Second Grade Work & Simple Machines Unit

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Unit Overview

The purpose of this unit is to help students develop a conceptual understanding of how work is done, both with and without simple machines. Students will engage in a variety of activities exploring different types of work, simple machines, and traditional Native American games using simple machines.

Unit Objectives and Benchmarks and Standards addressed:

1. Students will be able to identify the three types of work as push, pull and lift. (MT Science *Standard 1 Benchmarks 1, 3, 4)*
2. Students will be able to identify the six simple machines. (MT Science *Standard 2 Benchmark 2-3*)
3. Students will be able to identify the purpose of simple machines - to make work easier. (MT Science *Standard 2 Benchmark 5-6*)
4. Students will be able to differentiate between simple machines and motorized machines. (MT Science *Standard 2 Benchmark 5-6*)
5. Students will be able to construct six simple machines. (MT Science *Standard 2 Benchmark 6*)
6. Students will be able to identify different examples of simple machines from home and school environments. (MT Science *Standard 2 Benchmark 3,5,6*)
7. Students will be able to list ways to utilize simple machines to make work easier at home, in school, and with Native American tools and games. (MT Science *Standard 2 Benchmark 6*)
8. Students will be able to identify the purpose of simple machines. (to make work easier) (MT Science *Standard 5 Benchmark 1-2*)
9. Students will be able to list ways to utilize simple machines to make work easier at home, in school, and with Native American tools and games (MT Science *Standard 5 Benchmark 1-3*)
10. Students will be able to determine what type of simple machine each Native American tool and game could be defined as. (MT Science *Standard 5 Benchmark 3*)
11. Students will be able to revise ideas of machines from Lesson 2 to utilize simple machines, not motorized machines. (MT Science *Standard 2 Benchmark 5-6*)
12. Students will be able to construct original simple machine after revision. (MT Science *Standard 2 Benchmark 6*)

Time/Scheduling

This unit would be best done within a single 5-day school week using 40-60 minutes of each day.

Materials

- Science journals
- Objects to push, pull and lift (boxes, books, chairs)
- Enough assorted pasta for each student (see attached sheet for pasta types)

- Large table with each type of Simple Machine and its pasta components
- OPTIONAL: Construction paper and glue for each student to make copy of table with his or her pasta machines
- Large table from Lesson #2 to refer to
- Materials to use as classroom examples of simple machines (rulers, chairs or carts with wheels, desk surfaces, hand-cranked pencil sharpener, door wedge, screws, door handles)
- Scavenger hunt copies
- Guest speaker (Native American games specialist) and traditional tools and games (atlatl, hoop and stick, shinny, double ball)
- Adequate space for trying each game.

Lesson #1 - What is Work?

Summary of the lesson

In their science journals, students will write what they think work is. As a group, we will address and explore doing work without simple machines (for example, pushing, pulling and lifting objects, simple Work Relay). After discussion and relay, students will design a machine to help make those tasks easier in their Science Journals.

Grade level

Grade 2

Approximate time required/scheduling considerations

Approximately 40 minutes

Lesson Objectives and Standards and Benchmarks Addressed

Students will be able to identify the three types of work as push, pull and lift (MT Science *Standard 1 Benchmarks 1, 3, 4)*

Resources/materials needed

- Science journals
- Objects to push, pull and lift (boxes, books, chairs)

Teacher preparation

Clear space for Work Relay
Find and provide each team with identical objects to perform work on (box, book, chair)
Designate starting area and turn-around space

Background information

Work, as defined by Western science, is the force needed to move an object a certain distance. Students will be working with three types of work: push, pull and lift. As students complete the Work Relay (described below), each will be performing one of the three types of work. Students will not need to measure the amount of force or friction at this age. They simply will be asked to identify the three types of work performed in the Work Relay.

Procedure

Engage:

1. Clear some space for the Work Relay; mark the lanes and start and finish areas.
2. Whole group, in journals: Ask students to write and draw their ideas in their journals in response to the following question: "What is work?"

3. Discuss students' ideas as a whole group.
4. Divide students into three equal teams.
5. Provide each team with photographs of Native American work and tools. Have each group identify what work is being done or could be done in each picture. After small group discussion, move to their Work Relay stations.

