Sixth Grade Strand 6.4
Stability and Change in Ecosystems
Mystery Science Scope and Sequence
Salt Lake City School District 2023-2024

Standard 6.4.1 Analyze data to provide evidence for the **effects** of resource availability on organisms and populations in an ecosystem. Ask questions to predict how changes in resource availability affects organisms in those ecosystems. Examples could include water, food, or living space in Utah environments. (LS2.A)

Standard 6.4.2 Construct an explanation that predicts **patterns** of interactions among organisms across multiple ecosystems. Emphasize consistent interactions in different environments such as competition, predation, and mutualism. (LS2.A)

Standard 6.4.3 Develop a model to describe the cycling of **matter** and flow of **energy** among living and nonliving parts of an ecosystem. Emphasize food webs and the role of producers, consumers, and decomposers in various ecosystems. Examples could include Utah ecosystems such as mountains, Great Salt Lake, wetlands, or deserts. (LS2.B)

Standard 6.4.4 Construct an argument supported by evidence that the **stability** of populations is affected by changes to an ecosystem. Emphasize how changes to living and nonliving components in an ecosystem affect populations in that ecosystem. Examples could include Utah ecosystems such as mountains, Great Salt Lake, wetlands, or deserts. (LS2.C)

Standard 6.4.5 ***Evaluate competing design solutions*** for preserving ecosystem services that protect resources and biodiversity based on how well the solutions maintain **stability** within the ecosystem. Emphasize **obtaining, evaluating, and communicating information** of differing design solutions. Examples could include policies affecting ecosystems, responding to invasive species, or solutions for the preservation of ecosystem resources specific to Utah, such as air and water quality and prevention of soil erosion. (LS2.C, LS4.D, ETS1.A, ETS1.B, ETS1.C)

Instructional Pacing for Strand 6.4 Stability and Change in Ecosystems (Aug 28- Oct 27)

Aug 28 Colors of Great Salt Lake SEEd 6.4.1	**Sept 5** A Slug's Life SEEd 6.4.1	**Sept 11** Sunflower Problem SEEd 6.4.2	**Sept 18** Trees and Underground SEEd 6.4.2
Sept 25 Rotting Apples SEEd 6.4.3	**Oct 2** Ecosystem in a Bottle SEEd 6.4.3	**Oct 9** Wolves at Yellowstone SEEd 6.4.4	**Oct 16** Bark Beetle Outbreak SEEd 6.4.4
Oct 23 Required: RISE Benchmark 6.4.2			

Lesson Information	Materials and Assessment
Aug 28 **SEEd Standard 6.4.1** **Science and Engineering Practice:** Analyze Data **Crosscutting Concept:** Cause and Effect **Disciplinary Core Ideas:** LS2.A **Phenomenon:** The color of the water at Great Salt Lake changes with the seasons. The south arm of the lake is green in early spring. The north arm of the lake is pink in late summer and fall. **Lesson Plan:** Colors of the Great Salt Lake Lesson Plan **Lesson Slides:** Colors of Great Salt Lake SEEd 6.4.1 **Lesson Explanation:** The watercolor at Great Salt Lake changes seasonally due to populations of microbes that thrive in high-salt conditions. Pink algae in the North Arm increase in the late summer and fall due to increased temperatures and evaporation of lake water. Green algae in the South Arm increase in springtime due to an influx of nitrogen as the mountain snowpack melts and waterways emptied into the lake. The green watercolor changes back to blue by mid-summer due to brine shrimp that hatch and eat the algae, controlling the growth of the algae population. **Words to support student discourse related to the Disciplinary Core Ideas (DCIs):** limited resources, ecosystem, organisms, populations, survival, stability, instability Link to purchase Brine Shrimp ($8.99 Amazon)	**Phenomenon: (Slides 1-11) Introduce the phenomenon and have students explain the cause of seasonal changes in watercolor at the Great Salt Lake (GSL).** **Investigation #1 Gather Evidence: (Slides 12-32)** Make observations of the living and nonliving things in the two systems (North and South Arm of the GSL. **Student Materials:** Virtual Field Study Sheet, GSL Model. **Investigation #2 Gather Evidence: (Slides 33-54)** Collect data to determine the quantity of dissolved salt in the GSL North and South Arm. **Student Materials:** Refractometer **Plan and carry out an investigation:** Plan an investigation to determine the effect of salt on Brine Shrimp Growth and Development **Student Materials:** Brine Shrimp Cysts Non-iodized Salt Distilled Water Graduated Cylinders (250 mL) Clear plastic cups 9 oz Digital Scales Weigh boats or small cups Permanent markers (for labeling samples) **Investigation #3 Reason: (Slides 43- 55)** Organisms interact with other living and nonliving things in their environment. The living and nonliving things in an environment make up a system called an ecosystem. Students obtain information about the living and nonliving components of the GSL ecosystem. **Reading:** Physical characteristics of the GSL

