BOOTH WESTERN ART MUSEUM

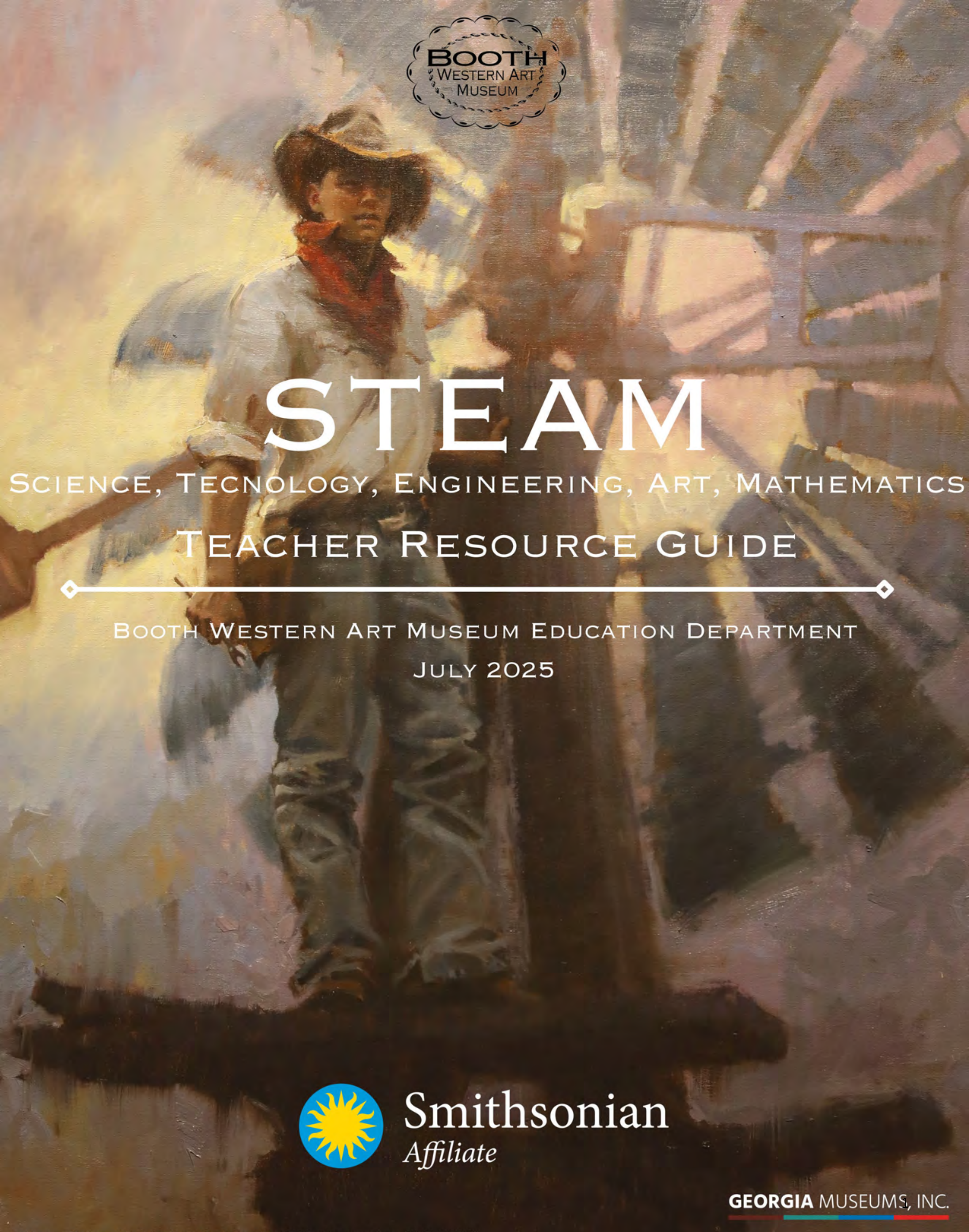
STEAM

Science, Tecnology, Engineering, Art, Mathematics

Teacher Resource Guide

Booth Western Art Museum Education Department

July 2025



© Nancy Boren, ***Aloft in the Western Sky***, 2010, oil on canvas, 39.5" X 29.5"

Smithsonian Affiliate

GEORGIA MUSEUMS, INC.

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This guide was created by the Education Department at the Booth Western Art Museum. Written by Nicolette Paglioni, Erin Zaballa, and McKenzie Brick. Edited by Jennifer Richardson and Patty Dees.

What is the Correct Terminology: American Indian or Native American?

Both of these terms are acceptable, but it is best to use the specific tribal name when discussing or describing Native people. In the United States, Native American has been widely used but is falling out of favor with some groups, and the terms American Indian or Indigenous are preferred by many Native people. According to a 1995 Department of Labor poll, 50% of Native respondents preferred the term American Indian while 37% preferred the term Native American. Other acceptable terms used to describe Native people in North America include First Nations (primarily used in Canada),Indigenous American, First American, and Alaska/Alaskan Native.

As a Smithsonian affiliate, Booth Western Art Museum follows the guidelines of the Smithsonian and uses the term American Indian when referring collectively to the Native peoples of North America. For more information from the Smithsonian National Museum of the American Indian, please refer to their Native Knowledge 360° Did You Know? Webpage: https://americanindian.si.edu/nk360/didyouknow#topq2

© Lakota Sioux, ***Beaded horse-mask with American flags***, c. 1890. Erik & Renee Lee collection.

What is Visual Thinking Strategies?

Visual Thinking Strategies (VTS) is an inquiry-based teaching strategy for all grade levels. It is a teaching strategy used for looking at **images**, **photographs**, and **artwork**. You do not need any special art training to use this strategy. The strategy is very simple: You, the teacher, act as facilitator and ask students a set of questions while looking at images.

Begin by asking students to look closely and silently at an image of your choice for a minute or two. Three questions guide the discussion:

- "What's going on in this picture?"
- "What do you see that makes you say that?"
- "What more can we find?"

The goal of VTS is not to teach the history of a work of art but, rather, to encourage students to observe independently and to back up their comments with evidence. At the beginning students should simply identify things they see, no matter how big or small it might seem. Artists always have a reason for including things within their artwork! After discussing what they see, the discussion can delve into what the painting means.

When a student responds to a question…

- **Listen carefully.**
- **Point** to the element in the painting that the student is talking about.
- After each student's response, **paraphrase** what the student said. Paraphrasing their answers is an important component of VTS —it lets students know that they have been heard and that their contributions to the discussion are valid.
- Comment on their observations **neutrally**, avoiding words such as "correct" or "wrong".
- **Link** student comments that are contrasting or complimentary.

The goal of VTS is to encourage critical thinking skills like group problem solving. VTS will not only help students understand artwork, but also be able to interpret images that they see in their everyday lives. This strategy can be used with any of the artworks provided within this educator guide.

For more information: https://vtshome.org

Stanford Design Model

The Stanford Design Model

The Stanford Design Model involves six distinct steps to engage the students' creativity and teamwork to solve problems.

Step one: **Empathize**

Students will imagine the people who have a problem and imagine how they might feel.

Step two: **Define**

Students will create a statement summarizing the problem with an emphasis on how the problem affects real people.

Step three: **Ideate**

Students will work together to brainstorm solutions to the problem, suspending judgment and building on each others' ideas.

Step four: **Prototype**

Having decided on a solution, now the students will use various craft materials to build a prototype.

