

STORYLINE 6.3.1: Water Cycle

Strand 6.3 EARTH'S WEATHER PATTERNS AND CLIMATES

All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. Heat energy from the Sun, transmitted by radiation, is the primary source of energy that affects Earth's weather and drives the water cycle. Uneven heating across Earth's surface causes changes in density, which result in convection currents in water and air, creating patterns of atmospheric and oceanic circulation that determine regional and global climates.

Standard 6.3.1

Develop a model to describe how the cycling of water through Earth's systems is driven by energy from the Sun, gravitational forces, and density. (ESS2.C)

NGSS Correlation: MS-ESS2-4

Phenomena Statement: I was told that the water dinosaurs drank is the same water we drink today.

Expected Student Explanation: Students will be able to explain why/how water moves throughout Earth's various systems when given a specific scenario.

Science & Engineering Practices (SEP)	Crosscutting Concepts (CCC)	Disciplinary Core Ideas (DCI)
<p>Developing and Using Models: Students will develop, use, and revise a model to describe the water cycle.</p> <p>Students do and use this Science and Engineering Practice (SEP) by:</p> <ul style="list-style-type: none"> Evaluating limitations of a model for a proposed object or tool. Developing or modifying a model—based on evidence – to match what happens if a variable or component of a system is changed. Using and/or developing a model of simple systems with uncertain and less predictable factors. Developing and/or revising a model to show the relationships among variables, including those that are not observable but predict observable phenomena. Developing and/or using a model to predict and/or describe phenomena. Developing a model to describe unobservable mechanisms. 	<p><u>Energy and Matter:</u> Within a natural or system, the transfer of energy drives the motion and/or cycling of matter.</p> <p>Students think and connect through this Crosscutting Concept (CCC) to reason that:</p> <ul style="list-style-type: none"> Matter is conserved because atoms are conserved in physical and chemical processes. Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). 	<p>(ESS2.C): The Roles of Water in Earth's Surface Processes</p> <p>Students know and apply the Disciplinary Core Idea (DCI) of (ESS2.C) The Roles of Water in Earth's Surface Processes in their thinking and reasoning to communicate that:</p> <ul style="list-style-type: none"> Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation as well as downhill flows on land. Global movements of water and its changes in form are propelled by sunlight and gravity.

<ul style="list-style-type: none"> Developing and/or using a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales. 	<ul style="list-style-type: none"> The transfer of energy can be tracked as energy flows through a designed or natural system. 	
Storyline Narrative		Documents for Storyline
<p>Storyline Narrative 6.3.1</p> <p>SEEd Standard 6.3.1 asks students to develop and use a model to describe how the cycling of water through Earth’s systems is driven by energy from the sun, gravitational forces, and density.</p> <p>As we begin our storyline, we will engage students by showing a picture of dinosaurs and tell them that scientists say that the water dinosaurs drank millions of years ago is the same water we drink today. We then ask, how can that be? We then have students make a list of places where water is found. After compiling this list, students will classify their lists into groups by <u>patterns</u> of similarities they have found and generate a list of questions they have. Based on this list, students will determine that water is found in different states of <u>matter</u> and in a variety of locations. Students will be left wondering why water is found at these different locations and in different states.</p> <p>In order to explore this question, students will analyze the function of water throughout Earth’s systems. Students will be led to the terminology, reservoirs and transfers, to explain how water is stored and moved from one location to another. This will leave students questioning what is the cause of water transfer from reservoir to reservoir.</p> <p>To construct an explanation and develop their models, students will use their understanding of how <u>energy</u> is transferred from the previous strand, 6.2. Students will discuss how the sun’s energy, density, and gravitational forces are driving water transfers.</p> <p>Students will elaborate on their understanding by watching a short video of the water cycle, including plants in the water cycle. Students will question how these living organisms play a role in the transfer of water. To obtain information to answer their questions, students will read an article on transpiration, the process by which water is transferred by plants. Students will develop their models further by expanding their understanding to include this process.</p>		<p>Review and/or print out the following documents for this storyline. To edit the following documents you must open, then make your own copy.</p> <p>Links: Storyboard Slides - episode instructions are in the slide notes Storyline Matrix Student Journal or composition notebook Summative Assessment</p>

