Chapter Project Worksheet 1

1. inclined plane, wedge, screw, lever, wheel and axle, pulley
2. pulley
3. lever
4. inclined plane
5. Answers will vary: top, side, or bottom
6. Answers will vary; only one of the six simple machines must be mentioned.
7. Answers will vary; only one of the six simple machines must be mentioned.
8–10. Students' designs will vary.

What Is Work? Guided Reading and Study

Use Target Reading Skills
Sample questions and answers:
Q. What is work?
A. Work is done when a force causes an object to move in the direction of the force.
Q. How is work calculated?
A. Work is force times distance.
Q. What is power?
A. Power is the rate at which work is done.

1. You do work when you exert a force on an object that causes the object to move a distance in the same direction as the exerted force.
2. pull out books: work
lift newspapers: work
push on stuck car: no work
hold wood in place: no work
pull sled: work
hold bag: no work
3. distance
4. In carrying an object, you exert an upward force. But to do work, you must exert a force in the same direction as the object's motion. Since the object's motion is horizontal and the force extended is vertical, no work is done.
5. When you pull a suitcase with wheels, you pull at an angle to the ground. Your force has a horizontal part and a vertical part. Only the horizontal part does work because that force is in the same direction as the motion of the suitcase.
6. force, distance
7. true
8. Work = Force × Distance
9. joule, or N·m
10. 1 joule
11. Power is the rate at which work is done or the amount of work done in a unit of time.
12. true
13. Power = Work ÷ Time
14. Power = (Force × Distance) ÷ Time

What Is Work? Review and Reinforce

1. She is doing work if the force causes the box to move some distance in the direction of the force.
2. Use this formula: Work = Force × Distance
3. 80 J
4. Exerting a force on an object that causes the object to move some distance in the direction of the force.
5. Amount of work done when you exert a force of 1 newton to move an object a distance of 1 meter.
6. The rate at which work is done.

What Is Work? Enrich

Total Work (in joules)
50
43.5
35.5
25
0

1. As the angle increases, the fraction of the force that contributes to work decreases.
2. None of the force applied to the object contributed to its movement because the directions of the force and movement were at right angles to one another.
3. No

How Machines Do Work
Guided Reading and Study

Use Target Reading Skills
Sample main idea: The mechanical advantage of a machine helps by:
Sample details:
changing force
changing distance
changing direction

1. A machine is a device with which you can do work in a way that is easier or more effective.
2. false
3. a, c, d
4. input force
5. output force
6. true
7. distance
8. true
9.

10. The number of times a force exerted on a machine is multiplied by the machine.
11. Mechanical advantage = Output force ÷ Input force
12. output, input
13. friction
14. efficiency
15. Efficiency = (Output work ÷ Input work) × 100%
16. actual
17. ideal

How Machines Do Work
Review and Reinforce

1. true
2. increasing
3. true
4. without
5. mechanical advantage
6. input force
7. machine
8. ideal mechanical advantage
9. actual mechanical advantage
10. efficiency
11. output force

How Machines Do Work
Enrich

1. The person is pulled downward by the force of gravity.
2. Force = 75 kg × 9.8 m/s^2 = 735 N
Work = 735 N × 0.5 m = 367.5 J
3. Force = 750 kg × 9.8m/s^2= 7,350 N
Work = 7,350 N × 0.05m = 367.5 J
It is the same amount of work.
4. Input force: 735 N
Output force: 7,350 N
Mechanical advantage: 7,350 N ÷ 735 N = 10
5. Efficiency: (367.5 J ÷ 367.5 J) × 100% = 100%.
This is complete efficiency and is very unlikely. Friction would cause a real treadmill to be less efficient.

Seesaw Science
Skills Lab

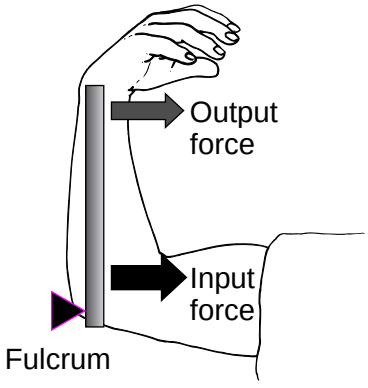
For answers, see the Teacher's Edition.

