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| **3D-Student Science Performance** *Author: Lorie Cavalli* |
| **Grade 2**  | **Lesson Title****Effect of Catastrophic Wildfire on Soil in** **Forest Watershed** |
| **Lesson Topic: Fire and Soil** |
| **Performance Expectations (Standard) from State Standards or NGSS:** **AZSS****2.E1U1.4:** [**Observe and**](https://www.nap.edu/read/13165/chapter/7#74) [**investigate**](https://www.nap.edu/read/13165/chapter/7#59) how wind and water change the shape of the land resulting in a variety of landforms.**2.E1U3.7** **Construct an argument from evidence** regarding positive and negative changes in water and land systems that impact humans and the environment. *[Clarification Statement: Examples of events could include catastrophic forest fires and flooding which happen quickly. Key concepts discussed are healthy forest watershed and ecosystem, healthy forest, unhealthy forest and healthy soil conditions.* |
| **Lesson Performance Expectations:*** ***Construct an explanation*** for the ***causes*** of unhealthy forests, forest fires and of the ***changes*** to the land and water flow in a forest ecosystem
* ***Plan and carry out an investigation*** to determine the ***causes*** of unhealthy forests, forest fires and the ***changes*** to forest ecosystem and watershed.
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| ***Engage******Explore******Explain******Core ideas*** *•Students will explore how fire causes the most changes to the surface of the land in a short time. Students will record how Fire changes the surface of the land, causing erosion and flooding.* *•Student will model how healthy forests reduce flooding and erosion****Crosscutting concepts*** *focus on change, stability, scale.*  | **Student Science Performance*****Phenomenon:* There are sandbags around town and in my playground after a Forest Fire!*****Gather***1. Students make observations strong (resilient) forest ecosystems and about crowded and uncrowded forests.

 (Teaching suggestions: Show photos of forest ecosystem, crowded and uncrowded forests) Students will participate in a simulation model demonstrating what a healthy forest looks like compared to an unhealthy forest. Movement Activity: Trees to Close to Me (Yellowbelly Ponderosa Project)1. Students engage in class discussion: What happens when it rains and when snow melts off mountains? [Teacher prompt: Refer to prior lesson and the models that students used and developed]
2. Gather evidence for the ***causes*** of a crowded forest versus uncrowded forest (Teaching suggestions: by reading the book Ponderosa Pete. What are the parts of each forest ecosystem? Which forest looks like a healthy/unhealthy forest? Why? Put vocabulary words on word wall.)
3. Students ***develop questions*** about the ***causes*** of a crowded forest versus uncrowded forest and what makes a forest ecosystem strong and resilient.
4. Student groups will develop a physical model using forest board and use it to explore forest ecosystems:
	1. (Teaching suggestions: Students will have available:
		1. Reference books
		2. Laminated copy of Healthy and Unhealthy Forest
		3. Forest Parts Laminated Cards
		4. Pair-share with other classmates to recreate storyboard as needed.)

***Class Discussion:****Questions to initiate class discussion****.*****Patterns*** Write a few sentences in journal to describe the patterns that you see in the forest ecosystem.
* What patterns do you see in the healthy forest/unhealthy forest?
* Describe any patterns you see in the healthy forest watershed
* Record any patterns you see in the forest ecosystem in journals.
* What patterns do you notice when you removed parts of the forest ecosystem?
* What features of these patterns can you explain using the forest board?
1. Students ***plan and carry out an investigation*** to determine the ***causes*** of an unhealthy forest ecosystem.
2. Students ***obtain information*** about what a managed and naturally resilient forest looks like and ***changes*** that happen to forest health when foresters clean up a crowded forest.

**Class Discussion:** *Students talk about what* ***changes*** *in the forest when foresters clear out debris, low hanging branches allowing the forest floor opens up to sunlight. plant more water to grow and food for animals.****Cause and Effect**** *What are the effects of removing plants in the forest ecosystem?*
* *What might cause plants to be removed from the forest ecosystem?*
* *What are the effects of having a mix of plants, trees and animals in the forest ecosystem (biodiversity)*
* *How does fire cause the forest ecosystem to change?*
* *When is fire good for forest ecosystem? When can it be harmful (catastrophic)?*
* *What happens to water on a forested watershed?*
* *What happens to water on a watershed that has a lot of bare ground?*
* *Write a claim for the most likely cause or causes of flooding after forest fire*
* *What mechanism may be responsible for the catastrophic forest fire*

*Teaching Suggestions:** Teacher shares a learning kiosk with interactive technology <http://gffp.org/kiosk/>
* Forest field trip. Teacher shows video to prepare: <https://youtu.be/62aygEwlzC4>

***Reason*** 1. Students ***construct an explanation*** for the ***causes*** of unhealthy forests and ***changes*** that happen to the forest ecosystem and watershed post catastrophic wildfire. Vocabulary words that should be on the wall by now include Healthy Forest, Unhealthy Forest, Forest Ecosystem and Watershed (refer back to lesson 1).
2. Students ***use a model*** (Soil Experiment) to classify various types of Forest watershed and ***changes*** in water flow rate, absorption, permeability and runoff.

