

# “Solutions-Oriented Learning” Storyline

## 5- Urban Forestry: Urban Heat Islands

### Storyline introduction and overview:

Students will learn how trees grow and cycle matter, and trees’ roles in a changing climate. The urban heat island effect is examined and students learn about the many benefits trees offer cities. The storyline culminates with students examining the trees and canopy cover in their or a nearby city and proposing actions to increase the urban forest through a letter to city officials.

**Urban Forestry NGSS Learning Progression:** The 5th grade storyline is part of a larger learning progression that includes students mastering standards pre-K to 12th grade. Look at how the 5th grade performance expectations fit in a continuum of learning for your students:

<p><b>Placemaking:</b></p> <p>How impacted are you by the heat island effect?</p>	<p><b>Anchoring phenomena:</b></p> <p>Heat on the Earth’s surface varies tremendously.</p>	<p><b>Drawdown:</b></p> <p><a href="#">Indigenous Peoples’ Forest Tenure</a></p> <p><b>Environmental Justice:</b></p> <p><a href="#">Tree Equity in America’s Cities</a></p>
<p><b>Indigenous and other relevant cultural connections:</b></p> <p>Trees were critical to the indigenous people of this area.</p> <p><a href="#">Teachings of the Tree People: The Work of Bruce Miller</a></p> <p><a href="#">The Power of Trees</a></p>	<p><b>NGSS PEs (progress towards):</b></p> <p>5- LS2-1 Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.</p> <p>5-ESS3-1 Obtain and combine information about ways individual communities use science ideas to protect the Earth’s resources and environment.</p>	

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**Estimated time required to implement this storyline: two to three weeks**

#### NGSS PEs:

5- LS2-1 Develop a model to describe the movement of matter among plants, animals, decomposers and the environment.

5-ESS3-1 Obtain and combine information about ways individual communities use science ideas to protect the Earth’s resources and environment.

Science & Engineering Practice (SEP)	Disciplinary Core Idea (DCI)	Cross Cutting Concept (CCC)
<p>Developing and Using Models Modeling in 3-5 builds on K-2 models and progresses to building and revising simple models and using models to represent events and design solutions.</p> <ul style="list-style-type: none"> <li>Develop a model to describe phenomena.</li> </ul> <p>Connections to Nature of Science Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena</p> <ul style="list-style-type: none"> <li>Science explanations describe the mechanisms for natural events</li> </ul> <p>Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 3-5 buildings on K-2 experiences and progresses to evaluating the merit and accuracy of ideas and methods.</p> <ul style="list-style-type: none"> <li>Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.</li> </ul>	<p>LS2.A: Interdependent Relationships in Ecosystems</p> <ul style="list-style-type: none"> <li>The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or their parts and animals) therefore operate decomposers. Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem.</li> </ul> <p>LS2.B: Cycles of Matter and Energy Transfer in Ecosystems</p> <ul style="list-style-type: none"> <li>Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases and water, from the environment and release waste matter (gas, liquid, or solid) back into the environment.</li> </ul> <p>ESS.C: Human Impacts on Earth Systems</p> <ul style="list-style-type: none"> <li>Human activities in agriculture, industry, and everyday life have had major effects on land, vegetation, streams, oceans, air, and even outer space. But individuals and communities are doing things to help protect Earth’s resources and environments.</li> </ul>	<p>Systems and System Models</p> <ul style="list-style-type: none"> <li>A system can be described in terms of its components and their interactions.</li> </ul> <p>Connections to Nature of Science Science Addresses Questions About the Natural and Material World</p> <ul style="list-style-type: none"> <li>Science findings are limited to questions that can be answered with empirical evidence.</li> </ul>

#### Materials:

Learning Session	Materials
1. Grounding Native Ways of Knowing	<ul style="list-style-type: none"> <li>Cedar Box Teaching Tools</li> </ul>
2. Heat Island Effect and Trees	<ul style="list-style-type: none"> <li>Class set or projected <a href="#">Urban Heat Island Profile image</a>.</li> </ul>