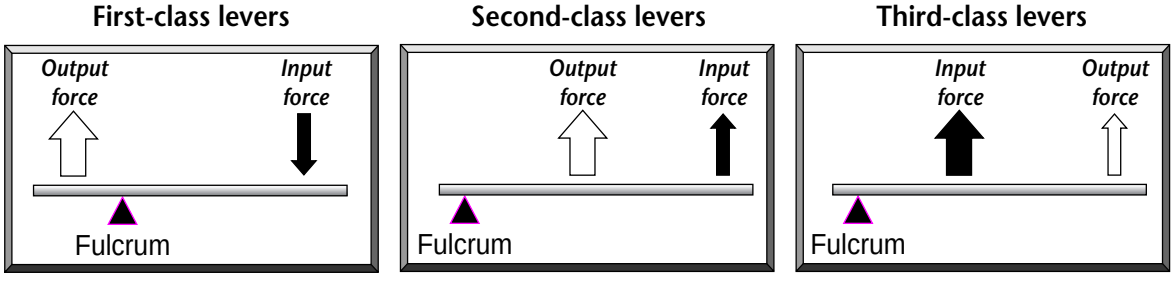
Simple Machines
Guided Reading and Study

Use Target Reading Skills
Sample questions and answers:
Q. What are the three classes of levers?
A. First, second, and third
Q. Which type of lever always changes the direction of the input force?
A. First-class levers

1. inclined plane, lever, wedge, wheel and axle, screw, pulley
2. An inclined plane is a flat, slanted surface.
3. Ideal mechanical advantage = length of incline ÷ height of incline
4. a, b, d
5. input force
6. A wedge is a device that is thick at one end and tapers to a thin edge at the other end.
7. true
8. true
9. A screw is an inclined plane wrapped around a cylinder.
10. threads
11. The input force is applied to the top of the screw. As the screw turns, the threads exert an output force on the wood.
12. A lever is a rigid bar that is free to pivot, or rotate, around a fixed point.
13. fulcrum
14. a, b, c
15.

16. Second-class lever
First-class lever
Third-class lever
17. Ideal mechanical advantage = distance from fulcrum to input force ÷ distance from fulcrum to output force
18. A wheel and axle is a simple machine made of two circular objects that are fastened together and that rotate around a common axis.
19. Ideal mechanical advantage = Radius of wheel ÷ Radius of axle
20. A pulley is a grooved wheel with a rope (or chain, or even a steel cable) wrapped around it.
21. fixed pulley
22. moveable pulley
23. They consist of bones and muscles.
24. tendons
25. The joint near where the tendon is attached to the bone acts as the fulcrum.
26.





27. wedges
28. When you bite down on something, the wedge shape of your teeth produces enough force to break it in half, just as an ax is used to split a log.
29. A compound machine is a machine that utilizes two or more simple machines.
30. You must know the mechanical advantage of each simple machine utilized in the compound machine.

Simple Machines
Review and Reinforce

1. wedge
2. wheel and axle
3. lever
4. inclined plane
5. pulley
6. screw
7. compound machine
8. lever
9. pulley
10. screw
11. inclined plane
12. fulcrum
13. wedge
14. wheel and axle

Simple Machines
Enrich

1. lever
2. inclined plane
3. pulley
4. wheel and axle
5. first-class lever
6. the magnifying glass (A) and the paper bag (B)

Angling for Access
Skills Lab

For answers, see the Teacher's Edition.

