the goal of our investigation is to try and answer the driving question, "*Why do people use different materials to make different objects?*" Tell students that to better help us start our investigation, we will watch a brief video clip to help us learn a little more about properties and materials.

Video Clip (Video link found under "Materials" or by clicking here)

The video identifies all five senses that can be used to observe properties. Emphasize to students that they will use their senses of touch, smell, sight, and hearing to observe properties for this investigation. Set the expectation that no items should ever be put in students' mouths during this investigation.

The video will ask a couple of basic questions throughout its roughly two-minute runtime. Either be prepared to pause the video and allow students a chance to respond to the questions in the moment, or let students know that questions will be discussed after the video and to just pay attention to the information while it is running.

After the video clip finishes, discuss the questions asked in the video with students. "What are some initial thoughts for why objects are made from certain materials?" "How would it be different if toy cars were made out of paper or cardboard?"

After the class discussion, let students know that we will all do an activity as a whole group to investigate the properties of materials. Afterward, students will do a follow-up investigation in small groups.

Whole-Group Activity (*Material Cards* document found under 'Materials' or by clicking here)

- Print one set of the large version of the materials pictures
  - Cut out each picture and each property name
- Print out one set of the small version of the materials pictures per student
  - Cut out each picture
- Print out 10 sets of the property tiles for each student (page 6 of *Material Cards* document)
  - Cut out and group the properties for students so that each student has a pile of "Smooth" tiles, a pile of "Rough" tiles, etc.
- Give each student five pieces of construction paper

Once the pictures and category headings have been cut out, inform students that together as a class we are going to look at each picture of a material and figure out which categories best describe that material. For example, glass is shiny, hard, rigid, and smooth. Consequently, it is NOT dull, soft, flexible, or rough. We can prove this by looking at the classroom window and gently feeling a window pane.

To get started, the teacher reviews the following properties with students: *dull, shiny, hard, soft, rough, smooth, rigid, and flexible.* In order to review the properties, the teacher can gather a variety of objects from around the room that demonstrate the property in question. For example, the teacher can locate a shiny book cover and a dull book cover to demonstrate for students the difference between *shiny* and *dull*. The teacher will do this for *shiny/dull*, *hard/soft*, *rough/smooth*, and *rigid/flexible*. Some suggested objects to demonstrate properties are as follows:

- *Shiny/Dull:* New vs. old book covers, new vs. old coins, new metallic or plastic vs. old metallic or plastic
- *Hard/Soft:* A blanket or stuffed animal vs. building blocks or student desks
- *Smooth/Rough*: Tiled floor vs. carpeted floor, ping-pong ball vs. new basketball with textured bumps

- *Rigid/Flexible:* A plastic straw vs. a wooden toothpick

The teacher displays a large picture of one of the materials and places the picture prominently on the board or overhead projector. The students mimic the teacher by gluing their version of the picture on their piece of construction paper. If possible, the teacher then provides a hands-on example of the material so students can feel the material for themselves (e.g., if looking at leather, the teacher brings a leather belt or leather bag so students can feel that leather is soft, smooth, and flexible). The teacher and students then discuss the material and which properties best describe that material. The teacher then places the appropriate property tiles beside the picture on the board (e.g., "Leather: soft, smooth, shiny, flexible"). After the teacher does this, students mimic the teacher by taking their versions of those same property tiles and gluing them on their construction paper beside their picture.

The teacher will see that misconceptions are addressed during this whole-group activity by pointing out any evidence from the pictures or hands-on samples that counters a misconception.

It would be beneficial to have a sample object on-hand made from each of the materials from the activity. For example, students can feel the head of a metal nail or screw that is safely embedded in their classroom chairs or desks. By having a real-life object made from each of these materials, students have the opportunity to engage their sense of touch as well as their sense of sight in determining a material's properties.

Small-Group Investigation

- Give each small group one "set of objects" from the "Materials" list
- Print off *Group Object Sorting T-Charts* for small groups
- Print off a set of property tiles for each group (page 6 of the *Material Cards* document)
- Students observe and feel the objects to determine which properties describe those objects
- Using their T-Chart, students glue two property tiles at the top and then sort their objects by placing them under the property tile that best describes them

Students will want to investigate these objects at their own pace, so during this part of the investigation, let students work in small groups to deepen their understanding of the properties of materials. The teacher arranges for each small group to receive a set of objects, a T-Chart template to help them sort their objects, and another set of property tiles that they used from the whole-group activity.

Students will take turns observing and feeling the objects in their sets to determine which properties best describe each object. The teacher will help student groups pick two opposing property tiles (e.g., “hard” and “soft,” or “rough” and “smooth”). Student groups will then take opposing property tiles (e.g., “hard” and “soft”) and glue those on their T-Chart. Finally, they will sort their objects by physically placing each object on the side of the T-Chart that matches with the property that best describes it.