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3. Pre-Assessment	<ul style="list-style-type: none"> <li>• <a href="#">Urban Forestry: Urban Heat Islands Pre-Assessment</a></li> <li>• <a href="#">Urban Forestry: Urban Heat Islands Rubric</a></li> </ul>
4. What do trees need to grow?	<ul style="list-style-type: none"> <li>• Chart paper or See-Think-Wonder chart <a href="#">See Think Wonder</a></li> <li>• Picture and article, <a href="#">Trees that are centuries old help tell story of Spokane</a></li> <li>• <a href="#">Trees for Kids   Learn all about trees in this fun educational video for kids</a>” video.</li> <li>• <a href="#">Tree Cookie Cross Section</a></li> <li>• <a href="#">Tree Rings</a>: template</li> <li>• <a href="#">Reading Tree Cookies</a>: How to read Tree Cookie worksheet.</li> <li>• <a href="#">PreK-8 Activity 76 - Tree Cookies</a></li> <li>• <a href="#">Virtual Tree cookies</a></li> <li>• Mind map or paper to make mind map.</li> <li>• Tree cookie picture and description: project or copy.</li> <li>• <a href="#">What Can Trees Tell Us About Climate Change?</a> Project or copy.</li> <li>• <a href="#">Tree Rings</a> worksheet: copy 1 page per person.</li> <li>• <a href="#">Reading Tree Cookies</a> : copy 1 page per person.</li> <li>• <a href="#">What Trees Need to Grow</a> : Project or copy.</li> <li>• Crayons, water color, markers, colored pencil, paper</li> </ul>
5. How do trees cycle matter?	<ul style="list-style-type: none"> <li>• <a href="#">Tree Carbon Cycle and Sequestration</a></li> <li>• <a href="#">Trees and the Carbon Cycle</a></li> <li>• <a href="#">Garden Activities- Catching Water</a></li> <li>• <a href="#">Earth Science: Carbon Cycle</a></li> <li>• <a href="#">Why it Matters: Climate</a></li> </ul>
6. What problems occur when cities lack trees?	<ul style="list-style-type: none"> <li>• <a href="#">Summer in the City</a> one copy per student- also used in Learning Session 8</li> </ul>
7. How do trees change the climate?	<ul style="list-style-type: none"> <li>• <a href="#">Why Do We Plant Trees?</a> page 12 of</li> <li>• Infrared thermometer</li> <li>• Dark and light color paper</li> </ul>
8. How do we increase urban forests equitably across a city?	<ul style="list-style-type: none"> <li>• Measuring Tape</li> </ul>
9. Post-Assessment:	<ul style="list-style-type: none"> <li>• <a href="#">Urban Forestry: Urban Heat Islands Post-Assessment</a></li> <li>• <a href="#">Urban Forestry: Urban Heat Islands Rubric</a></li> </ul>
10. Possible next	<ul style="list-style-type: none"> <li>• <a href="#">Lesson Plan   What Contains Carbon?</a></li> </ul>

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steps/off-ramps/actions	<ul style="list-style-type: none"> <li>• <a href="#">Urban Forestry Laboratory Exercises</a></li> </ul>
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### Learning Sessions

<b>1.</b>	<b>Grounding Native Ways of Knowing</b>	Estimated time: 60 minutes
<p>To connect to native ways of knowing consider exploring the following ideas in connection with your local tribal nation by researching stories of the past and learn about current work and actions the Tribe is taking to mitigate, adapt to, and find solutions to a changing climate.</p> <ul style="list-style-type: none"> <li>• <i>Cedar Box Teaching Tools-<a href="#">Western Red Cedar</a></i> includes abundant information about the relationship between cedar and Indigenous people. It includes the <i>Story of Grandmother Cedar</i> and <i>The Girl Who Was I-I-Esh</i>, told by Roger Fernandes, Lower Elwha S’Klallam Storyteller. Video of Roger Fernandez’s story can be viewed at. <a href="#">Traditional Native Storytelling with Roger Fernandes: “The Ay-ay-esh Girl; A Sahaptin Legend”</a> For more on using this resource see, <a href="#">Intro Cedar Box</a></li> <li>• <a href="#">Teachings of the Tree People</a> guides using the video <a href="#">Teachings of the Tree People: The Work of Bruce Miller</a></li> </ul> <p>To access information on how to reach out and build relationships with local tribes, visit the <a href="#">OSPI Office of Native Education: Partnering with Tribes</a>, and contact your district’s tribal liaison/Title VI coordinator.</p> <p>To learn more about respecting and building upon Indigenous Peoples’ Rights visit the <a href="#">Learning in Places website</a>, a project led by Dr. Megan Bang then read Practice Brief #10: <a href="#">Teaching STEM In Ways that Respect and Build Upon Indigenous Peoples’ Rights</a> and Practice Brief #11: <a href="#">Implementing Meaningful STEM Education with Indigenous Students &amp; Families</a> published on the University of Washington’s <a href="#">STEM Teaching Tools website</a></p> <p>Suggested activity for teachers and students: 3-2-1 research process.</p> <ul style="list-style-type: none"> <li>• Three new learnings about the Tribe most local to you</li> <li>• Two questions that you still have about the Tribe</li> <li>• One action you can commit to begin a partnership with the Tribe</li> </ul> <p>Below are some examples of regional tribal connections to Forestry. Most tribes and nations have active forest management departments, so these are just examples from around the state.</p> <ul style="list-style-type: none"> <li>• Port Gamble S’Klallam <a href="#">Forestry</a></li> <li>• <a href="#">Forestry — Colville Tribes</a></li> <li>• <a href="#">Puyallup Tribe Timber, Fish &amp; Wildlife</a></li> </ul>		