To **evaluate** their understanding of how water is cycled through Earth's systems, students will create diagrams to be shared with the class. Students will evaluate their own understanding as they discuss similarities among the different diagrams. Students will have the opportunity to add to their models as they write their final explanations of how energy from the sun, density, and gravitational forces drive the cycle of water through Earth's systems.

As a final assessment, students will be given a task where they will use their models to explain an example of a water reservoir and possible transfers.

STORYLINE: Episodes Matrix 6.3.1

Episode	Phenomenon/ Next Questions	Episode Descriptions & Student Performance Prompts	Conceptual Understandings	
			What We Figured Out: what will the students discover	Next Questions or Steps: what they will investigate next
Episode 1: Engage Time: 60 minutes	Phenomenon: <i>Scientists say that the water dinosaurs drank millions of years ago is the same water we drink today.</i>	Nearpod lesson link: https://share.nearpod.com/e/dm2kSYqoYcb Gather <ol style="list-style-type: none"> Students will gather information by brainstorming a list of all the places water is found in Earth's <u>systems</u>. <p><i>Teacher suggestions: Begin by having students independently brainstorm places where they might find water. Ideas might look like lakes, rivers, oceans, snow, ice, clouds, sinks, toilets, the ground, etc. Then in pairs or groups, have students discuss their lists and look for patterns. You could also have students write them on post-it notes and place them on the board.</i></p> <p><i>See Student Science Journal Page 2</i></p> Reason <ol style="list-style-type: none"> Students will evaluate information based on <u>patterns</u> and classify their lists into groups. 	Water is found in different states of matter and in a variety of locations.	Why is water found at these locations and in different states?

Teacher Suggestions: Have students work in small groups or as a class to sort their ideas. If they used sticky notes or a shared chart, ask them to begin grouping their examples by what they notice. Encourage them to describe their reasoning for placing ideas together.

Suggested Patterns for Sorting:

- *Where the water is (e.g., in the sky, on the ground, underground)*
- *What form the water is in (solid, liquid, or gas)*
- *Whether the water is moving or staying in one place*
- *Whether people or animals can use the water (drinkable or not)*

Encourage students to continue revising their categories until they notice a key pattern: some places store water and some places show water moving. Once these categories are clear, help them connect this to the state of matter (solid, liquid, gas) found in those places.

Guiding Questions for Discussion:

- *What do you notice about the water in each location?*
- *Is the water staying in one place or is it moving?*
- *What form is the water in — is it solid, liquid, or gas?*
- *Do you see any similarities between where the water is or what it's doing?*
- *Can we group any of these places together? Why?*
- *What makes some water useful for animals or people?*
- *Why do you think water is found in that place?*

Hold off on introducing terms like reservoir and transfer just yet. Let students build a strong foundation of their own ideas. These terms will be introduced later to help them deepen their understanding of how water moves through Earth's systems in the next lesson.