Individual Investigation and *Record Sheet*

- Individual Object Record Sheet
- 1 object from their "“set of objects”
- Driving Question Assessment Sheet

As an individual activity, students take one object from their set of objects and use the Record Sheet to describe some of its properties as well as draw a sketch of that object (since they do not get to keep the object).*

**Note: The final component of the Record Sheet asks students to consider if they think their material is human-made or made naturally. This component functions as a type of pre-assessment so that teachers can plan how much students will need support in understanding this part of the standard for future lessons in this unit.*

If time permits, it is also advisable to allow students to begin to look for properties of the objects or groupings for the objects that were not predetermined, which allows them to take ownership of their investigation and build their observational skills and awareness of patterns. By this time, students will be very familiar with their tiles, so allow them to describe some additional property of the materials (e.g., *pointy*, *round*) and create an additional T-Chart based on that property.

Expected student responses from *Object Record Sheet*

Responses should demonstrate that the student correctly identifies whether their object is *hard/soft* and *smooth/rough*. They also identify the main color of their object, and they make a prediction if they think the object is human-made or made from nature.

The final question on the first page is asking students to think about an object that is similar to the object they chose. By correctly identifying an object that is similar to their own, students demonstrate an understanding of patterns of physical properties.

Expected student responses from *Driving Question Assessment Sheet*

Students should identify that plastic ware is made from plastic because plastic is *hard*. If plastic were soft, then it would lose its shape easily and would be unable to function as a tool to carry food or liquid to our mouths.

Students should identify that pretty jewelry is made with gemstones because gemstones are *shiny*. By reflecting light, gemstones appear more enticing to our eyes. If the gemstones were dull, they would not catch our eye like they do if they are shiny.

Citations and Resources

Image of plasticware retrieved from:
https://commons.wikimedia.org/wiki/File:Plasticware_-_isolated.png

Image of gemstones retrieved from:
https://www.flickr.com/photos/butterflypsyche/2862908345

Name ___________________________________

Why do people use different materials to make things?

#1:

Plastic forks/knives/spoons are made from plastic.

Because plastic is:
(Circle one)

<u>Hard</u> or <u>Soft</u>

#2:

Pretty Jewelry is made from gemstones.

Because gemstones are:
(Circle one)

<u>Shiny</u> or <u>Dull</u>

Name: ______________________________

My Object’s Properties:
(CIRCLE the most accurate words)

My object is:	Its color is:		I think it is:
• HARD	RED	SILVER	
• SOFT	ORANGE	BLACK	• Made by HUMANS
----------	YELLOW		
And			
----------	GREEN		
• ROUGH	BLUE		• Made by NATURE
• SMOOTH	PURPLE		
	BROWN		

What is another object that is like your object?

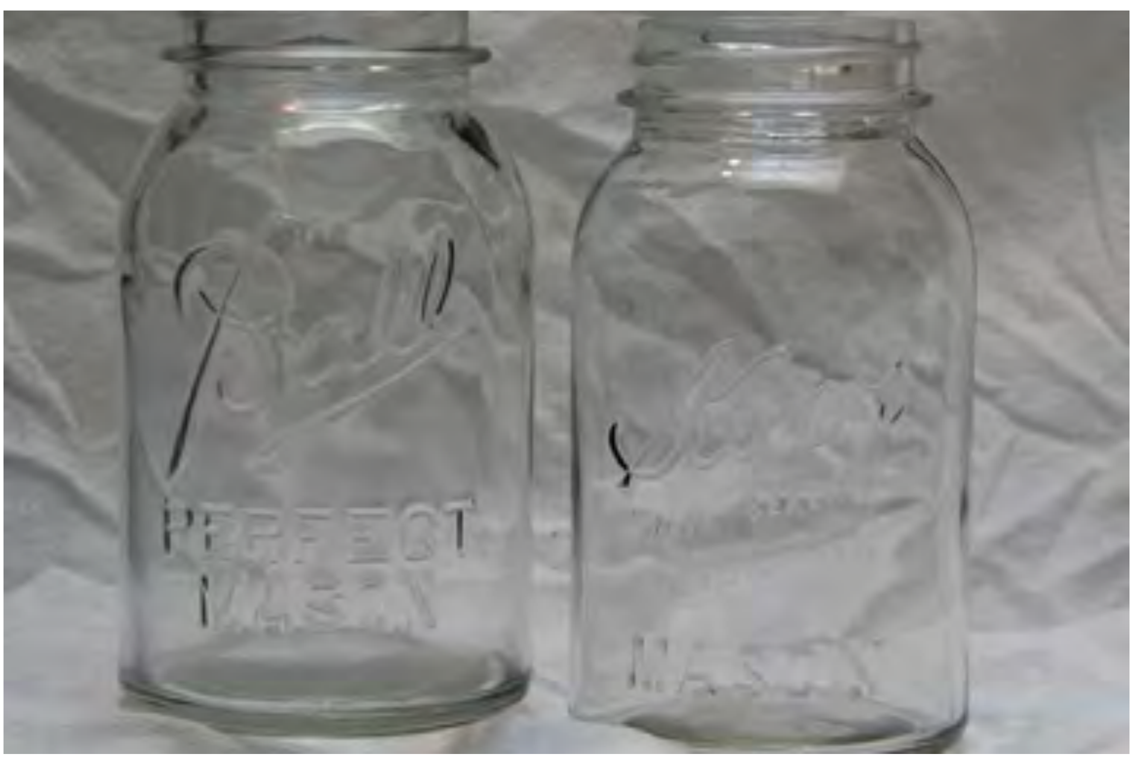
Drawing My Object:

My object is a ________________________.