	Investigation #4 Gather Evidence: (Slides 56-70) Make observations about the microbes living in the water at the GSL (Scale). Then develop a model of the GSL food web to describe how producers, consumers, and decomposers are interacting in this ecosystem. **Investigation #5 Analyze data: (Slides 71- 88)** Analyze data to identify patterns in seasonal changes at the lake. **Video:** Monitoring GSL Students make trend graphs. Students construct a written explanation supported by evidence for seasonal watercolor changes at the GSL.
Sept 5 **SEEd Standard 6.4.1** **Science and Engineering Practice:** Analyze Data **Crosscutting Concept:** Cause and Effect **Disciplinary Core Ideas:** LS2.A **Phenomenon**: The number of mollusks in Hilo changes when the quantity of algae changes. **Lesson Plan:** A Slug's Life SEEd 6.4.1 **Lesson Performance Expectations:** ***Develop a model to determine how one organism's population affects another's.*** ***Develop an argument*** for how the evidence collected to support the ***explanation*** that the population size of one organism is ***affected*** by the ***quantity*** of another organism. **Words to support student discourse related to the Disciplinary Core Ideas (DCIs):** limited resources, ecosystem, organisms, populations, survival, stability, instability	***Gather*** Students ***develop questions*** to ***obtain information*** about the ***causes*** of the mollusk population change and the life cycle of mollusks including their food sources, how they reproduce, and how they get their energy from the environment. Students ***develop questions*** to ***obtain information*** about the ***causes*** of algae population change and the physical characteristics of algae. Students ***obtain information*** on the life cycle of mollusks including their food sources, how they reproduce, how they get their energy from the environment. Students ***obtain and organize data*** from Appendix B.  ***Reason*** Students analyze and interpret data to provide evidence for resource availability's

	effects on organisms and populations in an ecosystem. Students ***develop a model*** (graph) to compare the populations of mollusks under different amounts of Gracilaria coverage. Students ***construct*** their own data ***table*** based on the mollusk they intend to study. ***Class Discussion:*** *Questions to initiate Discussion:* *Q: How does algae growth influence the* types *of mollusks found in each site sampled?* *Q: What caused changes in the system that affect the quantity of algae?* *Q: How do other populations of mollusks affect each other over changing algae conditions?* *Q: What roles do these species have in their habitat?* *Q: How does the mollusk population affect me, or does it?* *Q: How do mollusks fit into the subtidal food web?* *Q: What changes in the system affect algae growth?* Students ***construct an explanation*** for how the size of the mollusk population is ***affected*** by the ***quantity*** of Gracilaria coverage. ***Communicate Reasoning*** Students ***develop an argument*** for how the evidence they have collected supports the ***explanation*** that the population of mollusks is ***affected*** by the ***quantity*** of Gracilaria coverage.
Sept 11 **SEEd Standard 6.4.2**	**Phenomenon: (Slides 1- 11)** Introduce the garden phenomenon and have students observe how organisms interact in the

Science and Engineering Practice: Construct an explanation.
Crosscutting Concept: Patterns
Disciplinary Core Ideas: LS2.A

Phenomenon: A sunflower in the school garden begins to look unhealthy.

Lesson Slides: Sunflower Problem SEEd 6.4.2

Lesson Expectation: Define the problem and design a solution to improve the health of the sunflowers in your garden.

Problem: The sunflower in the school garden is unhealthy because it is being attacked by aphids. Aphids take shelter on the undersides of leaves and suck the juices from the sunflower to obtain energy. This explains why the leaves of the sunflower are turning yellow. Aphids can reproduce very quickly and so are considered garden pests.

The ladybugs observed in this community are helpful to the sunflower because ladybugs eat aphids (predation). In contrast, the ants observed in this community are harmful to the sunflower because ants protect aphids. Ants want to keep the aphids alive so they can milk them for honeydew (mutualism). Ladybugs and ants battle for aphids using sophisticated defenses (competition).

Solution: To better control the aphid population in the school garden, we could bring in additional native ladybugs and spray for ants.

Words to support student discourse related to the Disciplinary Core Ideas (DCIs):
interactions, mutualism, predation, competition, predator-prey relationship, ecosystem, survival, symbiotic

garden. Which insects are harmful/ helpful? Look for patterns that can be used for evidence.

Investigation #1 Video Interactions: (Slides 12-16) Make observations on how organisms interact in a garden. Read to obtain information about the interactions between organisms in a garden.
Reading: How Ants and Aphids help each other

Investigation #2 Core ideas and possible solutions: (Slides 17-25)

Sept 18

SEEd Standard 6.4.2
Science and Engineering Practice:
Construct an explanation.
Crosscutting Concept: Patterns
Disciplinary Core Ideas: LS2.A

Phenomenon: Utah Prairie Dogs and Uinta Ground Squirrels live in the desert areas of Utah and the Red Squirrels live in trees in the mountains of Utah.