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2.	<b>Examine phenomena: Heat Island Effect and Trees</b>	Estimated time: 60 minutes
<p>Have students look at the <a href="#">Urban Heat Island Profile image</a>. Go over the terms and what they mean. Have students describe the relationship of human’s surface activities and the effect on temperature in the late afternoon.</p> <p>Next: How do you think this might affect your neighborhood and the neighborhoods of others?</p> <p>Choose areas near your community and zoom in to look at tree cover in various areas using Google Maps satellite view. Please see the examples below.</p> <ul style="list-style-type: none"> <li>• Satellite view of two areas in Seattle- Rainier Beach &amp; Mercer Island</li> <li>• Satellite views of two areas in the Tri-Cities-Pasco and Richland</li> <li>• Satellite views of two areas in Spokane- Hillyard and Manito</li> </ul> <p>For more information on equity and trees in urban areas, see <a href="#">Tree Equity in America's Cities</a></p>		
3.	<b>Pre-Assessment:</b>	Estimated time: 45 minutes
<p><a href="#">Urban Forestry: Urban Heat Islands Pre-Assessment</a>  <a href="#">Urban Forestry: Urban Heat Islands Rubric</a></p>		
4.	<b>Guiding question: What do trees need to grow?</b>	Estimated time: 90-120 minutes
<p><b><u>Activate prior knowledge: See-Think-Wonder:</u></b></p> <p>Show students the picture from <a href="#">Spokane Finch Arboretum</a>. Do not tell them anything about the picture. In small groups or whole group, students ask questions and write them on chart paper or <a href="#">See Think Wonder</a> chart. (<a href="#">See / Think / Wonder</a> strategy explained)</p> <ul style="list-style-type: none"> <li>• What do you see? What do you think about what you see? What do you wonder?</li> </ul> <p>Share student answers. Take time to discuss hypothesis, ideas, or generate more questions.</p> <p>Read the <a href="#">“Trees that are centuries old help tell story of Spokane,”</a> article to find out about the picture, and discover the reason “Comfort Trees” were planted. Discuss how age and size may not compare.</p> <p>Extension:  <b><u>To look for other special trees:</u></b></p>		

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#### [Forest for the Trees](#)

##### **What is a tree? What does it need to grow?**

Watch the “[Trees for Kids | Learn all about trees in this fun educational video for kids](#)” video. (video tells about growth at 5:45, then rings at 7:24)

- Use Open discussion, mind map, or journal notes to record what trees need to grow.

One way to learn about tree growth is to look at annual rings. Tree rings show patterns of change in the tree’s life as well as changes in the area where it grows.

Observe annual growth rings using this [Tree Cookie Cross Section](#) of a 102-year-old ponderosa pine from northwest Nebraska to learn about the many changes in a tree’s lifetime.

##### **What can trees tell us about a changing climate?**

Using the infographic and article, read strategies to learn about tree rings. [What Can Trees Tell Us About Climate Change?](#)

Create your own tree cookie.

- [Tree Rings](#): template
- [Reading Tree Cookies](#): How to read Tree Cookie worksheet.

Optional:

[Virtual Tree cookies](#)

[Tree Rings Simulation - Dendrochronology | UCAR Center for Science Education](#)

\*Project Learning Tree activities and resources to enhance or extend the lesson.