Name ______________________________

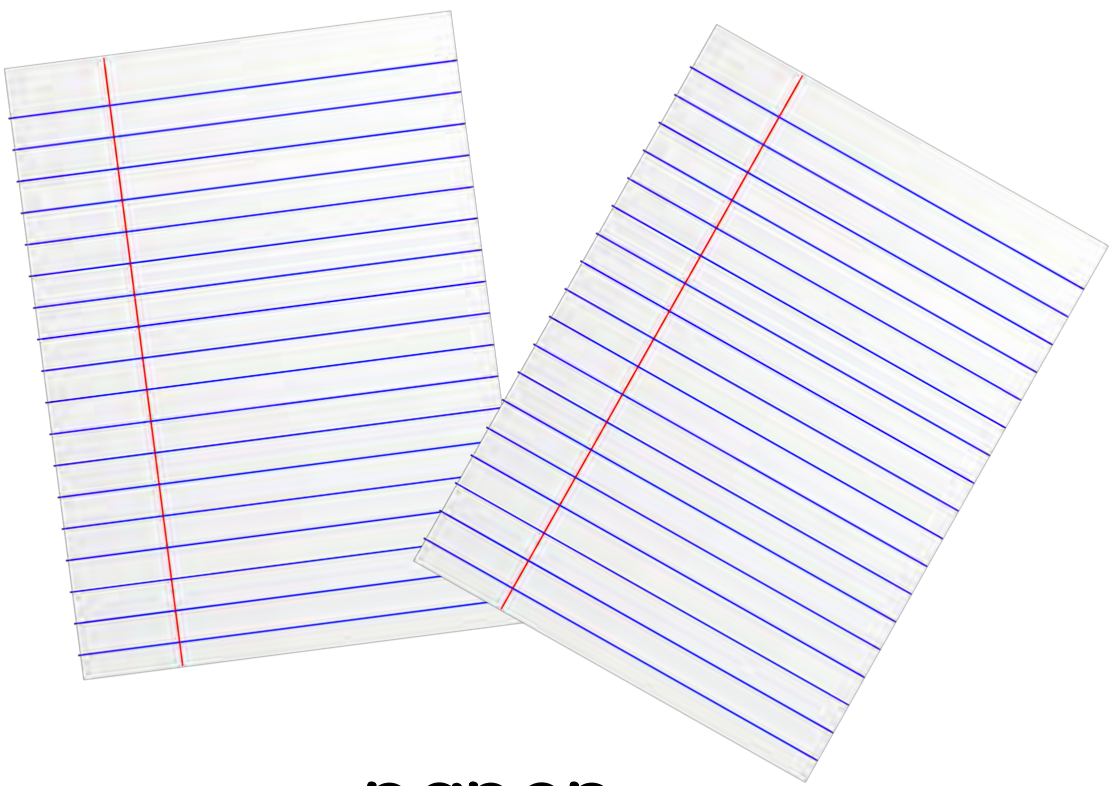
Category 1: ____________	Category 2: ____________