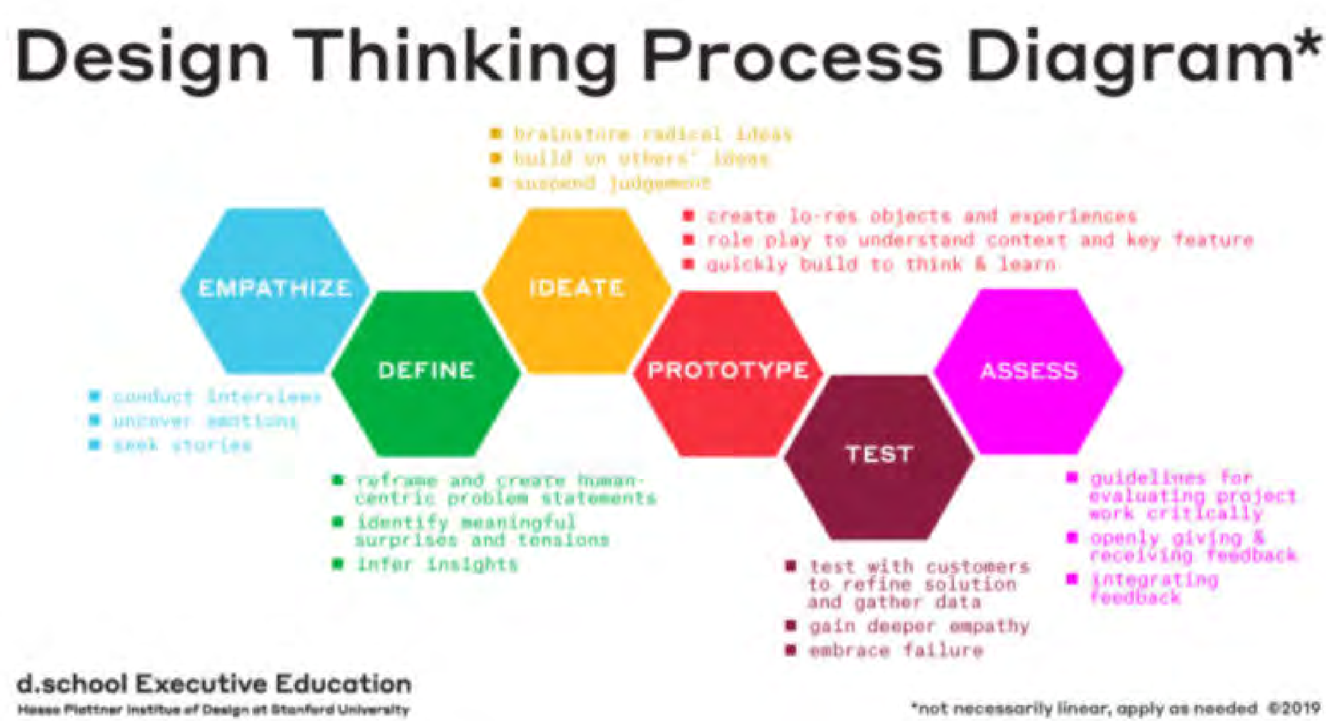
Step five: **Test**

The teacher will decide how the students would know their prototype succeeds. Then, the students will test their prototype, and embrace failure.

Step six: **Assess**

Students will give and receive feedback without judgment, and incorporate that feedback into improvements on their prototype.

Using this model will increase student engagement with their learning, and give them more control over how they learn.



STEAM Lesson 1: Crossing the River

Summary: Students will use the Stanford Design Model to design a wagon that will successfully cross a river on a trip out West via the Oregon Trail. They will learn about simple machines, distance, and the history of Westward Expansion.

Objectives: After completing this lesson, students will be able to:

Understand how simple machines work to create solutions to problems that pioneers faced.

Know how to determine the length, area, and perimeter of a wagon.

Use artwork to tell a story and solve a problem.

Georgia Standards of Excellence: SS4H3c, SS5H1d, S4P3a, S4P3c, 3MDR.5, 3.GSR.7.3, 3.GSR.8.1, 4.GSR.8.1, 4.GSR.8.2, 5.GSR.8.4, 5.MDR.7.1, V4RE.1a,b,c

Next Gen Science Standards: 3-5-ETS1-1,2,3

Suggested Materials:

- Cardstock
- Cardboard
- Construction Paper
- Cotton Balls
- Dowels
- Straws
- Rubber Bands
- Modeling Clay
- Tape
- Rulers
- Markers
- Aluminum Foil
- Glue
- Scissors
- Craft Sticks
- Building Blocks
- Styrofoam
- Balloons
- Chenille Sticks
- Twine
- Paper clips
- Basin of water

Procedure:

1. Lead students through VTS discussion with artwork (William H. Ahrendt, *The Bullwhackers*, and Jim Carson, *On the Oregon Trail*). See VTS Information sheet.
2. **Explain:** Pioneers on the Oregon Trail faced many problems on their journey. One of those problems would be crossing a river with a wagon filled with all of their belongings.
3. **Describe** the Stanford Design Model, with each of the six steps that the students will follow to solve the problem.
4. **Allow** students to come up with their own solutions. As long as they follow the Stanford Design Model, incorporate one simple machine, and create a solution that succeeds the test, they may create any solution they decide.
5. **Test** the students' creations by placing them in a shallow container of water.
6. **Give constructive feedback** on students' solutions, and allow them to make improvements. Allow other students to give feedback as well. It will help to have set rules for giving feedback in the beginning, to ensure everyone's comments are kind and constructive.

You can customize this lesson to support different math standards:

<u>To support 3rd grade math standards</u>: each wagon **must measure at least 6 inches** in length (3.MDR.5), have students **determine the area** (3.GSR.7.3) and **perimeter** (3.GSR.8.1) of the **base** of the wagon, or its wheels.

- Area of a Polygon = Width x Length
- Area of a Wagon = 2 x (Area of the Base) + Perimeter x Height
- Perimeter of the Wagon = 2 x (Length + Width)
- Circumference of the Wheels = 2 x π x Radius or π x Diameter

<u>To support 4th grade math standards</u>: have students **identify types of lines** in the wagon (4.GSR.8.1), or classify **polygons** used to make the wagon (4.GSR.8.2).

- Types of lines: Perpendicular, Parallel, Intersecting, Diagonal, etc.
- Types of Polygons: Quadrilateral, Rectangle, Pentagon, Octagon, Hexagon, etc.

<u>To support 5th grade math standards</u>: Have students **determine the volume** of the prism created by the shape of their wagon (5.GSR.8.4), and use **different units of measurement** to determine the wagon's **speed** (5.MDR.7.1).

- Volume of the prism = Base x Height
- Speed = Distance ÷ Time

<u>Additional Resources:</u>
Oregon Trail Center: https://oregontrailcenter.org/the-wagon

National Parks Service: https://www.nps.gov/articles/000/wagons-on-the-trails.htm

<u>Historical Background:</u> In 1862, Abraham Lincoln passed the **Homestead Act**, which guaranteed many people who went out West the chance to claim **160 acres of land for free.** As a result, people began to move in a mass migration to the Western plains to claim their free land. They followed various routes to get out West, one of which was the very famous **Oregon Trail**. Along the Trail, they would **face thousands of dangers**: animals, hunger, thirst, disease, exposure, and accidents being just a few. In order to successfully make the move, pioneers had to pack all of their furniture, belongings, clothing, tools, food, and animals into their wagons and make the trek across thousands of miles overland. Their wagons had to be **sturdy**, well-built, and **large** enough to hold everything they owned. If they lost their wagons for any reason— whether in weather, flood, or as the result of theft— they would be left with nothing. The threat of **losing all of their possessions** made the crossing of rivers very **dangerous**, because pioneers had **no way of knowing** the depth or speed of the rushing water. Crafting a wagon sturdy enough to **withstand difficult terrain** and river crossings would mean the **difference between life and death** in the West. The risk inherent in the trip was worth it for the pioneers, who hoped to build a better life for themselves. Many pioneers traveled out West not only seeking the land promised by the Homestead Act, but also in search of valuable **gold**. Between the **Gold Rush** and the promise of free land, hundreds of thousands of pioneers made their way out West, with everything they could carry in wagons that were designed to weather any terrain and circumstance.

DESIGN THINKING PROCESS: ON THE OREGON TRAIL

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INSTRUCTIONS: YOU ARE ON THE OREGON TRAIL WHEN YOU COME ACROSS A RIVER. USE THE STEPS BELOW TO DESIGN A SOLUTION.

1. EMPATHIZE

Take 2 minutes to think about what Oregon Trail Pioneers would have felt in this situation.

2. DEFINE

What is the biggest problem your group would like to solve?

3. IDEATE

Brainstorm solutions. Make sketches and provide feedback on each other's designs.