Explore:

1. Provide each team with identical objects that they can use to perform work. (box, books, chair).
2. Discuss with the students the work to be done with each object (push the box, lift the books, scoot the chairs).
3. Have teams start the Work Relay, thinking about how hard each task is.
    - First student in each team will push a box with some books down their lane (each box must weigh the same).
    - Second student in each team will pull the box back to starting area.
    - Third student in each team will lift the box, and place it on the chair, and push the chair with box down the lane.
    - Fourth student in each team will pull the chair with box back to the starting area.
    - Fifth student will lift the box of books up and over the chair, and place it behind the chair to finish.

Explain:

1. Gather students back into a whole group. Conduct a discussion about the tasks they just performed and how much work they felt like they were doing. Ask what each student was asked to do. Emphasize the three types of work they did: push, pull, and lift. Ask, "What words for work are you hearing over and over?" Students should identify "push, pull and lift."
2. Redistribute the photographs. In small groups, ask students to identify which of the three types of work they can see being done in each picture, or which type could be done.
3. Back at their desks, ask students to write the three words for the Western science definition of work. Then ask, "What can we do or use to make these tasks easier? Record your ideas in your science journals."

Elaborate:

Discuss students' ideas, and then ask students to design a machine to help with the tasks.

Evaluate: (see below)

<u>Formative assessment</u>

For Lesson #1, the teacher will be using students' journal entries after exploration and discussion as a formative assessment. Journal prompts should include:

- "What can we do or use to make these tasks (pushing, pulling, lifting) easier? Record your ideas in science journals."
- "Design a machine to make these tasks easier." (Any idea should be acceptable at this stage, not just simple machines.)

All students should be able to identify the three types of work at this point.

Summative assessment

No summative assessment for this lesson.

Lesson #2 - What is a Machine?

Summary of the lesson

As a group, discuss ideas from machine designs from Lesson 1. Review a simple definition of work, moving an object over a distance using force. (Eventually, students in KWH and PES will have worked with these concepts in Kindergarten and 1st grade.) Emphasize that the work we will be doing will be done WITHOUT motorized machines, but rather with Simple Machines. These Simple Machines are called "tools" by most people. Students will explore Simple Machines with provided materials (working with pasta to build 6 types of Simple Machines), recording observations and ideas in Science Journals.

Grade level

Grade 2

Approximate time required/scheduling considerations

Approximately 40 minutes

Lesson Objectives and Standards and Benchmarks Addressed

1. Students will be able to identify the six simple machines (MT Science *Standard 2 Benchmark 2-3*)
2. Students will be able to identify the purpose of simple machines - to make work easier (MT Science *Standard 2 Benchmark 5-6*)
3. Students will be able to differentiate between simple machines and Motorized Machines (MT Science *Standard 2 Benchmark 5-6*)
4. Students will be able to construct six simple machines (MT Science *Standard 2 Benchmark 6*)

Resources/materials needed

- Science journals
- Enough assorted pasta for each student (see attached sheet for pasta types)
- Large table with each type of simple machine and its pasta components
- OPTIONAL: Construction paper and glue for each student to make copy of table with his or her pasta machines

Teacher preparation

Sort pasta and provide each student with a complete set, enough to build each of the six types of simple machines
Create large, readable version of simple machines and pasta components table (Appendix A)
Practice building each of the types of simple machines with pasta, identify possible problem areas ahead of time

Background information

Work is a force used to move an object a certain distance. Students in this lesson will review the three types of work, Push, Pull and Lift. A simple machine is a device used to make work easier. The six types of simple machines are: incline plane, wedge, screw, lever, wheel/axle, and pulley. Students will explore and build those machines with pasta. Before reviewing the definition of work, the teacher will probably want to introduce a few examples of when he or she has done work (pushing, pulling, or lifting) and then ask for students' examples. Pull experiences from the Work Relay from Lesson #1. This lesson is centered around student-driven exploration with pasta, and the teacher's role should be that of an observer and guide.