***Soil in Forest Watershed Reasoning***1. Students will develop a 3D physical model in small groups to explain what makes a forest watershed system healthy.
	1. Students will have available:
		1. Forest board model made by class
		2. Bookmarked picture books
		3. Forest mystery box items
		4. Healthy Organic Soil
		5. Plants
		6. Rocks
		7. Soil Experiment Kit
2. Students will develop a 3D model in small groups to explain what makes a forest watershed system unhealthy.
	1. Students will have available:
		1. Forest board model made by class
		2. Bookmarked picture books
		3. Forest mystery box items
		4. Unhealthy forest parts to be matched to books (branches, depleted, burnt soil, sand, peat moss, less parts)
		5. Burnt soil water repellency video: <https://youtu.be/3a02Bf8977s>

*Teaching Suggestions:** *Teacher will visit each child engaged in the discovery box activity center creating a healthy forest ecosystem and watershed.*
* *Teacher will invite children to help build forest ecosystem and watershed with healthy soil for plants*
* *Teacher will provide clues about the features of healthy soil to children in identifying and classifying.*
* *Teacher will ask students to document what they see in the ecosystem and soil.*

***Class Discussion:****Questions to initiate class discussion****.******Structure and Function**** *What properties are important for the forest ecosystem and watershed to be healthy?*
* *What particular structures are observed in a healthy forest ecosystem and watershed?*
* *What roles do these structures have in the healthy forest ecosystem and watershed?*

***Systems and System Models**** *What system do we need to model in order to explain this phenomenon?*
* *Add each part of the system in a circle and show the interaction between healthy forests and healthy watershed*
* *What scale within the system do we need to model the forest ecosystem and watershed?*
* *What are small parts and large parts of a healthy forest ecosystem and watershed?*
* *Which are more important for a healthy forest ecosystem and watershed, small or large parts? Or equally important?*
* *How much more (or less) small parts are there compared to large parts in a healthy forest ecosystem?*
* *What are the components or sub-systems of this healthy forest ecosystem?*

***Energy and Matter****• Describe how matter (water) moves from forest to streams in this system.**• Draw one or more arrows to show how matter (water) moves between forest to streams**• Draw a model that show how matter (water) was changed after catastrophic wildfire****Stability and Change****• How can I improve the stability of the soil in the forest watershed?**• What conditions would cause this healthy forest ecosystem to become unstable or fail?**• Describe the processes that could have changed the unhealthy forest ecosystem.* ***Forest Reasoning***1. Student will discuss and use their models develop explanations about what a healthy forest ecosystem and watershed is
2. Students will discuss and develop explanations about resiliency of healthy forest ecosystems