Key Terms

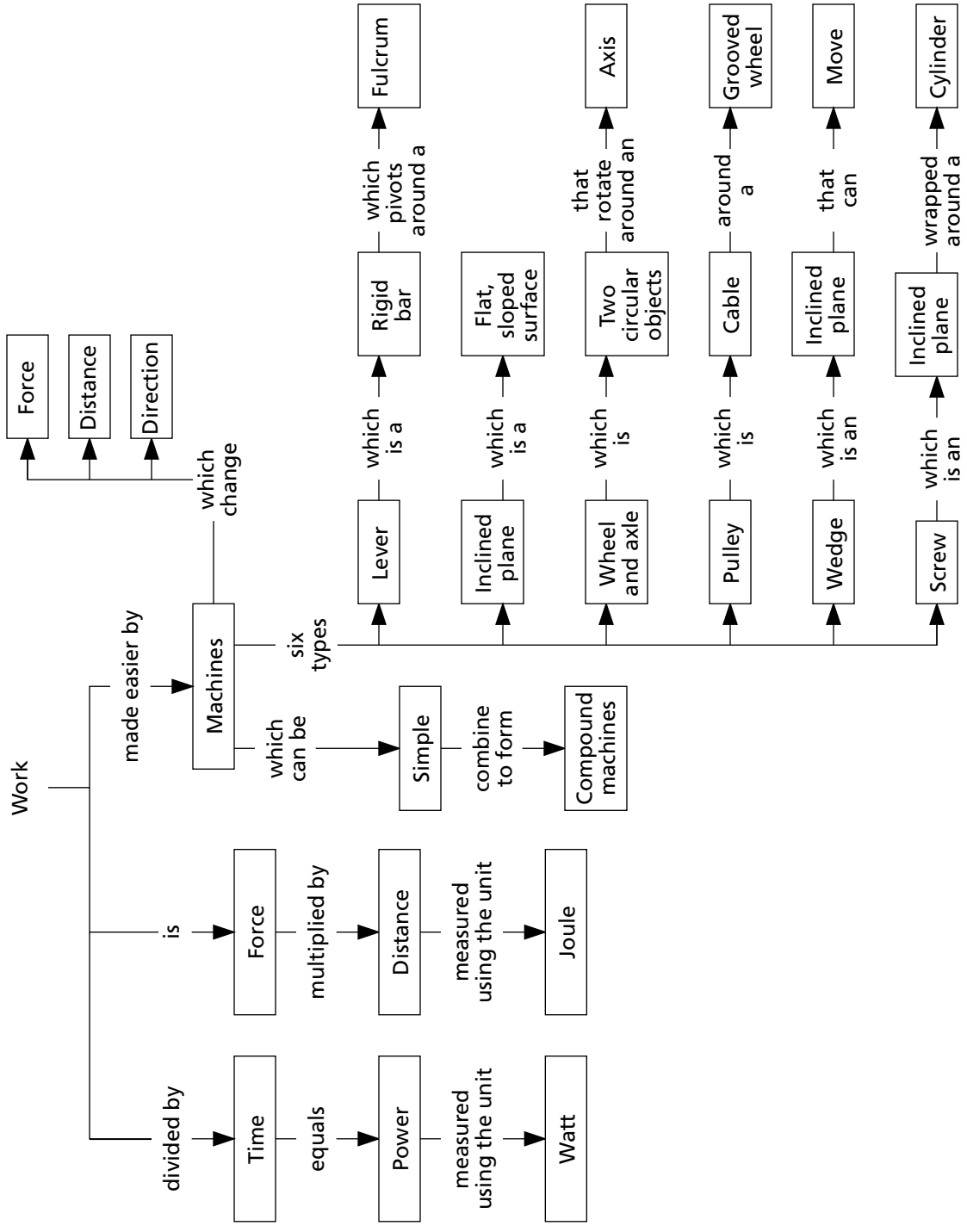
1. wedge
2. compound
3. output
4. fulcrum
5. work
6. axle
7. efficiency
8. lever
9. input
10. inclined
11. pulley
12. machine
13. joule
14. screw

Math Skills

1. 350 J
2. 15,000 J
3. 25,000 W or 25 kW
4. 200 W
5. 4
6. 3
7. 50%
8. 75%
9. 4
10. 5
11. 2
12. 2
13. 12
14. 6

Connecting Concepts

This concept map is only one way to represent the main ideas and relationships in this chapter. Accept other logical answers from students.