4. PROTOTYPE

Use the materials provided to create your solution! Write down your process so others can do the same thing.

5. TEST

Test your solution to see if it will be able to cross the river. Write down your observations and possible improvements.

SKETCHES

Artwork

Use **Visual Thinking Strategies** with this artwork:

1) What is going on in this painting?
2) What do you see that makes you say that?
3) What more can you find?

© William H. Ahrendt, ***The Bullwhackers***, 1988, Oil on canvas, 41.5 x 57.5”

© Jim Carson, ***On the Oregon Trail***, Oil on canvas, 2010, 40 x 60”

STEAM Lesson 2: Homesteading Weather Station

Summary: Students will use the Stanford Design Model to design a weather station, which is described as an observation post where weather conditions and meteorological data are observed and recorded. A weather station will successfully give them information about the temperature, air pressure, wind direction, and precipitation of the outdoors. They will learn about weather, measurements, and volume.

Objectives: After completing this lesson, students will be able to:

Understand how use a weather station to collect weather data.

Know how to determine the volume of an object.

Use artwork to tell a story and solve a problem.

Georgia Standards of Excellence: SS4H3c, S3P1b, S4E4a,b,c,d, 3.MDR.5, 4.GSR.8.1, 4.GSR.7.1, 4.NR.1.1, 4.MDR.6.2, 4.NR.5.1, 4.NR.5.2, 4.MDR.6.2, MGSE4.G.1, 5.GSR.8.4, 5.MDR.7

Next Gen Science Standards: 3-5-ETS1-1,2,3

Materials:

- Cardstock
- Cardboard
- Construction Paper
- Cotton Balls
- Dowels
- Straws
- Rubber Bands
- Dixie Cups
- Tape
- Rulers
- Markers
- Aluminum Foil
- Glue
- Scissors
- Craft Sticks
- Plastic cups with lids
- Styrofoam
- Plastic bottles
- Bottle caps
- Food coloring

Procedure:

1. Lead students through VTS discussion with artwork (Loren Entz, *A Helping Hand*, and Duane Byers, *A Day's Work Done*). See VTS information sheet.
2. **Explain:** Homesteaders faced many challenges for survival in the harsh climate of the Plains. One of those problems was the **weather**.
3. **Describe** the Stanford Design Model, with each of the six steps that the students will follow to build their weather station. **Divide** students into groups, and have them work together to create their weather station.
4. **Allow** students to come up with their own solutions. As long as they follow the **Stanford Design Model** to create a solution that succeeds the test, they may create any solution they decide.
5. **Test** the students' creations by placing them outside and seeing if they can measure air pressure, wind direction, temperature, and precipitation.
6. **Customize** this lesson by adding the following standards, and using the worksheets provided:

<u>To support 3rd Grade Math standards:</u> Have students measure the length of the various components of the weather station (3.MDR.5). Have students express their measurements of precipitation using base-ten numbers (3.NR.1.1), round up to the nearest 10 or 100 (3.NR.1.3), and express their measurements as fractions (3.NR.4.4). Have students write down the time they take each of their measurements (3.MDR.5.2). Have students compare the volume and mass of their precipitation in different containers (3.MDR.5.5).

To support 4th grade Math Standards: Have students write their measurements using **base-ten numbers** and **round up** to the nearest hundred-thousandth (4.NR.1.1). Have students represent the whole numbers of their measurements as **fractions**, and then those fractions as **sums of fractions** with the same denominator (4.NR.4.4, 4.NR.4.5). Have students **compare their results** with others **using the symbols >, <, or =** (4.NR.5.3). Have students **generate their own questions** about their measurements, and then answer them (4.MDR.6.2).

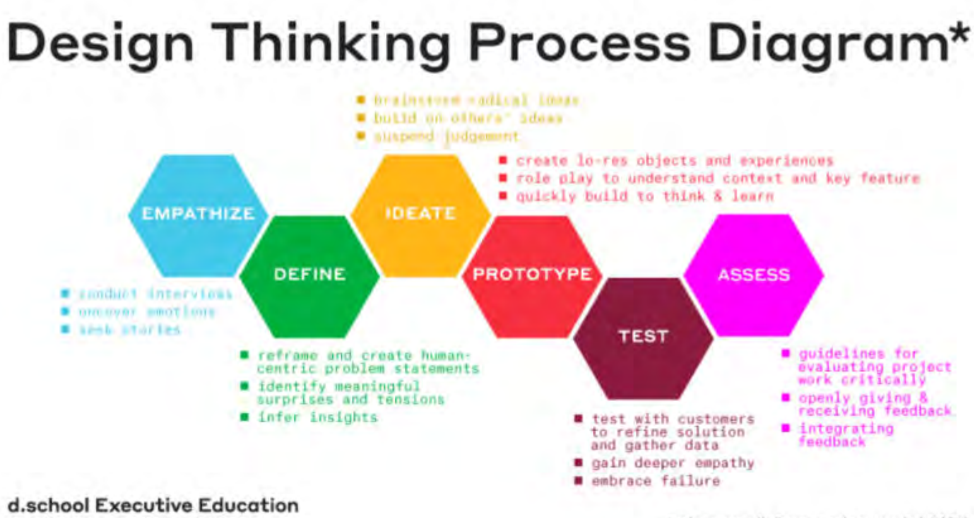
To support 5th grade Math Standards: Have students express their **measurements as fractions**, and compare fractions of **different denominators** (5.NR.3.2). Have students express their measurements in **decimal** and **expanded form** and **round up** to the nearest hundredths place (5.NR.4.1, 5.NR.4.3). Have students **compare their measurements** in decimal and fraction form **using the symbols <, >, and =** (5.NR.4.2).

Additional Resources:
https://inventorsoftomorrow.com/2018/01/22/diy-weather-station-for-kids/#thermometer

Historical Background: In 1862, Abraham Lincoln passed the **Homestead Act**, which guaranteed many who went out West the chance to claim **160 acres of land for free.** As a result, people began to move in a **mass migration** to the Western plains to claim their free land with the promise to improve the land within five years. They followed various routes to get out West, one of which was the very famous **Oregon Trail**. Many pioneers traveled out West not only seeking the land promised by the Homestead Act, but also in search of valuable **gold**. Between the **Gold Rush** and the **promise of free land**, hundreds of thousands of pioneers made their way out West, with everything they owned in their wagons. Once they received their claimed land, however, pioneers faced a new set of challenges: to live and work the land. Many pioneers started ranches or homesteads, and needed to innovate tools and equipment to live their life on the land. One of the major issues pioneers faced no matter where they were, or what they decided to do with their land, was the weather. In order to survive harsh **winters**, brave **dust storms**, or predict **sudden storms**, pioneers built **weather stations**. Weather stations include instruments to measure air pressure, wind direction, precipitation levels, and air temperature. Together, these instruments would give pioneers plenty of information about their surroundings to be able to survive whatever comes.

Stanford Design Model

Use the Stanford Design Model to guide students through the process of creating their weather stations.



DESIGN THINKING PROCESS: DUST STORM

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INSTRUCTIONS: A LARGE DUST STORM IS ABOUT TO HIT THE PLAINS REGION OF THE U.S. AND YOU NEED A WAY TO RECORD IT. USE THE STEPS BELOW TO DESIGN A SOLUTION.

1. EMPATHIZE

How do you think the people living in the Plains region would have felt about an approaching storm?

2. DEFINE

What problems might the storm cause if it is not properly recorded?

3. IDEATE

Brainstorm solutions. Make sketches and provide feedback on each other's designs.

4. PROTOTYPE

Use the materials provided to create your solution(s)! Write down your process so others can do the same thing.

5. TEST

Test your solution(s). Write down your observations and possible improvements.

DESIGN THINKING PROCESS: DUST STORM

SKETCHES

Math Worksheet: Decimals, Fractions, & Rounding

Use your precipitation measurement to fill out each space.