Lesson Plan: Trees and Underground SEEd 6.4.2

Lesson Performance Expectations:
Develop an argument to support the explanation that different types of squirrels live in different habitats but have similar roles in their own ecosystem.

Words to support student discourse related to the Disciplinary Core Ideas (DCIs):
interactions, mutualism, predation, competition, predator-prey relationship, ecosystem, survival, symbiotic

Gather
Students develop questions to obtain information about how different squirrel species have adapted to live in various ecosystems.
Students obtain information by reading about various types of squirrels and how different species have changed over time to be better adapted for the environments in which they live.

Reason
Students construct an explanation supported by evidence for why some squirrels in Utah (or other states) are better adapted to live in the mountain ecosystems and other squirrels are better adapted to live in the sagebrush desert ecosystem.

Students use a model to show the relationship between specific **structures** on squirrels and how the squirrel uses that structure. (Example of Model in Appendix C)

Questions to initiate Discussion:
- Q: Why do some types of squirrels live in trees and other underground or between rocks?
- Q: What purpose does the tree cavity or underground burrow have for squirrels?
- Q: Which adaptations do both types of squirrels have but use for different purposes?
- Q: Why do Utah squirrels need to hibernate/winter sleep in the winter?
- Q: What are the interactions of the Uinta ground squirrel in desert ecosystems similar to the interactions of red squirrels within the mountain ecosystem similar and different?

Communicate Reasoning
Students communicate an argument to support the explanation that different types

	of squirrels live in different habitats but have similar roles in their own ecosystem.
Sept 25 **SEEd Standard 6.4.3** **Science and Engineering Practice:** Develop a model. **Crosscutting Concept:** Matter & Energy **Disciplinary Core Ideas:** LS2.B **Phenomenon:** An apple that falls from a tree begins to rot on the ground. **Lesson Slides:** Rotting Apples SEEd 6.4.3 **Lesson Explanation:** An apple rots because tiny microorganisms (fungi and bacteria) break down the matter in dead plants and animals to obtain energy. Some of the decomposed matter is left behind in the soil where it can be used again by plants growing in the garden. Thus, matter cycles among living and nonliving components of a garden ecosystem. **Application (Optional STEM Project):** Students design a compost system and start a lunch composting program at their school, tracking pounds of food scraps collected over time. **Words to support student discourse related to the Disciplinary Core Ideas (DCIs):** producers, consumers, decomposers, recycling of matter, food web, energy, environment	**Phenomenon: (Slides 1- 7)** Introduce the apple phenomenon and have students look at explanations that they agree/ disagree with. **Investigation #1 Gather Evidence: (Slides 8-10)** Plan and carry out an investigation to determine the effects of different variables on a rotting apple. **Student Materials:** Plastic bags Grass clippings Decaying leaves Soil Water in spray bottles Apples Measuring cups **Part #2 Obtain Information: (Slides 11-16)** Students obtain information about how food scraps change into rich soil for a garden. **Part #3 Develop a model: (Slides 17-18)** Students develop a model to describe how matter cycles in a garden. **Part #4 Construct an Explanation: (Slides 19-25)** Students construct an explanation based on evidence for what causes an apple to rot.
Oct 2 **SEEd Standard 6.4.5** **Science and Engineering Practice:** Evaluating Design Solutions **Crosscutting Concept:** Stability and Change	**Phenomenon: (Slides 1- 4)** Introduce the phenomenon, what would a mouse need to live in a bottle. Discuss what is a system in science.

Disciplinary Core Ideas: LS2.B **Phenomenon:** A mouse dies in a sealed jar. However, when a plant is also placed in the sealed jar the mouse thrives. **Lesson Slides:** Ecosystem in a Bottle SEEd 6.4.3 & 6.4.5 **Explanation:** The mouse dies because it runs out of air to breathe. (The candle burning in the sealed container uses up all the oxygen.) Putting a green plant in the jar and exposing it to sunlight permits the candle to burn and the mouse to breathe. This is because plants produce oxygen. This experiment provides evidence that plants and animals depend on one another and on non-living things in their environment (e.g., air). This experiment also provides evidence that matter cycles and energy flows in the Earth system. **Application (Optional STEM Project):** Students design an ecosystem in a bottle that remains stable for at least three months. **Words to support student discourse related to the Disciplinary Core Ideas (DCIs):** preservation, resources, ecosystem, biodiversity, stability and instability, interactions, populations, problem, design solutions, criteria, constraints, data, optimal solution	**Part #1 Make Observations & Generate Questions: (Slides 5- 7)** Observe the natural world on three different scales and define boundaries of each system. Students ask questions about how organisms interact with one another and with nonliving things in their environment. Complete the reason together questions after students make observations and generate questions about three systems. **Part #2 Develop an Argument: (Slides 8- 12)** Students develop an argument that organisms depend on one another and on nonliving things in their environment. **Part #3 Design Challenge: (Slides 13-18)** Students design an ecosystem in a closed jar that will remain stable for at least two months. Students will explain why they included each component in their model system. Students will evaluate design solutions by identifying which designs best meet the criteria and constraints of the problem. **Student Materials:** Glass jar Different types of soil Different types of seeds and plants Different small organisms (Insects, spiders) Water **Part #4 Evaluate design criteria: (No slides)** Students will evaluate design solutions by identifying which designs best meet the criteria and constraints of the problem.
Oct 9 **SEEd Standard 6.4.4** **Science and Engineering Practice:** Construct an Argument supported by Evidence. **Crosscutting Concept:** Stability and Change	**Recommended Teaching sequence:** **Day 1: (Slides 1-4)** Students ask questions and generate claims. Students develop a model to identify factors that control elk population size.