leather

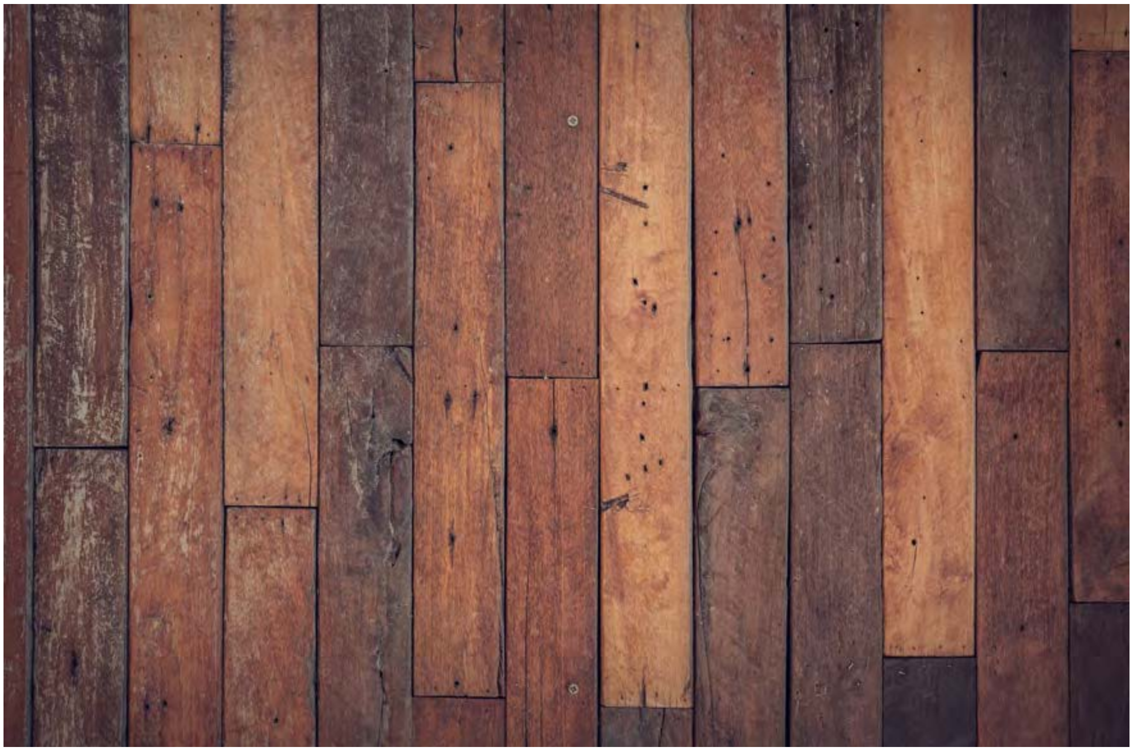


glass

sand



paper

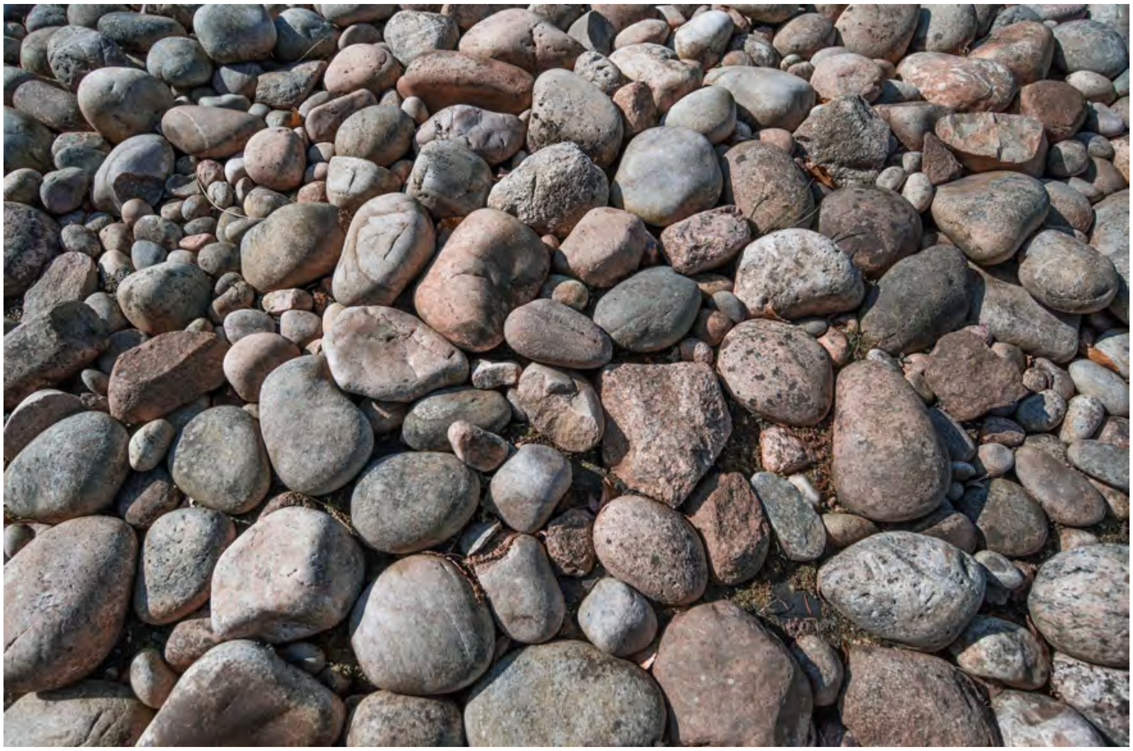


wood

plastic

aluminum

fabric

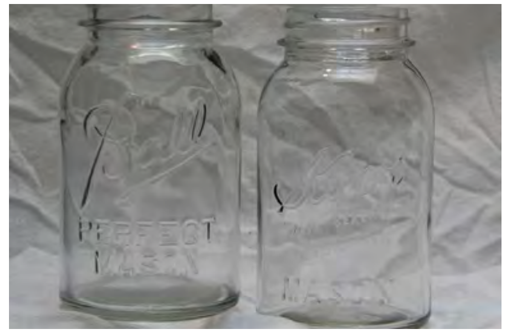


rock

metal

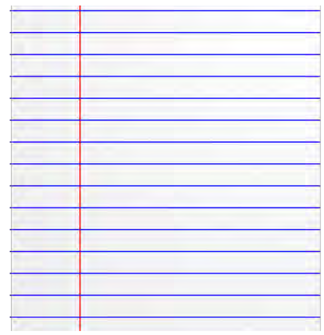
hard	dull
soft	shiny
rough	rigid
smooth	flexible