1. Measurement:

______________ **mLs**

______________ **inches**

2. Rounded up to nearest **tenth**:

______________ **mLs**

______________ **inches**

3. Rounded up to nearest **hundredth**:

______________ **mLs**

______________ **inches**

4. Rounded up to nearest **thousandth**:

_____________ **mLs**

_____________ **inches**

5. Fraction: ______ /______

6. Time: ______ : ______ **AM / PM**

7. Compare with a friend:

My friend's measurement is _________________ mLs, which is equal to _______ / ______.

8. Write both your measurement and your friend's measurement in the space below, as a **fraction or a decimal**. Then **circle the symbol** below that **best compares** your measurements:

______ < > = ______
(Friend) (Mine)

9. Add your measurements together as **fractions**:

___ / ___ + ___ / ___ = ___ / ___
(Friend) (Mine) (Total)

10. Move your water from one container to another. How did the measurement change?

Original Container: __________ mLs _____ / _____ _______ inches

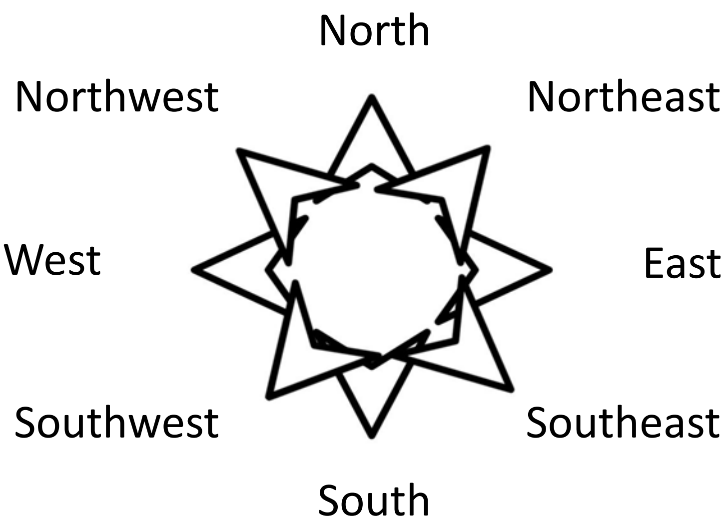
New Container: _________ mLs _____ / _____ _______ inches

Weather Worksheet: My Weather Data

Students will use the **Stanford Design Model** to design a weather station that will successfully give them information about the temperature, air pressure, wind direction, and precipitation of the outdoors. As you use your weather station, take notes on the wind direction, wind speed, air pressure, and temperature. Record your results below.

Wind Direction:

Draw a line on the compass that best represents the direction of the wind.



Time: ______ **:** ______ **AM / PM**

Temperature:

_________ °Fahrenheit

_________ °Celsius

Time: ______ **:** ______ **AM / PM**

Temperature:

_________ °Fahrenheit

_________ °Celsius

Time: ______ **:** ______ **AM / PM**

Temperature:

_________ °Fahrenheit

_________ °Celsius

Wind Speed:

Observe your anemometer closely as the wind blows. Set a timer for one minute. Count the number of rotations you see in one minute.

Number of rotations: __________ rotations per minute (RPM)

Precipitation:

Observe your rain gauge. How much water is in the gauge?

Milliliters: _________

Inches: ____________

Air Pressure:

Observe your barometer. Where is the needle pointing? How many inches of pressure does it read?

Inches: __________

Weather Station Craft: Thermometer

A thermometer measures the temperature of the air outside.

To Create:

1. Start with a bottle, either glass or plastic.
2. Fill the bottle almost halfway with either water or rubbing alcohol (rubbing alcohol will react faster).
3. Add food coloring to the water, just enough to get the surface of the water to halfway up the bottle.
4. Place a straw into the bottle. Make sure the straw is touching the water but not touching the bottom of the bottle.
5. Secure the straw with modeling clay, play-dough, or tape but make sure the top of the straw is not covered.

To Test:

Place the thermometer outside. Make sure the bottle is rested at room temperature before testing, to give you a baseline. If the weather is warmer outside the water should rise up the straw, supporting the principle of thermal expansion (objects expand and become larger due to change in temperature). If the weather is cooler, the liquid should contract and fall back into the straw.

Possible Variations:

Possible feedback that students might be able to incorporate into their design might include: adding a small amount of vegetable oil (one drop should suffice) to prevent evaporation, using a real thermometer to check the accuracy of the craft (students can guess where measurements should be placed on the bottle, then check to see if they were accurate with a real thermometer), and using more food coloring to make the water easier to see.

Weather Station Craft: Weather Vane

A weather vane shows the direction of the wind.

To Create:

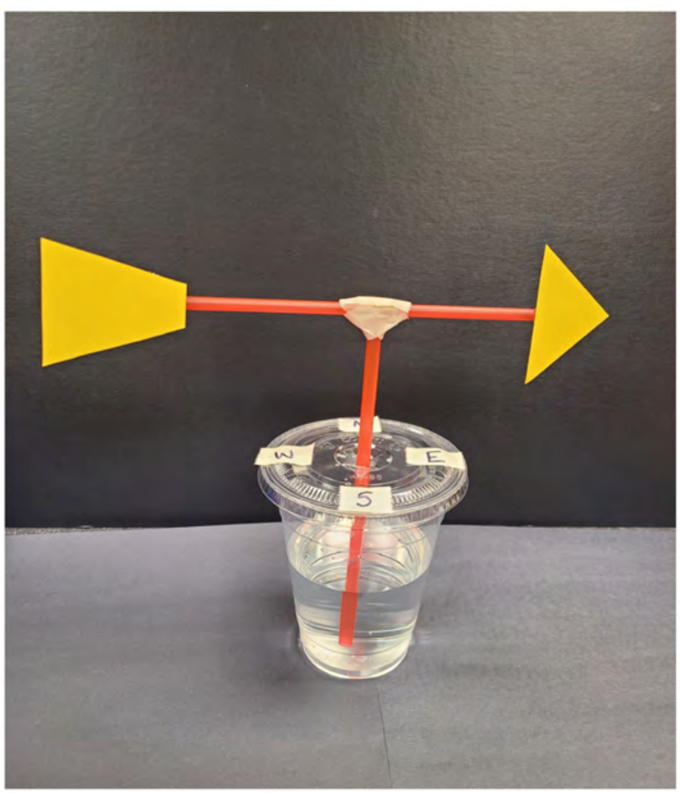
1. To start, grab a plastic cup with a lid, and label the four directions on the lid.
2. Place a straw into the lid. Do not secure it; the idea is for it to be able to turn easily.
3. Take a second straw, and lay it on top of the first straw horizontally. Tape or glue the straws together, making sure the horizontal straw is centered.
4. Next, take a piece of cardstock and cut out a triangle and a trapezoid.
5. Secure the triangle to one end of the straw with tape, a pin, or glue.
6. Secure the trapezoid to the other end of the straw with tape, a pin, or glue.

To Test:

Place the weather vane outside on a windy day. See which direction the arrow points in. For reference, use a compass to ensure the direction is correct on the lid.

Possible Variations:

Fill the cup with water or modeling clay to weigh it down. Make sure the hole in the lid is wide enough for the straw to spin, but not so wide that it gets wonky. Use a paper plate with the four directions on it in place of the lid.



Weather Station Craft: Anemometer

An anemometer measures how fast the wind is blowing, or wind speed.