Procedure

Engage:

1. Review definition and examples of work (use Work Relay, experiences at home, experiences they have heard about, any cultural and traditional examples students may know)
2. Review photos of Native American tools, identify which types of work are being done
3. Discuss and analyze students' ideas (from Science Journal, Lesson #1) for a machine to help us do those tasks from the Work Relay

Explore:

1. Give students their task: build several contraptions out of pasta to help push, pull and lift an object
2. Allow students time to work with their small groups with the pasta. If necessary, guide them by asking how to move a very heavy object in several ways: lift it to a higher place (inclined plane, pulley, lever), push or pull it a certain distance (wheel/axle), push two pieces of an object apart (wedge), or push/pull two objects together and hold them there (screw)
3. Bring the students together in a whole group to discuss and model their findings

Explain:

Identify which of the six types of simple machines each discovery represents, using the large table

Elaborate/Evaluate (see below, formative and summative assessments)**:**

1. Ask students for ideas about when and where to use each type of simple machine(to be recorded in students' science journal)
2. Ask students to determine if simple machines make work easier or harder.
3. Ask students to reflect on their original "machine." Is it a simple machine? Tell why or why not.
4. OPTIONAL: Have students build and glue each type of simple machine to a construction paper copy of the large table

Formative assessment

For Lesson #2, the teacher will be using students' journal entries after exploration and discussion as a formative assessment. Journal prompts should include:

- "How would you use these machines? Please tell me where and when you would use each type."
- "Do these machines make work easier or harder? How do you know?"

Summative assessment

For Lesson #2, the teacher will be using another journal entry after exploration and discussion as a summative assessment. Journal prompts should include:

- "Look back at your machine you designed in Lesson #1. Is your machine a simple machine? Why or why not?"

Lesson #2: ***What is a Machine?***
Rubric for Journal Entries

Advanced	**2pts-** Student correctly differentiates his machine from a Simple Machine by identifying more than 3 of the 6 types of Simple Machines.	**2pts-**Student correctly associates more than 3 of the 6 types of Simple Machines with the specific type of Work each does.
Proficient	**1pt**- Student correctly differentiates his machine from a Simple Machine by identifying more than one of the 6 types of Simple Machines.	**1pt-**Student correctly associates more than one of the 6 types of Simple Machines with the specific type of Work each does.
Emerging	**0pts**-Student merely states that his machine is NOT a Simple Machine, but does not compare his machine to Simple Machines.	**0pts-**Student identifies only the three types of Work done by Simple Machines.

Lesson #3 - *What is a Machine? (Part 2)*

Summary of the lesson

Revisit machines explored in Lesson 2. Reintroduce several specific simple machines (levers, wheel/axle, inclined plane). Students will identify, explore and build types of simple machines from classroom (and later home materials as possible home-school connection) that could do tasks from Lesson 1. As a group, we will discuss uses for these simple machines, with emphasis on levers. Students will write and draw their ideas in science journals. As a group, discuss hunting tools or games that utilized lever technology (for example, the atlatl, shinny, double ball, and hoop and stick). Students will be given a simple scavenger hunt to find simple machines in the classroom, then examples from home.

Grade level

Grade 2

Approximate time required/scheduling considerations

Approximately 40 minutes.

Lesson Objectives and Standards and Benchmarks Addressed

1. Students will be able to construct six simple machines (MT Science *Standard 2 Benchmark 6*)
2. Students will be able to identify different examples of simple machines from home and school environments (MT Science *Standard 2 Benchmark 3,5,6*)
3. Students will be able to utilize simple machines to make work easier at home, in school, and with Native American tools and games (MT Science *Standard 2 Benchmark 6*)

Resources/materials needed

- Science journals
- Large table from Lesson #2 to refer to
- Materials to use as classroom examples of simple machines (rulers, chairs or carts with wheels, desk surfaces, hand-cranked pencil sharpener, door wedge, screws, door handles)
- Scavenger hunt copies

Teacher preparation

Copy of the scavenger hunt
Gather and organize materials (possibly to work with at stations in groups)
Practice using several classroom materials as simple machines (tilt a desk, use ruler for lever, etc.)