Disciplinary Core Ideas: LS2.C **Phenomenon:** Elk populations change over time in Yellowstone NP. In the 1980's, the size of the elk population was at a record high. Plants were disappearing, especially along riverbanks. **Lesson Slides:** Wolves at Yellowstone SEEd 6.4.4 **Student Task:** Construct an explanation for what caused the elk population to increase in the 1980's. Evaluate a solution based on how well it controls elk population size and maintains the stability of the ecosystem at Yellowstone NP. **Lesson Explanation:** Wolves had been hunted to extinction in Yellowstone NP. This caused the elk population to triple in just a decade. To control the elk population, scientists reintroduced wolves to Yellowstone NP in 1995. As predicted, the elk population declined. Trees and grasses returned to the park. Biodiversity increased, indicating the return of a healthy and stable ecosystem. **Words to support student discourse related to the Disciplinary Core Ideas (DCIs):** populations, ecosystem, stability, instability, interactions, biodiversity	**Day 2:** (Slides 5-9) Students use the model (act out the simulation) and collect data. **Day 3: (Slides 10-15)** Students graph and analyze the data collected from the model (or simulation). Students construct an explanation for what causes elk populations to change over time. **Day 4: (Slides 16-17)** Students propose a solution for controlling the elk population at Yellowstone NP. Students read to obtain information about the reintroduction of wolves. Students read Timeline: History of Yellowstone NP and Did Wolves help restore Yellowstone Articles. **Day 5: (Slides 18-21)** Students analyze data to evaluate the effectiveness of wolf reintroduction. Students develop a written argument based on evidence to support the claim that wolves are necessary to maintain the stability of the Yellowstone ecosystem. **Assessment:** Use what students have written in their science notebooks as a formative assessment, including the data they collected and graphed from their model and the written explanation for the phenomenon. Do students use evidence to support their explanation? evaluate the solution?
Oct 16 **SEEd Standard 6.4.4** **Science and Engineering Practice:** Construct an Argument supported by Evidence. **Crosscutting Concept:** Stability and Change **Disciplinary Core Ideas:** LS2.C	**Recommended Teaching Sequence:** Day 1: (Slides 1-22) Make observations **of infested trees to predict how bark beetles and trees interact in a forest ecosystem.** Read to obtain information **about how a tiny bark beetle can cause the death of a large tree.**

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Phenomenon: Bark beetles are attacking forests across the Western United States and Canada, resulting in the death of many trees.

Lesson Slides: Bark Beetle Outbreak SEEd 6.4.4

Lesson Explanation: Bark beetle outbreaks are increasing in number and intensity due to a rise in global temperature. Warmer temperatures affect the timing of bark beetle growth and development and increase the number of beetles that survive the winter.

Words to support student discourse related to the Disciplinary Core Ideas (DCIs):
populations, ecosystem, stability, instability, interactions, biodiversity

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Day 2: **(Slides 23- 35) Plan and carry out an investigation** to determine the effect of temperature on the beetle life cycle.

Day 3: (Slides 36-49) **Develop and use a model** to describe how access to resources can limit the growth of bark beetle populations (and the scale of an outbreak).

Day 4: (Slides 50-67) **Analyze data** to identify changes in the forest ecosystem that could be associated with the recent bark beetle outbreaks.

Day 5: (Slides 68-89) **Use a computer model** to investigate the effect of rising temperatures on the number and intensity of bark beetle outbreaks over time.

Day 6: (Slides 90-111) **Construct an argument** supported by evidence for the cause of the recent bark beetle outbreak.

Formative Assessment: Use what students have written in their science notebooks as a formative assessment, including the observations they recorded and their written explanation for the phenomenon. Do students understand that small changes in the physical or biological components of an ecosystem can affect populations?

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Oct 23
Required: RISE Benchmark 6.4.2

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