To Create:

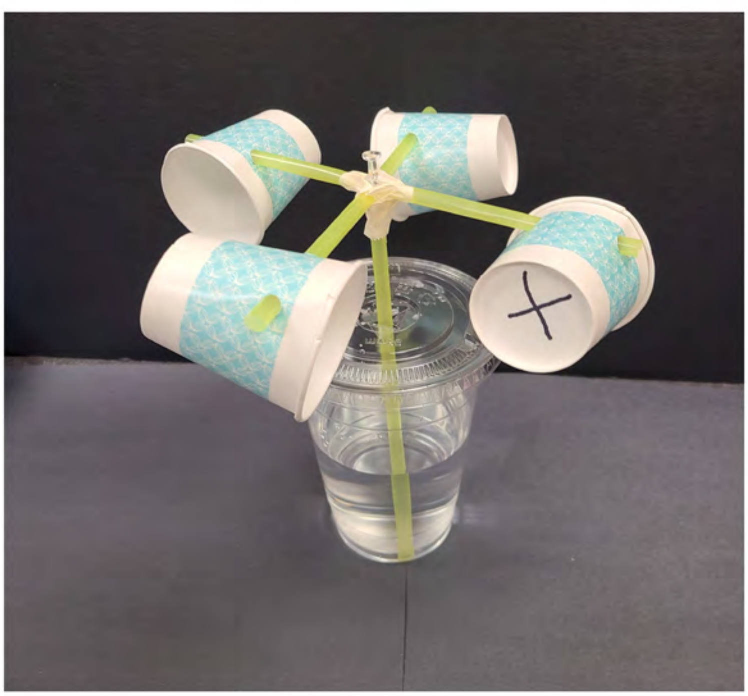
1. Start with a cup with a lid and a straw. Poke the straw through the lid.
2. Take 4 Dixie cups, and punch two holes in each cup, so that the holes are directly across from each other.
3. Take two straws and cross them to make an X or a + sign, tape them together.
4. Poke a pin through both straws and tape them to the vertical straw.
5. Slide one cup on the end of each straw. Make sure they are all facing the same direction.
6. Mark one cup with an X so you can track the rotations of the cups.
7. Fill the cup with water to weigh it down.

To Test:

Set the anemometer outside while the wind is blowing. Set a timer for 1 minute and count the rotations by following the cup with the X within the minute.

Possible Variations:

Mark the cup with an X as well so you can see when the X's cross, to better count the rotations. Make one cup a different color to have it stand out better. Weigh down the cup with modeling clay, dirt, or Play-Do. Make the straws longer, or add more straws and cups to give your anemometer more spinning power.



Weather Station Craft: Rain Gauge

A rain gauge catches rain to measure how much rain has fallen.

To Create:

1. Start with a two liter bottle. Cut the top off.
2. Place pebbles or glass beads in the bottom of the bottle to weigh it down. Add enough water to cover the pebbles and create an even waterline.
3. Turn the top of the bottle upside down, to form a funnel. Put the funnel into the bottom part of the bottle.
4. Tape the edges together to form a seal.
5. Stick one long vertical piece of tape onto the bottle and draw a horizontal line to mark the waterline at the top of the pebbles. This will be the zero mark.
6. Draw horizontal lines up the tape, a centimeter or quarter inch apart. Label them from bottom to top.

To Test:

Set the rain gauge outside and watch the water rise as it rains. Write down the level of the water at several intervals. Take note of the time that you take each measurement to figure out how much rain is falling over a certain amount of time.

Possible Variations:

Add food coloring to make the water level easier to see (make sure it's different from the color you chose for the thermometer!). Use a balloon rather than the top of the bottle for a funnel. Use clear tape to better see the water level, or draw the measurements directly onto the bottle.

Weather Station Craft: Barometer

A barometer measures the air pressure, or how heavy the air is outside.

To Create:

1. Start with a glass jar and a balloon.
2. Cut the end off the balloon and stretch the balloon over the top of the jar. Make sure it's nice and tight to seal the jar.
3. Secure the balloon with rubber bands.
4. Cut a small arrow out of cardstock. Make sure the point of the arrow is sharp to ensure a precise measurement.
5. Fit the arrow into the mouth of a straw. If it's loose, cut a larger arrow or tape the arrow to the straw.
6. Insert another straw into the straw with the arrow on the end by squeezing one end of one straw and inserting it into one end of the other straw. Alternatively, you can tape the straws together. The idea is to create a long, but still stable, straw. The longer the straw is, the better the reading will be.
7. Squeeze a drop of glue onto the center of the balloon. Stick the end of the straw onto the balloon.
8. Secure the straw with a piece of tape.
9. Take a long vertical piece of tape and secure it to a piece of cardboard. Label each centimeter using a ruler.
10. Stand the cardboard up on one end and place it next to the jar, so that the arrow points at one of the centimeters. If it won't stand up on its own, secure it to another piece of cardboard using glue or tape.

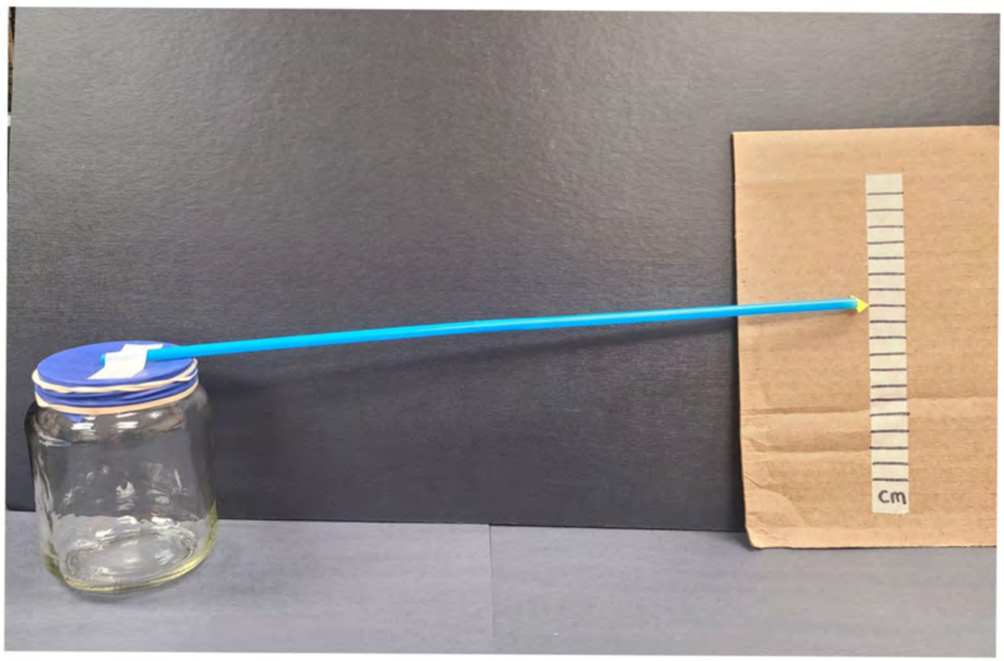
To Test:

Place the barometer outside and wait. Watch the arrow rise on the cardboard reading, and take measurements throughout the day. When the arrow points lower than the lid of the jar, that means the air pressure outside of the jar is higher (or heavier) than the air inside the jar. When the arrow points higher than the lid of the jar, that means the air pressure outside of the jar is lower (or lighter) than the air inside the jar.

Weather Station Craft: Barometer

Possible Variations:

Replace the straws with dowels or chopssticks. Replace the cardstock arrow by simply covering the straw or dowel with a small piece of paper, wrapping it until it forms a point and securing it with tape. Use a plastic cup weighted with pebbles rather than a jar. Use a paper towel holder as the measurement instead of a piece of tape on cardboard.



Artwork

© Loren Entz, ***A Helping Hand,*** 1994, Oil on canvas, 45 x 47”

© Duane Bryers, ***A Day’s Work Done,*** 1992, Oil on canvas, 40 x 50”

STEAM Lesson 3: Climate Homes

Summary: Students will use the Stanford Design Model to design their own climate homes, learn about climate and American Indian ingenuity in surviving their environments.

Objectives: After completing this lesson, students will be able to:

Understand the difference between weather and climate.

Use problem-solving skills to create a climate home for their assigned American Indian region.

Understand the lives of American Indians in various environments.