Background information

Work is the force used to move an object a certain distance, more specifically a push, pull or lift. The six types of simple machines are: inclined plane, wedge, screw, lever, wheel/axle, and pulley. Simple machines have been designed and refined to make the three types of work easier for the operator. Today's lesson focuses on reviewing the six types of simple machines, rebuilding them and introducing a traditional Native American focus. Traditionally, levers specifically impacted traditional cultures in regard to hunting tools and games. The atlatl, shinny, double ball, and hoop and stick games are all examples of traditional lever usage. Also discussed in Lesson 1 are ladders, travois, digging tools and hunting or fishing spears.

Procedure

Engage:

1. In small groups, have students discuss what they remember about simple machines. Focus on the types of work each machine does.
2. In whole group, reintroduce the six types of simple machines using blank large table from Lesson #2. Have students fill in the simple machines and the work they do.
3. Ask students to write down the table, in addition to ways we use those machines in class in their science journals.
4. After students have had ample time to write down their ideas (encourage them to find at least four examples of simple machines in class), share ideas with a partner. Next, discuss their ideas as a whole group.

Explore:

1. Break class into manageable groups and send them to stations provided with pasta samples from Lesson #2.
2. Quiz students on how to rebuild the six types of simple machines with pasta, as in Lesson #2. Circulate to monitor group collaboration, asking guiding questions when a group is uncertain or stuck.
3. Collect pasta samples when each group seems confident in the six types of simple machines. Distribute classroom materials for students to try the machines with.
4. Instruct the groups to start exploring ways to make those provided materials into different types of simple machines. Supervise group work, asking questions to encourage different constructions of the same machine (ex: other ways to build wheel/axle, etc).

Explain:

1. After allowing ample time for exploration, discuss findings in whole group.
2. Introduce the idea of levers in Native American traditions; ask if any students know of ways levers were used.
3. Discuss hunting tools or games that utilized lever technology (for example, the atlatl, shinny, double ball, and hoop and stick).

Elaborate:

Pass out scavenger hunt, looking for items from home that fit the definition of simple machines.

Evaluate: (see below)

Formative assessment

For Lesson #3, the teacher will be using students' journal entries after exploration and discussion as a formative assessment. Journal prompts should include:

- "Look at our chart of the six types of simple machines. Write down or draw any tools or other items we use in class that might be simple machines."
- "Think about the tools and things you think are simple machines. What are some uses for these things?"
- "Why do we use simple machines? Think about using some of them for the Work Relay we did in Lesson #1."

Summative assessment

For Lesson #3, the teacher will use the completed scavenger hunt as a summative assessment. If all responses are completed with at least one correct example, full points can be given. If responses are incorrect, work with students to identify why, and which responses would be more appropriate. Incorrect responses could be classified as a formative assessment, used to identify gaps.

Lesson #3 - *What is a Machine? Part 2*

Rubric for Scavenger Hunt

Advanced	**6pts-**Student correctly identifies one or more examples of each of the six types of simple machine (one point for each type).	**6pts-** Student correctly identifies which type of work each of the six types of simple machines is associated with (one point for each type of simple machine).
Proficient	**3-5 pts-** Student correctly identifies one or more examples of up to 5 of the 6 types of simple machines (one point for each type).	**3-5 pts-** Student correctly identifies which type of work up to five of the six types of simple machines is associated with (one point for each type of simple machine).
Emerging	**0-2 pts-** Student correctly identifies one or more examples of up to two of the six types of simple machines (one point for each type).	**0-2 pts-** Student correctly identifies which type of work up to two of the six types of simple machines is associated with (one point for each type of simple machine).

Lesson # 4 - *Application with Traditional Tools*

Summary of the lesson

As a group, we will discuss expected behaviors before speakers arrive. We will revisit levers and the purpose of work (moving an object using force) and that using tools or Simple Machines makes work easier. Traditional Native games and tools will be presented, after which students will be able to explore the technology behind each. Discuss how work is being done with each tool or game before playing. After the speaker's presentation, students will design a machine to complete a specific task in their Science Journals.

Grade level

Grade 2

Approximate time required/scheduling considerations

Approximately 40-60 minutes, end of day, weather permitting. The first part of the lesson is to take place outdoors, and the Elaborate/Evaluate component can be stretched to other days.

