

Lesson Plans

Teacher: High School Physical Science

Grade: 9th

Curricular Areas/s: Simple machines and mechanical advantages

Standard/s: Understand and apply knowledge of motions and forces

Objects change their motion only when a net force is applied. Laws of motion are used to calculate precisely the effects of forces on the motion of objects.

Lesson Objective/s:

- Students will be able to correctly identify different simple machines
- Students will understand how machines change the forces and make work easier

Materials: Windmill Diagram, Simple Machine Chart, Follow-up Worksheet

Instruction/Modeling/Checking for Understanding:

Pre trip: Make sure this field trip follows a lesson on simple machines and mechanical advantage.

Students should go in the video viewing room and hear a presentation on how the windmill works with the diagram on the inner parts in the room. Be sure the speaker brings up the fact that for every one turn of the windmill, the grinding stone turns nine times. Make sure any questions the students have are answered at this point.

Guided Practice: Review of simple machines.

Bring the students into the bottom floor of the windmill and stop at the wall of tools. Review the six types of simple machines asking the students to point out an example of each. Examples: Pulley-tape measure, Lever-hammer, screw-drill, wedge-saw, wheel & axle-dolly, & Incline plane-stairs (This one is a hard one and there are not very many.)

Closure/Evaluation/Assessment: Simple Machine Chart

Explain to the students that they are going to be walking through the windmill and learn how it operates. They need to identify as many different simple machines that they see during this tour and write them down on the simple machine chart. They can use the diagram of the windmill as a reference for specific names of parts.

Walk the students through the windmill starting at the top showing them how it works, having them fill out the chart as they go. Stop at each floor and review the different simple machines to check for understanding.

Simple Machines in the windmill

Top floor:

Wheel & Axle

- Show them how the cap rotates so the shutters face the wind
- The brake wheel , windshaft wallower, and countershaft
- The wheel on the friction pulley

Lever

- The friction pulley rope system
- The brake wheel & brake

Pulley

- The friction pulley system
- The pulley in the cap that runs the shutter control assembly

Wedge

- Nails in the floors

Screw

- Nuts & bolts holding everything together

Incline plane

- The stairs

3rd floor:

Wheel & Axle

- Spurwheel, gear and guant shaft

Lever

- Hinges on the trap door
- Press on the work bench

Pulley

- None

Wedge

- Nails in the floors

Screw

- Nuts & bolts holding everything together
- Press on the workbench

Incline plane

- The stairs

2nd floor:

Wheel & Axle

- Guant shaft & Runner stone
- The bedstone grabber

Lever

- The bedstone grabber
- Stone tension lever

Pulley

- The rope that controls the amount of grain that pours out

Wedge

- The bedstone grooves that cut the grain

- The grain scoop
- Nails in the floors

Screw

- The bedstone grabber
- Nuts & bolts holding everything together

Incline plane

- The grain hopper
- The stairs

Outside:

Wheel & Axle

- The failtail assembly

Lever

- The shutter control rod on the stocks
- The shutter opening and closing

Pulley

- The weight control to open shutters

Wedge

- The shutters

Screw

- Nuts & bolts holding everything together

Incline plane

- The shutters
- The stairs

1st floor:

Wheel & Axle

-

Lever

- the stone tension lever system
- Grain bag holder

Pulley

- none

Wedge

- The flour chute stopper
- Nails in the floors

Screw

- Nuts & bolts holding everything together

Incline plane

- Flour chute
- The stairs

Independent Practice: Follow-up Worksheet

Have students fill out the follow-up worksheet the next day in class and go over the answers together.

Activities/Extension of Lesson:

Have the students figure out the mechanical advantage of the windmill using the statistic that for one turn of the windmill, the grinding stone turns nine times.

Answers: to the follow-up worksheet

- 1) Many simple machines are needed and work together to make the windmill able to grind grain.
- 2) The bedstone grabber helps lift the bedstone.
The cap rotating system and fantail turn the shutters into the wind.
The stock and gears connected to it turn when the wind hit them.
The lever system adjusts the coarseness of the grain.
The friction pulley grain hoist system- lifts the grain up to the grindstone
- 3) The difference in size of the gears increases the mechanical advantage or work that can be done. In one turn of a large gear, the small gear connected will turn more times because it has a much smaller circumference.
- 4) The difference in the size of gears increases the mechanical advantage 9 times.
- 5) Student open response.

Name: _____

Windmill Follow up Questions

1. How many different simple machines were necessary to turn wind energy into power to run the grain mill? Explain your answer
2. List the different compound machines that make up the windmill and their purposes in the operation of the grain mill.
3. Why were some of the gears really big while others were small. (Hint: Think in terms of mechanical advantage)
4. For every turn of the windmill, the grinding stone turns nine times explain why.
5. What did you learn from this field trip and do you think it increased your understanding of simple machines and energy?

Windmill Simple Machine Chart

Name: _____

Write down any simple machines you see, as well as their location or floor, during your tour of the windmill in the correct column.

Incline Plane	Wheel & Axle	Wedge	Lever	Screw	Pulley
Example: Stairs on all floors					

Windmill Simple Machine Chart

Name: _____