Georgia Standards of Excellence: SS4H3c, S3P1b,c, S4E4d, S5E1a, 3.MDR.5.3, 3.MDR.5.4, 3.GSR.6.2, 3.GSR.7.3, 3.GSR.8.1, 4.PAR.3.1, 4.MDR.6.2, 4.GSR.7.1, 4.GSR.8.1, 4.GSR.8.2, 5.GSR.8.4, 5.MDR.7.1, 5.MDR.7.2, V4RE.1a,b,c

Next Gen Science Standards: 3-5-ETS1-1,2,3

Suggested Materials:

- Cardstock
- Cardboard
- Construction Paper
- Cotton Balls
- Dowels
- Straws
- Rubber Bands
- Modeling Clay
- Tape
- Rulers
- Markers
- Aluminum Foil
- Glue
- Scissors
- Craft Sticks
- Building Blocks
- Styrofoam
- Fabric scraps
- Ping pong balls
- Ice cubes
- Thermometer
- Spray bottle of water

Procedure:

1. Lead students through VTS discussion with artwork (J. Doyle Rogers, *Cliff Palace*, Kevin Red Star, *Ready for the Two Step*, and Warren E. Rollins *Indian Water Carrier*). See VTS information sheet.
2. **Explain:** For thousands of years, American Indians of all nations had to find ways to survive in various climates. Different regions have different **climates**, or **weather patterns**. American Indians had to design and build their homes using **natural resources** so that they can be comfortable in the climate they live in.
2. **Describe** the **Stanford Design Model,** with each of the six steps that the students will follow to build their own climate home. **Divide** students into groups, and have them **select a climate** from the stack of cards. They must **work together** to create their climate home.
3. **Allow** students to come up with their own solutions using the **Stanford Design Model.** Have students **use the grid as a base** to build their climate home, and have them **count the squares** to determine the **area of the house.**
4. **Test** the students' creations by subjecting them to "rain," "snow," "hail," and "wind." Use the craft materials provided to create the "weather".
5. **Customize** this lesson by adding the following math standards:

To support 3rd grade Math Standards: Have students measure the length, area, and perimeter of each shape they use to build their climate home. Have students categorize the lines and shapes they use to build their climate home, and measure them to the nearest inch and half-inch.

To support 4th grade Math Standards: Have students identify the types of lines and polygons used in the construction of their climate home. Have students generate and answer their own word problem related to their climate home and gathered information about their climate. Have students identify the different angles used in the construction of their climate home.

To support 5th grade Math Standards: Have students measure the volume of their climate home, including the mass, weight, perimeter, area, and height of the structure. Have students identify the polygons and angles used in the construction of their home, and then compare them.

Additional Resources:

https://www.ncei.noaa.gov/access/climateatlas/

https://impactlab.org/map/#usmeas=absolute&usyear=1986-2005&gmeas=absolute&gyear=1986-2005

https://www.nnvl.noaa.gov/view/globaldata.html

https://nca2023.globalchange.gov/chapter/16/

https://www.cakex.org/

https://www.teachengineering.org/activities/view/a_house_for_me

https://www.solar4stem.com/blog/five-easy-solar-power-experiments-for-kids-steam-stem

https://climate.earthathome.org/teacher-friendly-guide/

https://nso.edu/wp-content/uploads/2018/10/Energy-Card-Game.pdf

Historical Background: For thousands of years, **American Indians** of every culture and nation survived their natural environments. These environments ranged from the **cold of the Arctic** to **swamplands** to **hot, dusty deserts**. Different American Indian nations living in different environments built different **homes to adapt** to those environments. **Eastern Woodlands Northeast** tribes such as the Narragansett and the Haudenosaunee (Iroquois) lived in huge wooden structures called **longhouses**. These homes could house **up to 100 people**, provide **warmth** and **protection** from Northeastern snows, and shade in the summertime. **Eastern Woodlands Southeast** nations like the Cherokee and Muscogee (Creek) lived in **roundhouses** made of clay, with a thatched roof. The clay would **absorb the heat** of the sun during the day, keeping the inside cool, until the evening when the warmed clay could **insulate the interior** during the night. Tribes in present-day Florida such as the **Seminole** used reeds and lumber to build open-air shelters called **chickees**, which allowed wind to flow through freely. **Southwestern** tribes lived in a variety of homes. Many Zuni people lived in **pueblos** which were made of clay and functioned similarly to the roundhouses. Dine (Navajo) people lived in **hogans**, which were also made of clay, and **built into the ground** to protect from high winds. Nomadic Plains nations such as the Očhéthi Šakówiŋ (Sioux), Cree, and Apsalooké (Crow) used the abundant **buffalo** to make their **tipis**, which were **collapsible** and easily transported as they hunted the buffalo. **Arctic** nations such as the Inupiaq (Inuit) built **igloos** made of ice, lined with the skins and fat of animals like walrus and whales, which kept the inside warmer than the frigid outside, and protected the interior from icy winds. **Pacific Northwest** nations such as the Haida, the Coast Salish, and the Tlingit people used the cedar wood of the surrounding forests to build their **plank houses**. Similar to the longhouses of the Northeast, plank houses were made of long planks of wood, without windows and with a low-pitched roof, to **conserve heat** and **allow rainwater to flow** easily off the roof. It's important **not to overgeneralize** about American Indian nations, and to remember that houses often differed among nations and even among tribes of the same nation, **depending on their resources, uses, and needs**.

Climate Homes

Select a Climate Card and use the **National Oceanic and Atmospheric Administration (NOAA)** website to gather the statistics about the temperature, precipitation, and severe weather. Please follow **www.noaa.gov** for more information.

1) **What does each piece of information tell you about the climate you have chosen?**

Temperature:

Precipitation:

Severe weather:

2) **What is the difference between climate and weather?**

3) **What materials are best for your climate?**

4) **Which of the houses below would you choose for your climate home? Why?**

Igloo

Tipi

Pueblo

Longhouse

Plankhouse

Roundhouse

Building a Base for a Climate Home

Use the grid pattern below to map out a base for your home. Use the boxes to measure the area of your home.

DESIGN THINKING PROCESS: CLIMATE HOMES

BOOTH WESTERN ART MUSEUM

GEORGIA MUSEUMS, INC.

INSTRUCTIONS: YOU NEED TO BUILD A HOME SUITED TO YOUR CHOSEN CLIMATE. USE THE STEPS BELOW TO DESIGN A SOLUTION.

1. EMPATHIZE

Take 2 minutes to think about what problems the people living in your climate might face.

2. DEFINE

What problems do climates create for homes and the people who live in them?

3. IDEATE

Brainstorm solutions. Make sketches and provide feedback on each other's designs.

4. PROTOTYPE

Use the materials provided to create your solution(s)! Write down your process so others can do the same thing.

5. TEST

Test your solution(s). Write down your observations and possible improvements.

DESIGN THINKING PROCESS: CLIMATE HOMES

SKETCHES






Arctic

Temp:

Precip:

Severe Weather:

Plains

Temp:

Precip:

Severe Weather:

Northeast Woodlands

Temp:

Precip:

Severe Weather:

Southwest

Temp:

Precip:

Severe Weather:

Southeast Woodlands

Temp:

Precip:

Severe Weather:

Pacific Northwest

Temp:

Precip:

Severe Weather:

Artwork

Use **Visual Thinking Strategies** with this artwork:

1) What is going on in this painting/sculpture?
2) What do you see that makes you say that?
3) What more can you find?

© J. Doyle Rogers, ***Cliff Palace,*** 2023, Hand plasma cut stainless steel, 14 x 42 x 16"

© Kevin Red Star, ***Ready for the Two Step,*** 2006, Mixed media on canvas, 50 x 62"

© Warren E. Rollins, ***Indian Water Carrier,*** c. 1910, Oil on canvas, 47 x 39"

STEAM Lesson 4: Oil Spill

Summary: Students will use the Stanford Design Model to design a solution for cleaning up an oil spill that they will model hands-on. Students will also learn about the effects of oil spills on the environment and the historical significance of oil in the American West.

Objectives: After completing this lesson, students will be able to:

Understand the historical significance of the discovery of oil in the American West.

Understand the impact of oil spills on the environment.

Use online resources to explore an issue from multiple points of view.