\*Tree Cookies and other activities: [PreK-8 Activity 76 - Tree Cookies](#)

##### **Smart Trees!** (Review)

[What Trees Need to Grow](#) Consider the mighty Redwood. Ask the question, how did it adapt?

##### **Tree Art: (formative assessment)**

Choose a type of tree you like or want to know more about.

**Create a Quick-Sketch** of your tree; add a bullet list of tree facts for your tree.

- Where is your tree found?
- Habitat and Tree characteristics?
- What environmental events could affect your tree’s growth?
- How has your tree adapted to the area where it grows?
- How do humans and wildlife need/use your tree to live?
- Why did you choose this tree?

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	Students can post their pictures to share with class.
	Extension: Students review 3 classmates’ sketches, and comment.

<b>5.</b>	<b>Guiding question: How do trees cycle matter?</b>	Estimated time: 45 minutes
<p>Learn about how carbon moves through trees.</p> <p>Lead with the visual, <a href="#">Tree Carbon Cycle and Sequestration</a>. Make sure to have picture of trees with arrows on the chart. The next step will be writing information in pencil lightly. Teacher models each section and then writes over the pencil. Students will repeat each section as teacher writes it. Make sure to color chunk out each part of the tree cycle in different colors to organize the information.</p> <p>Students say it and do it as facilitated practice (guided practice) with the teacher.</p> <p>Students neighbor pair-share, negotiate for meaning, and apply the term to new contexts.</p> <p><b>Extension Activity</b>  <a href="#">Garden Activities- Catching Water</a>          *Ground needs to be porous so water is absorbed/ not flowing          *Soil conditions impact water availability and soil erosion.</p> <p><b>Carbon Sequestration</b>  <u>Sit Spot</u>: Sit outside on a patio, lawn, field, or sidewalk. Draw and label a map/model/examples of carbon sequestration in your outdoor area.          OR  <u>Flip Grid</u>: Record an explanation of places/things you see where carbon sequestration is happening in the yard or outdoor area.</p> <p>Resources:  <a href="#">Earth Science: Carbon Cycle</a>  <a href="#">Why it Matters: Climate</a></p> <p>Interesting fact:          Today's <a href="#">#WackyWordWedesdsay</a> is <b>psithurism</b>.          You pronounce it: sith-er-ism. It refers to the sound of rustling leaves. Can you hear the <b>psithurism</b> that the wind is causing?</p>		

<b>6.</b>	<b>Guiding question: What problems occur when cities lack trees?</b>	Estimated time: 30 minutes
Learn how to keep cities cool in the summer. Cities can become Urban Heat Islands, places that are much warmer, than surrounding countryside. After this lesson, students will		



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	<p>understand the concept of Heat Islands, how it is created, and ways to make cities cooler.</p> <p>Have students explore the Heat Island effect by completing the part 1 of the <a href="#">Summer in the City</a>. Looking for an additional source, check out <a href="#">Why is one neighborhood hotter than another?</a></p>
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<b>7.</b>	<b>Guiding question: How do trees change the climate?</b>	Estimated time: 2- 60 minute classes
<p>Have students watch the video, <a href="#">The Power of Trees</a></p> <p>Observation/sit spot:</p> <ul style="list-style-type: none"> <li>● Find a space outdoors within view of a large shrub or tree.</li> <li>● Take a few minutes to sit and observe the tree.             <ul style="list-style-type: none"> <li>○ Record the number of organisms observed during this time.</li> <li>○ Is there a difference in the type and amount of plants and animals near the tree vs. further away from the tree?</li> </ul> </li> </ul> <p>Have students read page 12 of <a href="#">Why Do We Plant Trees?</a> And list all the ways trees benefit a community.</p> <p>How do trees impact the climate? Trees or lack thereof can impact the temperature of an area and can ultimately impact the climate of an area.</p> <p>Activity: Students will explore the impacts trees can have on outdoor temperatures. Students will use their background knowledge to hypothesize temperatures of different landscapes in their surrounding area; then test their ideas through a schoolyard investigation.</p> <p>Sit spot: Have students sit outside and observe their surroundings. Students can use this time to think about temperature and the landscape. Students can hypothesize or rank areas in their schoolyard from warmest to coolest and articulate why they chose the rankings.</p> <p>Students can now test their hypothesis by participating in an infrared thermometer activity: Divide students into groups. Using an infrared thermometer</p> <ul style="list-style-type: none"> <li>● Is there a difference between the temperature under a tree and on the pavement?</li> <li>● If so, what causes that difference?</li> <li>● Do trees act as a buffer (cool and warm) to the outside temperature?</li> <li>● How do trees impact?</li> </ul> <p>If you do not have access to an <a href="#">It's Gettin' Hot! Urban Heat and Trees</a> or <a href="#">What Makes Cities Hot?</a> activity to measure the</p>		