Laboratory Investigation

Pulleys as Simple Machines

Pre-Lab Discussion

1. The mechanical advantage of a machine is the number of times a machine multiplies a force exerted on it.

2. Machines make work easier by changing the direction or amount of force needed to accomplish a task. Pulleys and pulley systems do both of these.

Analyze and Conclude

1. Yes, The single fixed pulley has an ideal mechanical advantage of 1; the ideal mechanical advantage of the single moveable pulley is 2. Actual mechanical advantage for these pulleys will probably be somewhat different because of friction and measurement of error.

2. Less input force was needed with more pulleys.

3. The number and arrangement of the pulleys determine what the mechanical advantage will be.

Critical Thinking and Applications

1. The single fixed pulley has an ideal mechanical advantage of 1. Its practical use is to change the direction of effort.

2. **a.** 1
b. 2
c. 2
d. 3
e. 4

3. Mechanical advantage for a pulley system is the same no matter how it is calculated. However, measurements of actual mechanical advantages will vary because of friction and measurement error.

4. Diagrams should show six supporting sections of rope.

5. The distance through which the input force moves increases.

6. In a machine, work output can never be greater than work input. Because work input is input force times distance, if the input force decreases, the distance must increase.

More to Explore

If the input force and the output force move the same distance, the pulley system will have a mechanical advantage of 1. If the input force moves a greater distance than the output force moves, the pulley will have a mechanical advantage greater than 1.

Performance Assessment

Students' tables will vary. See expected outcome on the Teacher Notes page for some examples of possible machines and their benefits.

Analyze and Conclude

1. Answers will vary. Sample: I would choose my first-class lever made from a triangular block and a rectangular block. It was simple to make and had only two parts. It was the only machine I made that both multiplied the input force and changed the direction of the force.

2. Answers will vary. Check students' work. For an inclined plane, the ideal mechanical advantage is equal to the length divided by the height. For a lever it is equal to the distance from the fulcrum to the input force divided by the distance from the fulcrum to the output force.

3. Answers will vary. Sample: I could combine the pulley and the wheels and axle. Instead of pulling down on the pulley's string to lift the weight, the string could be tied to the axle. Then the wheels could be turned to lift the weight.

Chapter Test

1. b
2. a
3. a
4. d
5. c
6. d
7. b
8. a
9. c
10. b
11. move some distance
12. mechanical advantage
13. axle
14. tendons
15. ideal mechanical advantage
16. does not decrease
17. screw
18. true
19. direction
20. true
21. Since the table and stool moved, Eric and Jill did work.
22. Jill performs 120 J of work. Eric performs 60 J of work. Jill performs more work.
23. Answers will vary. Sample: You would exert a force, but not do work when you hold a heavy bag of groceries. You would exert a force and also do work when you lift that heavy bag of groceries out of a shopping cart.
24. The six kinds of simple machines and examples are: screw—jar lid; inclined plane—wheelchair ramp; pulley—flagpole; wedge—sharp knife; lever—baseball bat; wheel and axle—bicycle
25. A machine makes work easier by changing the amount of force you exert, the distance over which you exert the force, or the direction in which you exert your force. A ramp lets you exert a smaller force over a larger distance. The higher gears on a bicycle let you apply a greater force over a shorter distance. A pulley lets you change the direction over which you exert a force.
26. The ramp makes the work easier by multiplying the distance and reducing the required input force.
27. I.M.A. = length of incline divided by height of incline. $5 \div 1.5 = 3.3$
28. Because a machine makes work easier by changing the direction or the amount of force needed
29. The input and output forces are the same. Students' examples may vary. Sample: a fixed pulley
30. The more friction there is, the less efficient a machine is. You could make a machine more efficient by reducing friction by lubricating the machine.