Georgia Standards of Excellence: CSS.KC.6-8.16, S6E6, 6.MP, VA6.RE.1, VA6.RE.2, S7L4 , 7.MP, VA7.RE.1, VA7.RE.2, S8P1, 8.MP, VA8.RE.1, VA8.RE.2

Next Gen Science Standards: MS-LS2-4, MS-ETS1-1, MS-ETS1-2, MS-ETS1-3, MS-ETS1-4

Materials:

- Aluminum pie pans or similarly sized containers, 1 per group of students
- Vegetable oil
- Cocoa powder (mix small amount with vegetable oil to mimic the appearance of crude oil and make it easier to see)
- Small graduated cylinder, 1 per group of students
- Materials to try to absorb oil (paper towels, cotton balls, pieces of sponge, gauze, cloth, etc.)
- Materials to try to skim oil off the surface of the water (pipettes, spoons, etc.)
- Fasteners like rubber bands, paper clips, chenille sticks so that students can combine materials
- **Design Thinking** worksheet
- **Viewpoints** worksheet
- Computers with internet access

Procedure:

1. Lead students through VTS discussion with artwork (John Bye, ***Sunset Ranching***). See VTS information sheet.

2. **Explain:** American Indians began using oil deposits in North America in prehistoric times, gathering oil from **petroleum seeps** (places were petroleum naturally comes to the Earth's surface). In the mid to late 1800s, large oil wells were constructed in the eastern United States, and as the population spread west during **Westward Expansion**, the search for oil continued. In 1901, a huge **oil strike** at Spindletop Oil Field in Texas began the **Texas Oil Boom**. Within a few years the oil fields of America became the top producers of petroleum in the world. This led to **industrialization** in the West, and towns that had previously been small and rural (like Houston) became **large cities** very quickly. Oil has had a tremendous effect on the **economy** of the United States since the boom began. In recent years, however, **environmental concerns** have led some people who live where oil is produced or transported to **protest** the construction of oil rigs and pipelines. One of the most well-known conflicts was between the **Dakota Access Pipeline** and the **Standing Rock Sioux** American Indians.

3. Prior to activity, mix the cocoa powder with the vegetable oil, use just enough to make the oil darker and easier to see.
4. **Activity Part 1:** Pass out **Viewpoints** worksheet and instruct students to use online resources to research, compare, and contrast the viewpoints of those who supported the Dakota Access Pipeline and those who protested against it.
5. **Activity Part 2: Explain:** You're going to imagine that there has been an oil spill into a pond (represented by the container of water) and try to clean it up.
6. Pass out **Design Thinking** worksheet and lead students through steps 1-3 (Empathize, Define, Ideate).
7. Divide students into groups and pass out containers of water and oil removal materials.
8. Add 1 tablespoon of the vegetable oil/cocoa powder mixture to each container of water.
9. **Explain:** Notice the oil sits on top of the water. The molecules in oil are **hydrophobic**, meaning that they are repelled by water molecules rather than being attracted to them and forming bonds. Your task is to try to remove as much oil as you can from the water. You may try **absorbing** the oil with materials like gauze, or **skimming** the oil off the top of the water with items like spoons. *Remind them that they should try to remove as much oil as possible while removing as little water as possible*. Try to gather collected oil in the graduated cylinder (for absorbing methods, students will not be able to squeeze all the oil out of the absorbent materials and into the cylinder, they should just do what they can). Instruct students to fill out Design Thinking worksheet steps 4 and 5 (Prototype, Test) as they go along.
10. Encourage students to refine their designs and try new solutions based on the effectiveness of their results as they go.

To support 6th grade standards ask**:** What is the difference between sustainable and non-renewable resources? Is oil a sustainable resource or a non-renewable resource? Why is oil classified as non-renewable?

To support **7th grade standards ask**: What effects might oil spills, caused by human activity, have on the environment and organisms that live there? What effects might oil spills have on local food chains and animal populations?

To support **8th grade standards ask**: Does the oil or water undergo any physical or chemical changes when the oil is poured into the water? Explain your answers.

Additional resources:

NOAA "Oil Spills" https://www.noaa.gov/education/resource-collections/ocean-coasts/oil-spills

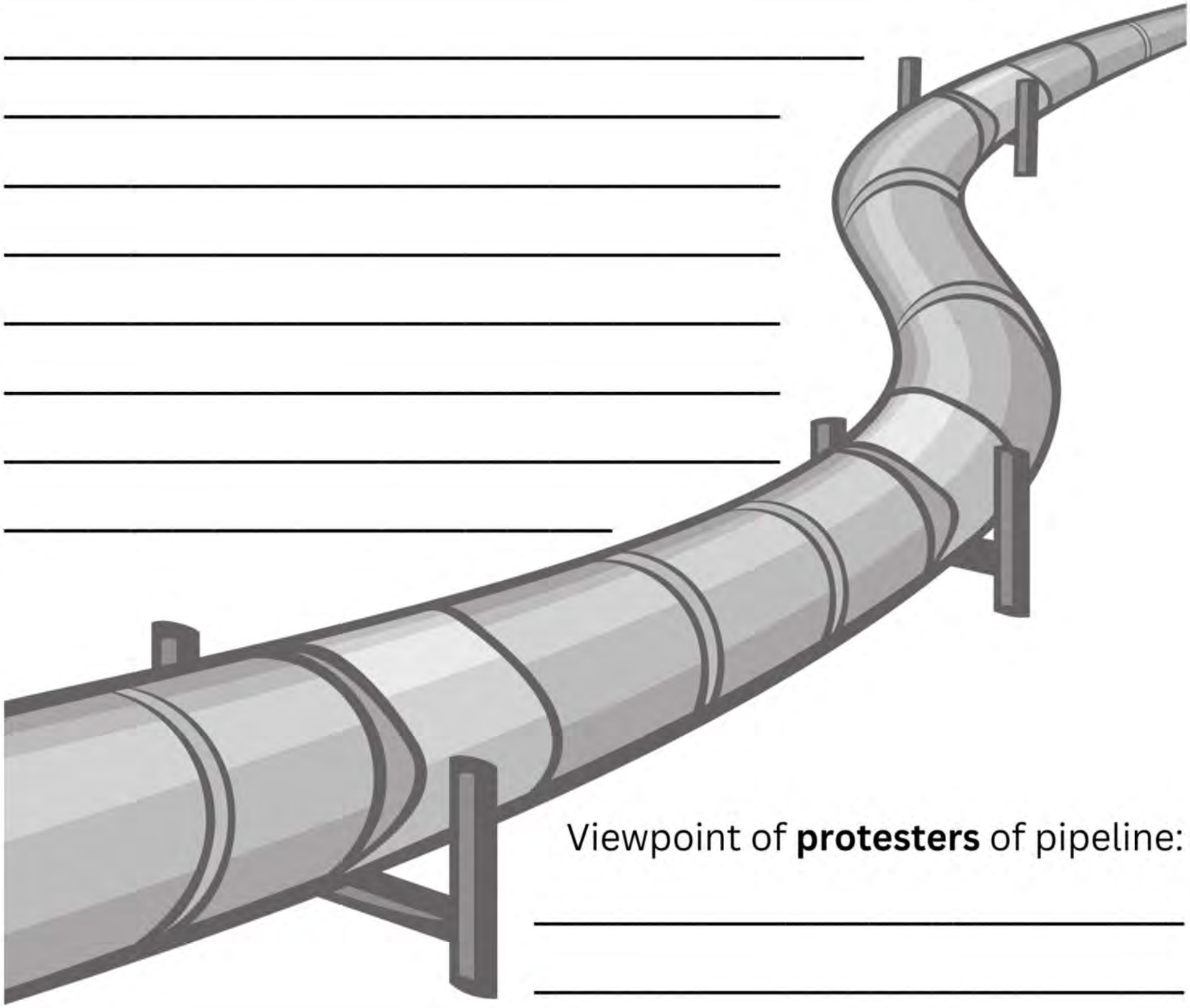
UN Environmental Programme "How to manage the damage from oil spills" https://www.unep.org/news-and-stories/story/how-manage-damage-oil-spills

Historical Background:

Humans have used oil deposits in North America since prehistoric times, when Native Americans first began gathering oil from naturally occurring **petroleum seeps**. In 1859, the first **commercial oil well** in the United States, the Drake well, was constructed in Titusville, PA. Oil wells continued to be discovered and utilized as **Westward Expansion** led to European-American settlement in areas farther west. In 1901, the unprecedented size of the oil strike at Spindletop Oil Field near Beaumont, TX led to what is now known as the **Texas Oil Boom**. Also called the Gusher Age, this period (1901-1940s) was a time of drastic change and swift **industrialization** of the American West. The **oil fields of Texas, Oklahoma, and California** soon became the leading producers of petroleum in the world, surpassing the production of the Russian Empire. In more recent times, however, **environmental concerns** about the production and transportation of oil via **pipelines** in the western United States have emerged. Concerns about the effect of potential oil spills and leaks into the environment and possible **contamination of drinking water** have led some communities to protest the construction of pipelines, sometimes leading to confrontations with oil companies. One of the most well-known protests had to do with the **Dakota Access Pipeline** – a 1,172 mile long underground pipeline running from North Dakota to Illinois. Part of the pipeline was constructed under the Missouri River at Lake Oahe, just half a mile from the reservation of the **Standing Rock Sioux** American Indians. The Standing Rock Sioux were concerned not only that a leak could impact their drinking water and devastate the environment, but also about the fact that pipeline construction would pass through, and potentially destroy, some of their **sacred areas and burial sites**. Despite the objections of the Standing Rock Sioux and their supporters, the pipeline was constructed as planned.