Lesson Objectives and Standards and Benchmarks Addressed

1. Students will be able to identify the purpose of simple machines (to make work easier) (MT Science *Standard 5 Benchmark 1-2*)
2. Students will be able to list ways to utilize simple machines to make work easier at home, in school, and with Native American tools and games (MT Science *Standard 5 Benchmark 1-3*)
3. Students will be able to determine what type of simple machine each Native American tool and game could be defined as (MT Science *Standard 5 Benchmark 3*)
4. Students will be able to revise ideas of machines from Lesson #2 to utilize simple machines, not motorized machines (MT Science *Standard 2 Benchmark 5-6*)
5. Students will be able to construct an original simple machine after revision (MT Science *Standard 2 Benchmark 6*)

Resources/materials needed

- Science journals
- Guest speaker (Native American games specialist) and traditional tools and games (atlatl, hoop and stick, shinny, double ball)
- Adequate space for trying each game.

Teacher preparation

Assemble necessary resources and set time, date and location up with guest speaker.
One game the teacher may have to make from scratch is the hoop and stick. (Appendix C).
Practice each game ahead of time, to work out any possible problem areas.
Practice demonstrating how each tool is a lever, or extension of our arm.
Ask guest speaker to address how each tool or game is used, and how each makes work easier.
Identify the practical use for each game or tool, as well as, which simple machine it resembles.

Background information

Traditional tools and games are great examples of cultural uses of simple machines. We will focus on lever usage in this lesson. The atlatl, a hunting tool, is a lever extending the length of the hunter's arm. This tool was used to increase speed and distance of a dart using a small amount of force. Hoop and stick is a game used to increase hand-eye coordination. This game uses a stick as a lever, increasing the length of the player's arm. This also serves to minimize the work needed to swing the hoop. Shinny is a game similar to hockey, with each player using a stick as a lever to increase the force of impact on the ball. Double ball is a game used to practice aim and stamina. Each player again uses a stick as a lever, minimizing the work needed to hurl two balls attached by a string. Continually address the fact that these tools are simple machines (levers, specifically), used to make a task easier. Identify the task each game or tool accomplishes. Ask guest speaker to identify which tribes used which games or tools, and where and when they may have used them (seasons, local areas).

Procedure

Engage:

1. Define expectations for students during a presentation.
2. As a whole group, discuss the nature of simple machines, or tools (making work easier). Break into small groups to review types of simple machines. Ask students to build them with pasta or classroom materials.
3. Bring students back to whole group to quickly discuss each of the six simple machines and the work they do.

Explore:

1. Introduce guest speaker (or another tribal member knowledgeable of culturally relevant machines) and ask them to explain the materials they have to share.
2. Ask guest speaker to define each game or tool, discuss its purpose, and which task you would use it for. (these will likely include atlatl, shinny, hoop and stick, double ball)
3. Divide class into groups (OPTIONAL), explore each of the tools or games guest speaker brought.

Explain:

As a whole group, discuss the results of each game or tool. Identify how each tool makes work easier.

Elaborate/Evaluate: (see below)

Allow students to design their own machine to complete a specific task (move a box or weight from point A to point B). Students can use one or more simple machines in this design, but no motorized machines.

Formative assessment

For Lesson #4, the teacher will use informal monitoring for a formative assessment. Wander from group to group, listening to conversation and ideas. Ask questions to lead students into discussion with their group members. A class list with a few of the following questions can be used as a checklist, to ensure equal engagement and discussion roles. Students should be able to address the following points:

- What type of simple machines are we working with at each station?
- Why are we using these machines? What do they do for us?
- What type of work are we trying to do at each station?
- What is the most common simple machine here today?
- Explain why Native Americans developed these machines.

Summative assessment

For Lesson #4, the teacher will use the final machine design from students' science journals for a summative assessment. The teacher will look for the following:

- Did the design incorporate one or more types of simple machines?
- Is the machine designed without ANY motorization?
- Will the machine accomplish the specific task determined by the student (either push, pull or lift an object)?

If all three points are addressed correctly, the student will earn three points. If two points are addressed, students earn two points, and so on.