See Student Science Journal Page 2

		<p>Communicate</p> <p>3. Students will communicate about the pattern of water in Earth's <u>systems</u>.</p> <p><i>See Student Science Journal page 3</i></p> <p>Formative Assessment</p> <p><i>Students should identify locations where water can be found, such as glaciers, oceans, lakes, rivers, underground, clouds, and air.</i></p>		
<p>Episode 2:</p> <p>Explore/ Explain</p> <p>Time: 60 min</p>	<p>Phenomenon:</p> <p>I was told that the water dinosaurs drank is the same water we drink today.</p>	<p>Nearpod lesson link: https://share.nearpod.com/e/23OLcwroYcb</p> <p>Gather</p> <p>1. Students will obtain information using a model of water cycling through Earth's <u>systems</u>.</p> <p><i>Teacher suggestions: Begin by having students describe what they see. This will look like "I see arrows", "I see words", "I see an ocean", "I see mountains", etc. Then ask them what they notice. This looks like "Ocean water turns into clouds", "There is water underground", Have students discuss what the arrows mean and help them notice the relationship between the pattern of where water is stored and where water moves. Ask students if they would classify the different parts of this model the same as in episode 1 or would they use another system of classification. Have students in pairs or groups, write their own explanation/definition of reservoir and transfer and have them share and discuss their explanations.</i></p> <ul style="list-style-type: none"> • What do you see in this model? • What do you notice happening to the water in the model? • What do you think the arrows mean? Do all arrows show the same kind of movement? • Are there any patterns in where water is stored or how it moves? • Which parts of this model show reservoirs, and which parts show transfers? 	<p>Places that hold water are called reservoirs, and how water gets from reservoir to reservoir is called transfer.</p>	<p>What causes water to transfer from reservoir to reservoir?</p>

- *How does this model connect to what we learned in Episode 1?*
- *Would you classify the different parts of this model the same way we did before, or differently? Why?*
- *With your group, create your own definition for reservoir. Where do you see examples in the model?*
- *Now create your own definition for transfer. Where do you see transfers happening in the model?*
- *How does this model help you better understand how water moves through Earth's systems?*

See Student Science Journal Page 4

Reason

2. Students will **use a model to argue from evidence** about the classification of energy and matter as either a transfer or a reservoir.

Teacher suggestions: Water in the model is either being stored (reservoir) or is moving (transfer). Ask students to identify the components in the model and their function in the water cycle and record it in their student journal. Transfer and reservoir language will help students make sense of Earth's systems and develop a deeper model of the water cycle. It is important that students realize that water from earth doesn't float into space, but stays within Earth's systems.

Reservoir: Lakes, glaciers, ponds, aquifers, plants, etc.

Transfer: Precipitation, rivers, streams, evaporation, runoff, etc.

***Clouds could be used as a discussion point where students argue if it's a form of transfer or a reservoir.*

Allow students to argue about their classification and explain why they classified it as such. This could be done in pairs, groups or as a class.

		<p><i>See Student Science Journal Page 5</i></p> <p>3. Students will obtain information from an article about the classification of <u>energy and matter</u> as a reservoir or transfer.</p> <p><i>Teacher suggestions: Have students read the article in their journal to solidify their understanding of reservoirs and transfers. This can be done individually, in pairs or as a class.</i></p> <p><i>See Student Science Journal Page 6</i></p> <p>Communicate</p> <p>4. Students will communicate their understanding by arguing from evidence whether the <u>matter</u> in the images are a reservoir or a transfer.</p> <p><i>Teacher suggestions: Have students pair up and take turns classifying the image as a reservoir or a transfer. Students should communicate why and question each other. Walk around and listen to their explanations.</i></p> <p>Formative Assessment</p> <p><i>Students should be able to accurately classify location in the water cycle as either a reservoir or a transfer and use states of matter language and evidence from the article in the explanation.</i></p>		
<p>Episode 3:</p> <p>Explain</p> <p>Time: 60minutes</p>	<p>Phenomenon:</p> <p>When transferring, water falls and rises.</p>	<p>Nearpod lesson link: https://share.nearpod.com/e/ykZlW9roYcb</p> <p>Gather</p> <p>1. Students will ask questions to help them determine the <u>cause</u> of the transfer of water.</p> <p><i>Teacher suggestions: Students should have already identified that the arrows represent a transfer. Guide students to ask questions that will help them understand the cause of the transfer. Students should have background knowledge about gravity and density from previous 6th</i></p>	<p>Energy from the sun, gravitational forces, and density are the cause of transfers.</p>	<p>How do living organisms play a role in the transfer of water?</p>