***Communicate Reasoning*** * + Students use their ***evidenced based explanations*** about the ***changes*** to Forest Ecosystem Health, Soil Health and Watershed Health to ***develop an argument*** about positive and negative changes in water and land systems that impact humans and the environment.
	+ Students will demonstrate water repellency using the 3D models created
	+ Students will document findings in notebook
	+ Students will present models in small groups
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| **Formative Assessment for Student Learning** |
| **Elicit Evidence of Learning: *develop an argument*** for how the evidence they collected from adding plants to forest ecosystem supports the ***explanation*** that plants in an ecosystem ***changes*** to the forest watershed. Explain why this would help soil conditions. |
| **Evidence of Student Proficiency** Students will create a tree chart and be able to match samples of healthy forests and unhealthy forests. *This will be a work sample.*•A checklist of what the student can observe and record about healthy watershed soil versus soil post fire will be completed.•Student participation in locating and referencing various parts of forest ecosystem and watershed to our board and books on forest fires. Students will record what happens when water is poured on soil in watershed that is healthy versus soil that hasexperienced a catastrophic wildfire in journal*. These will be anecdotal observations.* | **A Range of Typical Student Responses***Descriptors of grade-level-appropriate student responses:****Full Understanding*** *:* Water post-fire causes the most changes to the surface of the land in a short time. The water, post-fire, was able to change the surface of the land by causing erosion and flooding. Based on our data, we have evidence that water post-fire is able to make more changes to the surface of land than water without extreme fire. Healthy and resilient forests reduce flooding and erosion.***Partial understanding:*** fire and water cause erosion. The rainwater after a forest fire causes more flooding.*The student explains that post-fire erosion and water can cause a change in the land, but does not have clear evidence to support the**explanation.****Limited understanding:*** When we washed water over the burnt dirt we got a lot of dirt to wash off, but when we washed water over dirt with plants, not as much as water.*The student provides the evidence but does not argue for how it supports any explanation.* | **Acting on Evidence of Learning** ***Appendix C.****Description of instruction action and response to support student learning.*•Students will identify and label forest ecosystem parts and sort them, separate the parts and name the type of plants and trees. •Students will Build a healthy forest ecosystem and watershed with diverse parts using a 3D Model.•Students will communicate the components of healthy soil in forest watershed in journal•Students will sort and classify forest ecosystem and soil parts by using cups and/or paper charts.Evidence of learning: Students will be able to record an observation of soil permeability and impermeability pre and post fire. Students will develop an argument supported by evidence that fire causes changes to soil by making the soil hydrophobic. Students will demonstrate with a 3D model the effects of plants, biodiversity and healthy soil in a forest watershed. |
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| *SEP, CCC, DCI Featured in Lesson* | **Science Essentials** *(Student Performance Expectations From Appendix C, D, E)* |
| **Science Practices** | Pose questions that art testableMake careful observations that generate evidenceExplain science observations using evidenceUse evidence to support arguments about scientific explanations and phenomena |
| Ask questions Plan and carry out investigationsConstructing ExplanationsDevelop an argument |
| **Crosscutting Concepts** | Use patterns as evidence to support explanations.Identify the components contributing to the cause of an effectDescribe stability and change in terms of time scales |
| PatternsCause and EffectStability and Change |
| **Disciplinary Core Ideas** | Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe. (2-ESS1-1) |
| ESS1.C: The History of Planet Earth |

**Appendix:**

Engineering Design Process



Diagram of Water Repellent Soil



Supplemental Video Learning

[In Process]

* Ft Valley Experiemental Forest
* Ft Valley Restoration Area
* Dry Lake Hills
* Seed Fields at Museum of Northern Arizona

**Activities**

**Forest Board:** The Forest Board is a large poster board that demonstrates a forest ecosystem with Ponderosa Pine Trees, native grasses, wildflowers, pine needles, pine cones, squirrels, birds, bees, sunlight, rain and a stream.

**Matchstick**

Students can be given an opportunity to independently plan and conduct an investigation of different fire strengths (using a match stick vs. pack of matches) and water amounts (a cup of water vs a pitcher of water) over time. Video demonstration alternative.

**Yellowbelly Movement Activity**: Too Many Trees Between You & Me Adapted from Yellowbelly Ponderosa Project

**3D Forest Watershed Model** with Soil Experiment

**Vocabulary:**

Resiliency, organic, hydrophobic, watershed, impermeable, infiltration, runoff, catastrophic, stormwater, flooding, vegetation, crown fire, ladder fuel, duff layer

**Concepts:**

***Erosion*** *happens when rocks are picked up and moved to another place by ice, water, fire.*

***Forest Treatments*** *help protect the watersheds and provide healthy forests to ensure abundant,*

*clean water.*

***Forest Treatments*** *help our community protect our environment, property and water supply.*

***Forest Treatments*** *reduce risk for extreme fires that cause flooding.*

*Studying what happens at the coast, in rivers or in the desert can help us figure out how*

*landscapes* ***change.****.*

**Materials:** Laminated cards with healthy forest (park-like) and unhealthy (crowded, duff layer, ladder fuel). Forest board with pictures of trees, streamflow, meadow, plants, native grasses, fire, soil, rocks, sand

**Suggested Reading:** Ponderosa Pete *by Julie Blake Gidley* takes young learners on a journey

through a ponderosa pine forest and tells tales about forest health.

**Technology Integration:**

Interactive fire ecology kiosk

<http://gffp.org/kiosk/>

**Field Trip:**

If you have the opportunity to take students on a field trip, the kiosk is in Ft Tuthill County Park

and has a demonstration area that illustrates a thinned vs. un-thinned forest. For the three

kiosks posted in the Park, see: <http://gffp.org/essential_grid/fort-tuthill-kiosks/>