leather

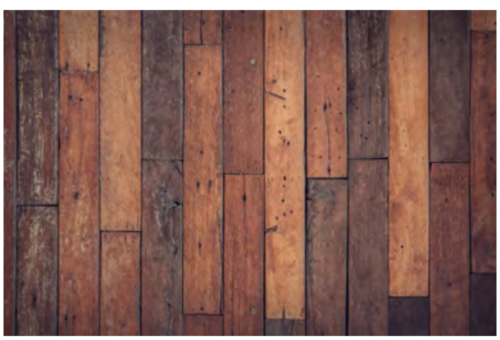


glass

sand



paper



wood

plastic

aluminum

fabric

rock

metal

Tab page front

Label: Constructing Explanations and Designing Solutions

TN Department of Education

Constructing Explanations and Designing Solutions

Tennessee Academic Standards for Science

Teacher Guide for Kindergarten

Standard
K.PS1.3 Construct an evidence-based account of how an object made of a small set of pieces (e.g., blocks, snap cubes) can be disassembled and made into a new object.

Tennessee Academic Standards for Science: Page 19

Three-dimensional Learning Performance for Lesson
Students will construct an evidence-based account[*] in order to show that multiple objects can be constructed from a certain number of blocks[**] highlighting that the concept of energy and matter are conserved even though multiple things can be constructed from a finite number of sources. [***]

Science and Engineering Practice for Lesson
Constructing Explanations[*]
The goal of this three-dimensional learning performance is for students to develop an explanation through authentic experiences. Students at this level will be able to construct an explanation based on something that they did or experienced. The final explanation may be verbal or demonstrated by pictures. Engaging students with already well-understood concepts in science is a foundation for them to begin to be able to explain and describe scientific phenomena based on their own experiences and accords. Incorporating relevant evidence is instrumental for constructing an appropriate scientific explanation, and students at this grade level can gather evidence through hands-on learning activities.

Disciplinary Core Idea for Lesson
Physical Science 1.A: Structure and Properties of Matter[**]
"The substructure of atoms determines how they combine and rearrange to form all of the world's substances. Chemical reactions, which underlie so many observed phenomena in living and nonliving systems alike, conserve the number of atoms of each type but change their arrangement into molecules. A great variety of objects can be built up from a smell set of pieces."

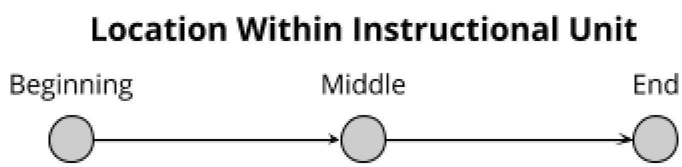
A Framework for K–12 Science Education: Pages 106-107

Crosscutting Concept for Lesson

Energy and Matter: Flows, Cycles, and Conservation[***]

Students will begin to experiment with the law of conservation of mass and energy, which states that neither can be created or destroyed, only transformed. Students at this grade level may not be learning the statement of the laws, but they are learning that multiple things can be made from a finite number of objects and that these things can be rearranged without adding or removing any blocks. This concept is the basis of the laws of conservation and will be the foundation for student understanding of energy and matter in later grade bands.

Prior Knowledge



- Concepts that should be covered before this lesson:
  - No other lessons needed prior to this learning performance
- This lesson covers all portions of standard K.ESS3.1

Materials

- Student “Shape Bags”–one for each student
  - Colored paper, shape cutter, Ziploc or paper bags
- *When I Build with Blocks* book by Niki Alling
- Building blocks
  - Jenga blocks, snap cubes, building bricks or any other type of appropriate building block
- Glue
- Chart paper
- Formative Assessment sheet – one for each student
- Crayons/Markers
- Tetris pieces
  - Either the wood tetris puzzle (Wood Innovations)
  - Or pre-cut, colored tetris pieces (*Tetris Pieces* PDF)

Lesson Sequence and Instructional Notes

Student Introduction to Content

Begin this learning performance with an introduction to focused block play by reading the book *When I Build with Blocks* by Niki Alling. This book highlights some of the ideas and structures that have been built by actual pre-K and kindergarten students. The book is a great way to start inspiring the class before they get to build with the classroom blocks. The teacher should read the book a couple of times to the class and start a discussion with the students to begin to get them thinking about the variety of things that can be built with the same number of blocks.

Potential Guiding Questions:
- What was your favorite part of the book? Why?
- What was your favorite thing that was built with blocks? Why
- Have you ever built any of the objects mentioned in the book? Did yours look exactly the same or did it look different?
- Have you ever wanted to build anything that was mentioned in the book?

Once students have had a chance to participate in the discussion, inform them that they are going to be experimenting with building things today.

Introduction to Concept

Preparation
Use a shape stamp/scissor to cut various shapes out of different colored paper. Take a handful and fill a paper bag or Ziploc bag; you will need one for each student. Reference the pictures below. It doesn't matter if each bag varies in the colors, shapes, or number of items.