		<p><i>grade strands to support their ability to question. Asking good questions is critical to making sense of the world. Help students stay focused with their questions by questioning their questions. I.e: “If we ask that question what type of information do you expect to gather? How will that information help us make sense of what is causing water to move?”</i></p> <p><i>Some questions that might be helpful:</i></p> <ul style="list-style-type: none"> • <i>What causes the water to move up towards the sky?</i> • <i>What causes the water to fall towards the earth?</i> • <i>What is the difference between the two?</i> • <i>What is happening at the molecular level?</i> • <i>How does the molecular level help us make sense on a larger scale?</i> <p><i>See Student Science Journal Page 7</i></p> <p>Reason</p> <p>2. Students will obtain information about the role <u>energy</u> plays in transfers.</p> <p><i>Teacher suggestions: Have students read an article to support their understanding of the role the Sun, gravity and density plays in Earth’s systems. This can be done individually, in pairs or as a class. Discuss as a class the role energy plays in transfers.</i></p> <ul style="list-style-type: none"> • <i>What do you already know or think about what causes water to move through Earth’s systems?</i> • <i>When you think about the Sun, gravity, and water—how do you think they might be connected?</i> • <i>What does the article say about how thermal energy affects water in different places (like the ocean, clouds, or rain)?</i> • <i>What patterns do you notice in how warm or cold water moves compared to other water?</i> • <i>How did your thinking change after reading about the roles of gravity and density in moving water?</i> 		
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<p>Episode 4:</p> <p>Elaborate</p> <p>Time: 60 min</p>	<p>Phenomenon:</p> <p>Living organisms play a role in the transfer of water.</p>	<p>Nearpod lesson link: https://share.nearpod.com/e/2DbqKitoYcb</p> <p>Gather</p>	<p>Transpiration is a form of transfer.</p>	<p>Can I explain my model of how water cycles through Earth's systems?</p>

		<p>1. Students will obtain information from an animated video to make sense of the role living organisms play in transfers driven by <u>energy</u>.</p> <p><i>Teacher suggestions: Play the video for the students and have them record questions they have about what they are observing. Students should notice a variety of water transfers and be curious about the role the plant plays.</i></p> <ul style="list-style-type: none"> • <i>What do you notice happening to water as it moves through the environment in the video?</i> • <i>What role do you think the plant plays in this cycle?</i> • <i>Where do you see energy being involved in the water movement?</i> • <i>What in the video makes you think the plant is involved in energy transfer?</i> • <i>Can you describe what you saw happening to the water near or in the plant?</i> • <i>What clues does the animation give about where the water is going and how it changes?</i> • <i>How does this relate to what we've already learned about evaporation or condensation?</i> • <i>Have you heard of transpiration before? How might it relate to what we just saw?</i> • <i>How might the Sun's energy be connected to what happens in or around the plant?</i> • <i>What do you think causes the water in the plant to move into the air?</i> • <i>How might energy from the Sun be helping the plant move water?</i> • <i>How does the water leaving the plant affect the rest of the water cycle?</i> <p>Water Cycle Animation</p>		
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See Student Science Journal page 10

Reason

2. Students will **obtain information** about the role living organisms play in transfers driven by energy.

Teacher suggestions: Students should use the information from the video or the article to answer questions they had from the water cycle animation video. The article is written at a level above 6th grade so it would be good to read through the article as a class and discuss the information and how it helps answer their questions for the role living organisms play in transfers. If you use the video, you may want to pause the video and discuss the information as well and how it supports their understanding of the role living organisms play.