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	<p>temperature of different landscapes.</p> <p>After both activities, students can compare the results of their hypothesis and investigation and answer the question, do trees and other vegetation make a difference in the temperature of an area? Do you think we can change the temperature of an area by altering landscapes?</p> <p>Extension activity: Using GoogleEarth/Maps/GIS map out all the trees around your school. Where would you suggest planting more trees?</p> <p>Explore outdoors. Choose trees in your community or near your school to find out what their benefits are worth. Use Project Learning Tree <a href="#">Family Activity: Name That Tree</a> and <a href="#">Family Activity: What's the Value of that Tree?</a> to identify and measure trees. Then use <a href="#">My Tree</a> to calculate the benefits and value of the tree. Check out <a href="#">National Tree Benefit Calculator</a> and <a href="#">Learn about i-Tree   i-Tree</a> if you want to go more deeply into measuring tree benefits.</p> <p>Teacher Background &amp; Support Materials: <a href="#">Western Washington and Oregon Community Tree Guide: Benefits, Costs and Strategic Planting</a> <a href="#">Project Learning Tree's Teaching with i-Tree</a></p> <p>Additional resources that support learning about benefits of trees include: <a href="#">Trees in Our City Slides</a> <a href="#">Urban Forest Data</a></p>
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<b>8.</b>	<b>Guiding question: How do we increase urban forests equitably across a city?</b>	Estimated time: 4-5 60 minute classes
	<p>Many cities have plans and programs to increase trees and their benefits in their communities. For example, <a href="#">Spokane</a>, <a href="#">Tacoma</a>, <a href="#">Pasco</a>, <a href="#">Vancouver</a>, <a href="#">Seattle</a>, <a href="#">Yakima</a>, <a href="#">Bellingham</a>. Learn about what your city is doing to manage their urban forests or choose one of these cities to examine.</p> <p>Learn about careers related to urban forestry by inviting a guest speaker from the program. Or, examine forestry related career professionals using Pacific Education Institute’s <a href="#">Career Cards</a>. to visit. Prior to your visit, use <a href="#">Google Maps</a> Satellite View or <a href="#">Google Earth</a> to analyze the location and amount of tree canopy in that area. Then visit the area using <a href="#">Summer in the City Part 2: Field Investigation</a> as a guide. Have teams of students propose actions to improve the urban forest in this area. For some ideas, see <a href="#">Innovative Ways to Create More Urban Green Spaces</a> or <a href="#">Sidewalk Design Street Trees Policies</a>. Alternately, engage in an extended study of an urban area using <a href="#">Lesson Plan: Urban Forests in your Neighborhood</a> as a guide.</p> <p>Finally, have students complete <a href="#">Summer in the City Part 3: Essay</a>. Write a letter to your city planner explaining the Urban Heat Island Effect, why this is a problem, and what your city can do to decrease heat during the summer months.</p>	

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	Teacher Background Resources: <a href="#">SCENARIO 04: Building the Urban Forest</a> <a href="#">The Sustainable Urban Forest</a>
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<b>9.</b>	<b>Post-Assessment:</b>	Estimated time: 45 minutes
	<a href="#">Urban Forestry: Urban Heat Islands Post-Assessment</a> <a href="#">Urban Forestry: Urban Heat Islands Rubric</a>	

<b>10.</b>	<b>Possible next steps/off-ramps/actions:</b>	
	To explore more about stormwater, check out Pacific Education Institute’s <a href="#">DRAIN RANGERS</a>  <b>What Contains Carbon?</b> by California Academy of Sciences, can be used to extend learning about carbon <a href="#">Lesson Plan   What Contains Carbon?</a>  Extended study methods for the urban forest can be found in <a href="#">Urban Forestry Laboratory Exercises</a>	

### Teacher Resources

#### [OER Tracker](#)

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