Figure 1 - Example of various shapes and colors for student bags. Picture taken from "Thousands of Tiny Pieces Can Create Something Big" lesson by Jeri Faber from Betterlesson.com

In order to introduce students to the concept of using a certain number of things to build many different objects, start with a small, individualized activity. Hand each student a "shape bag" and ask them to take the contents of the bag out and place it on their desk. Instruct students that they will have four minutes to make their own design using *all* of the pieces in the bag. They can arrange them however they like, but they only have four minutes to complete the task. Keep a timer displayed on the board so students can practice monitoring their time. Have the entire class start at the same time. When the timer goes off, tell students to put their hands up in the air. Ask the class, “Do you think each of us made the same design?” Based on student responses, probe them by asking why they think we did or didn’t, and get their predictions on what they think some of their classmates may have made. Once the discussion is complete, invite students to walk around the room and count how many different designs there are. Instruct students to pay attention to each design and how it might be different from the one they made by what colors were placed where, what shapes are next to each other, and the overall shape of the design.

Continue to probe students by asking the following questions:

- Was any design exactly like another? Why or why not?
- What makes a design different from another?
- If we did this activity again, what do you think would happen? Why?

The discussion should lead students to the conclusion that most (if not all) of the designs were different because they were made by different people with slightly different materials (one bag may have had more triangles then squares, or more blue pieces then red). They should also be able to draw the conclusion that if this activity was repeated, everyone would again likely make a new design, even though they have the exact same materials (the teacher can repeat the activity to affirm this prediction, if time permits).

Now, allow students to paste their designs onto the *Shape Artist* page of their student handout. They should be able to paste all of the shapes exactly where they are. (Tell them not to move anything!) Students can then construct the bar graph that will represent the different number of shapes that each student used in their design (bar graph page is in the student guide handout). Have students count how many of each shape they used, and draw a bar for each one. They will have to label the axis for “number of shapes” based on the shape bags that were made. Students can compare each other’s graphs to determine similarities and differences in the number and type of shapes they each had. The teacher can display these designs and bar graphs in the room under a heading “Same Materials Different Designs” or something similar to help remind students of the results of this activity.

Transition students into the next activity by again emphasizing that even though you had the exact same materials, you can build many different designs with them.

Building Challenge

In this portion of the learning performance, students will be grouped together to try to build as many different structures as they can with the same number of blocks. Students should be placed into groups of two to four individuals. It is important to make sure that each group has the same type and number of blocks. If the blocks that are being supplied are larger, keep the number of blocks per group smaller, no more than 10 blocks per group. If the blocks are smaller, such as Legos, a larger number, such as 15 or 20 blocks, can be given to each group. Again, place the timer in the front of the room for all groups to see. Inform the students that they will have three minutes to build a structure: anything they can imagine (reference the book that was read earlier to help spark their imaginations).

Allow students to go through one round of the build. They can build the structure upwards, or outwards; it is their choice. Once the time has ended, ask students to draw* (to the best of their ability) the outline of their structure in their student handouts. Repeat this process between three and five times, with the students drawing their outlines after each event.

*This does not have to be identical to the actual structure—a rough outline will be sufficient. The point of them drawing each structure is the evidence that they will use to construct their explanation about how multiple things can be built from the same number of blocks.

Student Discussion
Ask students to come together in a central location in the room (have them leave their final built structure up so everyone can view them). Ask similar guiding questions that were used earlier, listed below:

- Did you and your group build the same thing each time?
- Look around the room. Did any groups build a structure similar to yours?
- What was it like to build a different structure each time? Did you want to keep building the same thing?
- Sources of inspiration: What were you thinking about when you were building your objects?
- Make a prediction: What would happen if we added more blocks each time you built?

Construct a Classroom Explanation
The teacher can model the process of constructing an explanation by using the results that were just discussed. On chart paper, model this process using the template below. Then, allow students to complete their own explanations.

Tell students that now we are going to write out what we did (if necessary, ask students again what they just accomplished). Have students help you formulate a statement that explains how the same number of blocks can be used to build so many different things (the final build should still be up and each students workspace, so they can look back at these for reference). The teacher can do this by writing their ideas on chart paper, one titled "Why" and one titled "How." Under the "Why," list the suggestions by the students as to why the same number of blocks can build multiple things; under the "How," listen for ways students actually built the different structures (they wanted to build something like a ship, or a space rocket, etc). The final explanation can vary somewhat based on the student input, but below is a general guideline for what the explanation should look like and include.

Constructed Explanation: Using __(x number of blocks,)__, we were able to build ________(x number of different objects)____ because _____(why explanations from students)___.

The "Why" should include something about different students having different ideas on what to build: everyone has different thoughts; everyone builds things differently; because the blocks are not permanent, they can move and be changed.

Formative Assessment

For the formative assessment, students will be using tetris pieces (either the wood puzzle version or printable versions with graph paper) to construct multiple solutions to a "problem." If using the cut-out tetris pieces, ensure that every child has the exact same set of pieces to work with. Students will initially start the assessment alone, working individually, but then will partner up with another student to construct their explanation and share their solution. The students will not be writing their explanations for this assessment, but will verbally state their explanation to their partners and the teacher using the a similar template from the previous activity.