VIEWPOINTS

Viewpoint of **supporters** of pipeline:



Viewpoint of **protesters** of pipeline:

DESIGN THINKING PROCESS: OIL SPILL

BOOTH WESTERN ART MUSEUM

GEORGIA MUSEUMS, INC.

INSTRUCTIONS: AN ACCIDENT HAS CAUSED AN OIL SPILL IN THE LAKE THAT PROVIDES A TOWN'S DRINKING WATER. DESIGN A SOLUTION.

1. EMPATHIZE

How would the people of the town feel in this situation?

2. DEFINE

What problems might the oil cause for the people and environment if it is not cleaned up?

3. IDEATE

Brainstorm solutions, provide feedback on each other's designs.

4. PROTOTYPE

Use the materials provided to create your solution(s)! Write down your process so others can do the same thing.

5. TEST

Test your solution(s). Compare and contrast how well each solution worked.

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DESIGN THINKING PROCESS: OIL SPILL

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SKETCHES

© John Bye, ***Sunset Ranching***, n.d., acrylic on canvas, 30 x 40"

STEAM Lesson 5: Windmills of the West

Summary: Students will use the Stanford Design Model to design a windmill that they will model hands-on. Students will also learn about the historical significance of windmills in Westward Expansion and gather data about the location of Earth's water sources.

Objectives: After completing this lesson, students will be able to:

Understand the function and importance of windmills.

Understand the historical significance of windmills in the era of Westward Expansion.

Use online resources to find data and answer questions.

GA Standards of Excellence: CSS.KC.6-8.16, S6.E3b, VA6.RE.1, 6.MP, S7L3c, VA7.RE.1, 7.MP, S8P2c, VA8.RE.1, 8.MP

Next Gen Science Standards: MS-ETS1-1, MS-ETS1-2, MS-ETS1-3, MS-ETS1-4

Materials:

Materials to construct the body and blades of the windmill can include paper, craft sticks, dowels, cardboard, etc. No matter what building materials you choose students must have a way for their blades to rotate. For example: a push pin stuck into an eraser or piece of cork, or a brad punched through paper or cardboard.

Procedure:

1. Lead students through VTS discussion with artwork (Nancy Boren, *Aloft in the Western Sky*). See VTS information sheet.
2. Pass out copies of the Plains Times student worksheet for students to read.
3. Ask: What events led to the "cattle boom" in the American West?
4. Explain: During the Civil War, cattle in the west went untended and herds multiplied. When the war ended in 1865, these cattle became an in-demand resource, as the population wanted beef to eat. The passage of the Homestead Act during this time period encouraged people to move West. This act, signed into law by President Abraham Lincoln, granted 160 acres of free land in the western United States to qualifying citizens as long as they agreed to "improve" the land in some way.
5. Pass out Design Thinking worksheet and lead students through steps 1-3 (Empathize, Define,Ideate).
6. Direct students to the following USGS webpage - https://www.usgs.gov/special-topics/water-science-school/science/how-much-water-there-earth and instruct them to use the information in the article to determine where water is located on Earth, and the proportion of water in each location.
7. Explain: Finding water was one of the biggest challenges of living in certain areas west of the Mississippi River, like the Great Plains. Much of the water in these areas is located underground and can only be accessed by digging wells. Farmers and ranchers needed large amounts of water for cattle and turned to windmills to pump water quickly from the well to the surface. Steam engine trains also relied on windmill powered pumping stations to cross the Plains because they needed to refill their water tanks as they travelled.
8. Instruct students to use the materials to construct a model windmill with blades that spin, filling out Design Thinking worksheet steps 4 and 5 (Prototype, Test) as they go along.

To support 7th grade standards: Ask students to explain the difference between natural selection and artificial selection as it relates to the longhorn cattle mentioned in the Plains Times worksheet. What characteristics of the cattle were humans selecting for?

To support 8th grade standards: Ask students to describe the types of energy transformations that happen as a windmill operates.

Additional Resources:

USGS "Groundwater decline and depletion" https://www.usgs.gov/special-topics/water-science-school/science/groundwater-decline-and-depletion

Aermotor Windmills "How a windmill works" https://aermotorwindmill.com/pages/how-a-windmill-works

Historical Background:

Windmills have been used for centuries by many cultures around the world. The earliest known working windmill design comes from Persia in the 9th century and was built to pump water (this design was later modified to grind grain as well). In the American West, the windmill's most important function was to allow people to access groundwater (water that occurs below the surface of the ground) and aquifers (layers of underground rock and sediment that contain groundwater in usable quantities). Surface level water, like rivers and lakes, are scarce on the Plains, and without access to underground sources of water farming is impossible. Heavy, hard to assemble European-style windmills were impractical for use in the West, but in the 1850s Daniel Halladay developed the American style windmill – it was smaller, less expensive, and easy to build. This design was further improved in the 1870s when all metal windmills were developed. These metal windmills had curved blades, which allowed them to "capture" more wind than flat wooden blades. In addition to providing farms and towns with water, these windmills also enabled trains to cross the vast plains, as steam engines needed to refill their water tanks every 20 to 30 miles.

July 25, 1867 Special Edition

Plains Times

WATER WOES FOR NEW RANCHERS

The end of the Civil War and the passage of the Homestead Act has driven many would-be cattle ranchers West in search of opportunity. Great fortunes can be made raising and selling longhorn cattle for meat, but finding enough water to sustain the herds has been a challenge for many new ranchers.

“There aren’t many rivers in these parts, the water’s all underground sitting in the water table. You need a way to get it up to the surface and lowering one bucket at a time won’t do when you have 2,000 cattle to water. You have to find a way to pump the water up from underground,” explained local rancher John Bullard.

Originally a product of natural selection between interbreeding populations of escaped or abandoned Spanish and English cattle in the American West, today longhorn cattle are bred for characteristics that make them ideal to work with. They have long legs and thick hooves that enable them to travel long distances, they are resistant to many diseases, and they can eat a wide variety of grasses which makes them easy to feed. They are hardy beasts, and while they can survive for a few days without water, they require a regular source of water in order to be healthy. Some may drink over twenty gallons per day!

A solution for this problem is desperately needed, ranchers are asking any readers with an idea to contact the Plains Times.

DESIGN THINKING PROCESS: WINDMILL

BOOTH WESTERN ART MUSEUM

GEORGIA MUSEUMS, INC.

INSTRUCTIONS: DESIGN A WINDMILL THAT COULD HELP RANCHERS PUMP WATER FOR THEIR CATTLE..

1. EMPATHIZE

How would the ranchers feel if they struggled to provide water for their cattle?

2. DEFINE

What problems would the ranchers, and the cattle, face if they did not have enough water?

3. IDEATE

Brainstorm solutions, provide feedback on each other's designs.

4. PROTOTYPE

Use the materials provided to create your model windmill! Write down your process so others can do the same thing.

5. TEST

Test your windmill, modify the design if needed based on the results.

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DESIGN THINKING PROCESS: WINDMILL

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SKETCHES

Nancy Boren, ***Aloft in the Western Sky,*** Oil on Canvas, 39.5” x 29.5”