- *What new information did you learn about plants and how they move water?*
- *How does the article or video explain what causes water to move out of plants?*
- *What questions from the animation are starting to make more sense now?*
- *What evidence in the article or video helps explain how energy is involved in transpiration?*
- *How do you know the plant isn't just storing water instead of releasing it?*
- *What role does the Sun's energy play in how the plant moves water?*
- *How is transpiration similar to or different from evaporation?*
- *Why do you think transpiration matters for the water cycle?*
- *Can you connect what you learned here to what we've studied about energy and matter?*
- *What's happening at the molecular level when water leaves a leaf?*
- *How do plants "move" water against gravity, and what role does energy play in that?*

		<ul style="list-style-type: none"> How do living organisms like plants help move water from one reservoir to another? <p>Transpiration article Transpiration Video</p> <p><i>See Student Science Journal page 10</i></p> <p>Communicate</p> <p>3. Students will revise their models further to include the role of living organisms in transfers driven by <u>energy</u>.</p> <p><i>Teacher suggestions: Allow students to communicate their understanding for the role living organisms play in transfers either by revising their model from the previous episode or by completing the task in their journal for this episode.</i></p> <p><i>See Student Science Journal page 9 and/or 10</i></p> <p>Formative Assessment</p> <p><i>Explanations should include details for the role living organisms play in transfers driven by energy. Students should be able to describe how plants take up groundwater through their roots and transpire the water not used during photosynthesis, a process driven by the sun.</i></p>		
<p>Episode 5:</p> <p>Evaluate</p> <p>Time: 60 min</p>	<p>Phenomenon:</p> <p>Water the dinosaurs drank millions of years ago is the same water we drink today.</p>	<p>Nearpod lesson link: https://share.nearpod.com/e/LmUu4LtoYcb</p> <p>Gather</p> <p>1. Students will construct an explanation for how water is cycled through Earth's <u>systems</u>.</p> <p><i>Teacher suggestions: Have students briefly explain how water is cycled through Earth's systems. This explanation should include the language around reservoirs, transfers, states of matter, gravity, density, sun, energy, cools, warms, rises, evaporates, condenses, transpiration, etc. After that, have them explain how water that</i></p>	<p>How the cycling of water through Earth's systems is driven by energy from the Sun, gravitational forces, and density.</p>	

dinosaurs drank is the same water we drink today. This explanation should accurately connect to the previous explanation.

See Student Science Journal page 11

Reason

2. Students will **model** their understanding of how the cycling of water, driven by energy, explains how the water drunk today is the same as dinosaurs.

Teacher suggestions: Have students create a graphical model to communicate how water that dinosaur's drank a million years ago is the same water they drink today. This can be done individually or in pairs. They should explain/listen to each other as they collectively create their model. Remind students to include the cycling of water through Earth's systems, energy, molecular understanding, transfers and reservoirs, etc. Students do have an understanding of the conservation of matter from 5th grade that may come up. It will be important for students to know that they will be revising their model so they should save the artistic detail for after they have looked at others. Students tend to be frustrated when they have spent time artistically and then have to make changes.

See Student Science Journal page 12

Communicate

3. Students will **revise and finalize their models** to clarify their understanding of how the cycling of water, driven by energy, explains how the water drunk today is the same as dinosaurs.

Teacher suggestions: Allow students to do a gallery walk and gather ideas or provide feedback to their peers. This would also be a great time for you to walk around and provide feedback. Students should then take the time to finalize their understanding of how the cycling of matter, driven by energy, through Earth's systems explains how

		<p><i>water drunk by dinosaurs is the same water drunk today. This model will be used again in 6.3.3.</i></p> <p><i>See Student Science Journal Page 12</i></p> <p>Formative Assessment <i>Models should include explanations of Earth's systems and how energy from the sun, density, and gravitational forces are the driving factors of the cycling of water. Since water is cycled, it is the same same water that has been in Earth's systems since the dinosaurs.</i></p>		
Summative Assessment	Seed Storylines 6.3.1 Summative Assessment			
USBE FORMATIVE ASSESSMENT	USBE 6.3.1 Sixth Grade Core Guide Formative Assessment			