Assessment Directions

Distribute the materials to the students (if using the wood puzzles, make sure each child has their own). Then, read the following story out loud to students: "Bryce was playing in his room and knocked over his favorite picture! Help Bryce put the pieces of his picture back together so he can hang his favorite picture back up on the wall!"

At this time, allow students to try to put all of the pieces back together again. Give students about five minutes to come up with their solution to Bryce's problem. Once every student has either put all of the blocks back on the wooden puzzle or glued their tetris pieces to graph paper, partner the students up. Have the students show off their work to their partner and analyze the similarities and differences between the solutions. Students should see that no two designs are the same, even though they all had the same materials. They will then use the following template (to be written on the board) to discuss their differences with their partner and the teacher. In the blank lines of the template, students should be focusing on identifying specific placements of shapes and comparing them. So, for example, a student might say, "I was able to build a design solution that looks like a rectangle, with my straight line pieces all at the bottom."

Constructed Explanation: Using tetris pieces, I was able to build a design solution that looks like __________. My partner designed something different because his/hers looks like __________.

Once students have made their own explanations, allow them to circle around the room to look at all of the designs made by students. Continue to encourage students to compare and contrast designs, using positive words and specific details about where shapes are placed from one design to the next. Then, wrap up the assessment by emphasizing how many different design solutions were constructed for the same problem.

Teacher Evaluation Notes

- *Full Understanding:* Students with a full understanding of this concept will be able to realize that each student made a different design using the same pieces. They will be able to accurately compare their work with their partners and identify which pieces are placed in different places. They will be able to communicate this information using the template provided to the teacher and their peers.
- *Partial Understanding*: Students with a partial understanding will either recognize that the designs are different, but then struggle to formulate it into a coherent explanation; or will be able to use the template but will not be able to identify specific differences between the designs.
- *Limited Understanding*: Student with a limited understanding may struggle to complete the activity. They may not be able to adequately place the Tetris pieces in a coherent manner, and will likely not be able to communicate their design. Students with a limited understanding may not recognize that each student has created a different design using the same pieces.