Lesson #4 - *Application with Traditional Tools*

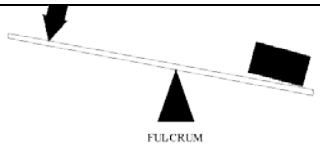
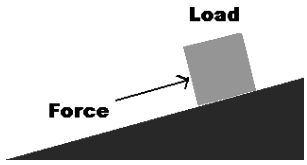
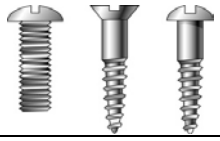
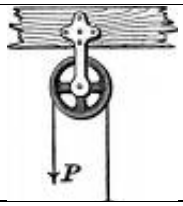
Rubric for Machine Designs

Advanced	**3pts-** The student has designed a machine that fulfills all three required elements, using one or more types of simple machines, has not used any motorization, and which will accomplish the chosen task.
Proficient	**2pts-** The student has designed a machine that fulfills two of the three required elements (see above).
Emerging	**1pt-** The student has designed a machine that fulfills one of the three required elements (see above)

Appendix A – (Lesson #2) ***What is a Machine?***

Types of Pasta needed:

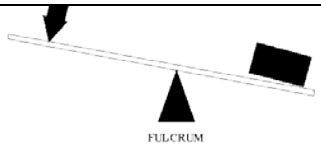
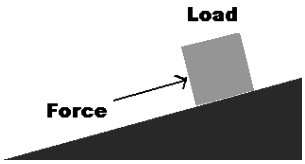
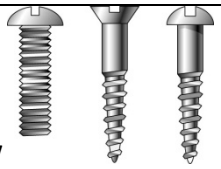
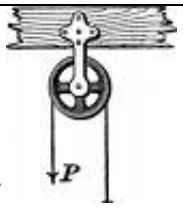
Manicotti, Linguine, Rotelle, Rigatoni, Spaghetti, Penne, Rotini

Simple Machine	What does it look like?	What type of Pasta did we use:
Lever		Rigatoni and Linguini, Spaghetti (or ruler)
Inclined Plane		Manicotti and Linguini, Spaghetti (or ruler)
Wedge		Penne or Manicotti
Screw		Rotini
Wheel and Axle		Rotelle and Spaghetti
Pulley		Rotelle and yarn

Appendix B – (Lesson #3) ***What is a Machine? Part 2.***

Scavenger Hunt for Home Materials Template:

Name_____

Simple Machine	What was it? Where was it?	What type of Work does it do?
Lever 	Example: Shovel in the garage	Lifts
Inclined Plane 		
Wedge 		
Screw 		
Wheel and Axle 		
Pulley 		

Appendix C – (Lesson #4) ***Application with Traditional Tools***

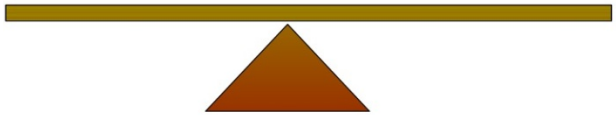
Hoop and Stick directions:

1. Each student needs one stick, about 2.5 feet long.
2. Each student needs about 3 feet of yarn or string.
3. Each student needs a hoop, either a twig tied in a circle, or a round of PVC pipe, about 3 inches in diameter.
4. Tie the yarn to one end of the stick, and then to the hoop.

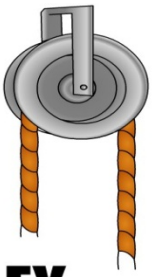
This game is used for increasing coordination and concentration. Stand still, swing the stick in front of you, and try to catch the hoop on the end of the stick as it comes down.

Appendix D - (Lessons #1-4) ***Images of Native American tools and uses***

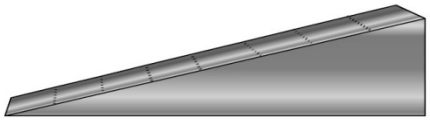
Appendix E – (Lessons #1-4) ***Simple Machines Visual Aid***



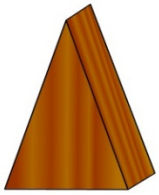
LEVER



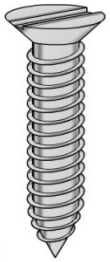
PULLEY



INCLINED PLANE



WEDGE



SCREW