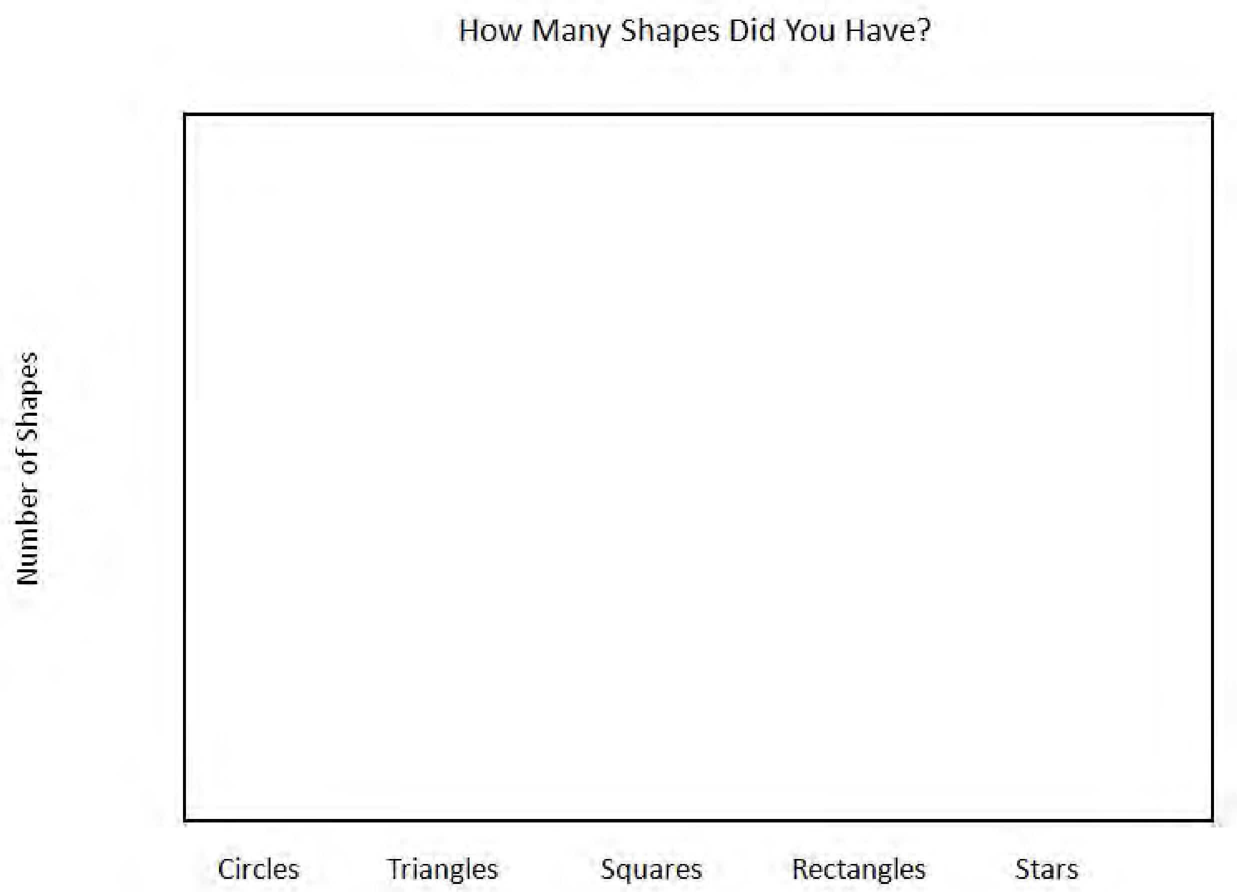
Citations and Resources

https://betterlesson.com/lesson/636230/thousands-of-tiny-pieces-can-create-something-big

Shape Artist!

Place your shapes in the box to make your design

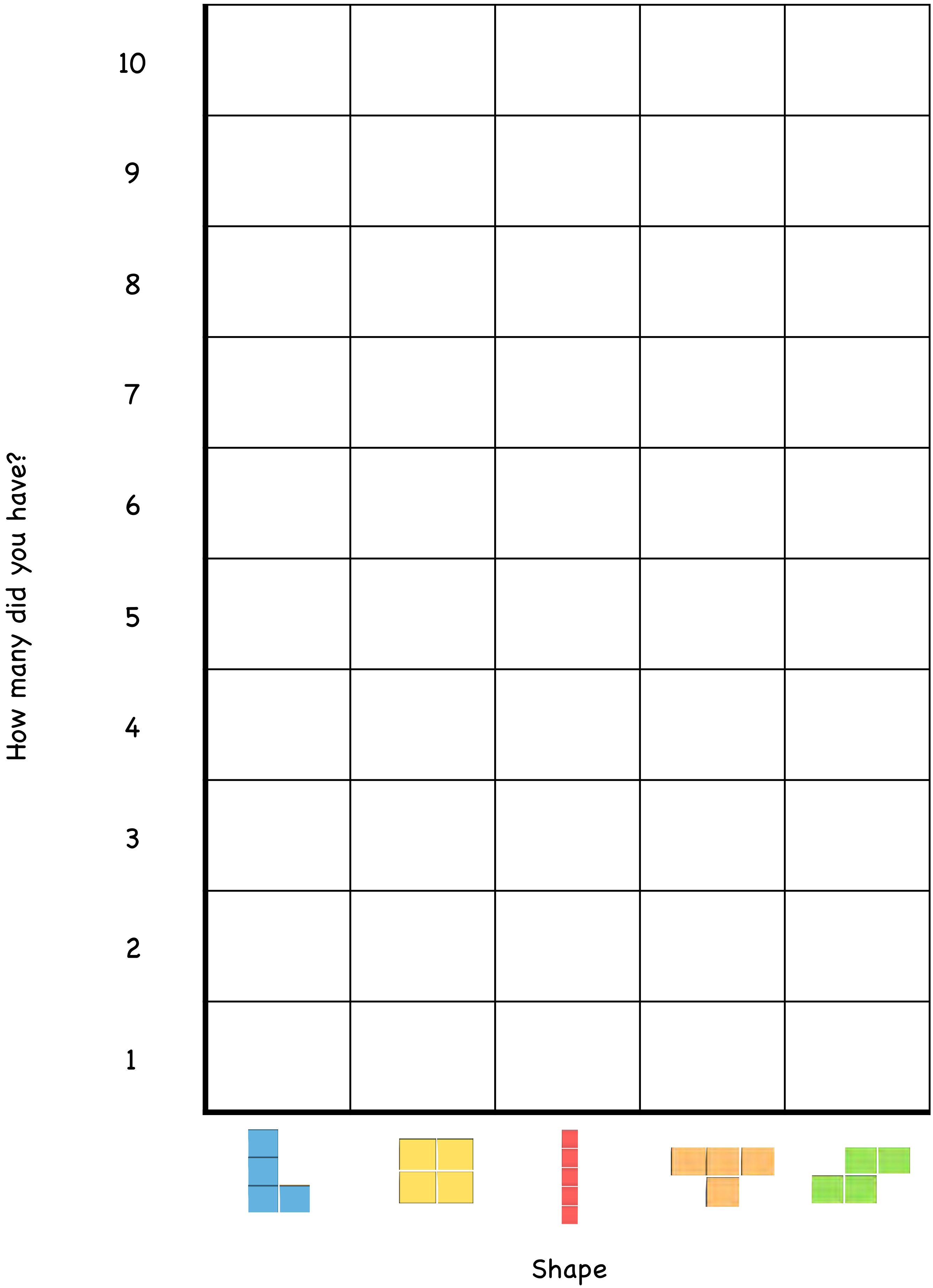
Shape Bar Graph



OBJECT #1

OBJECT #2

OBJECT #3


How many did you have?
10
9
8
7
6
5
4
3
2
1
Shape

Tetris Pieces