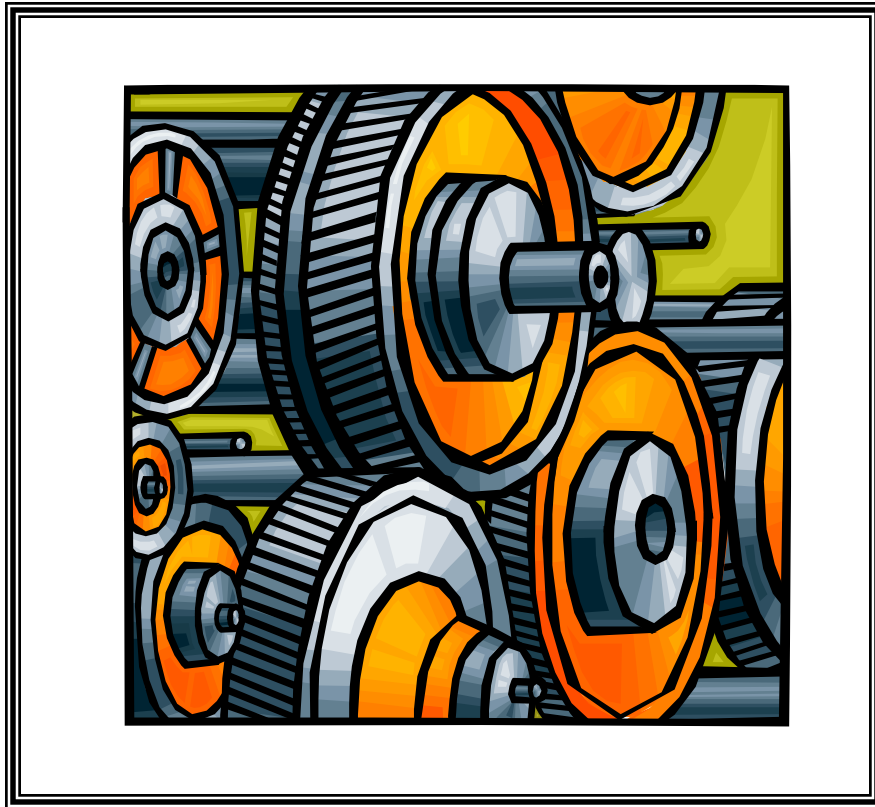


**Forces and Motion**  
**Work**  
**Promotion Benchmark 14**  
**Student Copy**



**Vocabulary**

**Pulley** – A simple machine made up of a rope wrapped around a wheel.

**Lever** – A simple machine made up of a bar that turns about a fixed point.

**Inclined plane** – A simple machine made up of a slanted surface or a ramp.

**Force** – A push or a pull that one object makes on another.

**Effort force** - Force applied to a machine when a machine is used to do work.

**Net force** – The sum of all the forces acting on a given object.

**Work** - The transfer of energy through motion.  $Work = force \times distance$

**Review for Promotion Benchmark 14:**  
***Applies the scientific meaning of work; explains how simple machines  
( inclined plane, pulley, and lever) make work easier***

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The concept of work usually brings to mind a job that people perform. Millions of people head off to work each morning to teach, run companies, build roads, and sell products. Scientifically, however, work is defined as the transfer of energy through motion. The act of simply using your hand to pick up a pencil from a desktop is work. A scientist would explain that you have applied a force to the pencil causing the pencil to move in the direction of the force. Work produces motion. If you push against a brick wall, but the wall does not move, no work has been done even though your effort may have produced a lot of sweat and achy muscles. Similarly, if the motion produced is not in the same direction as the applied force, no work has been performed. For example, when you lift a book and carry it across the room, you have performed work to lift the book. When you carry the book across the room, no additional work is being done on the book because the force being applied to the book is upward; the book is moving forward.

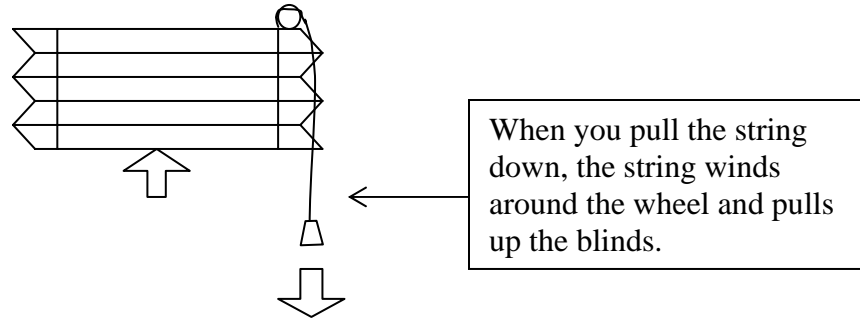
To calculate the amount of work performed on an object, you need to know how much force was applied and the distance the object moved. The relationship between these variables is shown in the formula: *Work = Force × Distance* (**W=F×D**). The units used to quantify the amount of work or energy required for a

task are called joules (j). In work calculations, force is measured in newtons (N) and distance is measured in meters (m). One newton-meter equals one joule.

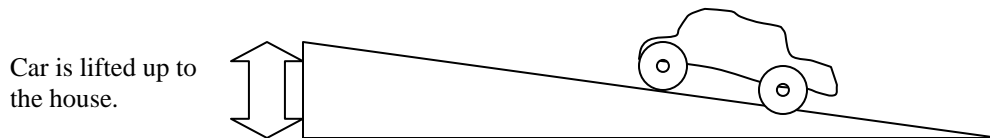
In order to produce motion, energy must be transferred from one object to another object. This is accomplished by applying a **force**, a push or pull, to the object. To achieve motion, the size of the applied force must be large enough to overcome the forces acting on the mass of the object you wish to move, or its **net force**.

Some tasks, such as moving heavy objects, can be difficult, so people use machines to help make the work easier. They do this by changing either the direction, speed, or size of the applied force. When using a machine, the applied force is called the **effort** force. Machines range from simple ones to extremely complex ones. The difference is that a simple machine performs its work using one motion. Complex, or compound, machines are made up of two or more simple machines. There are three main types of simple machines that you use every day: the pulley, the inclined plane, and the lever.

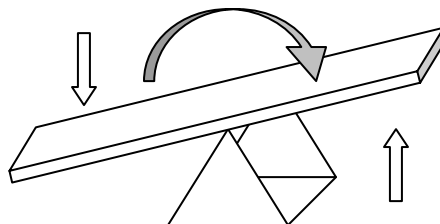
A **pulley** is a simple machine that changes the direction of the force applied and is made up of a rope wrapped around a wheel. An example of this is blinds for a window. When you pull down on the string, the blinds come up.



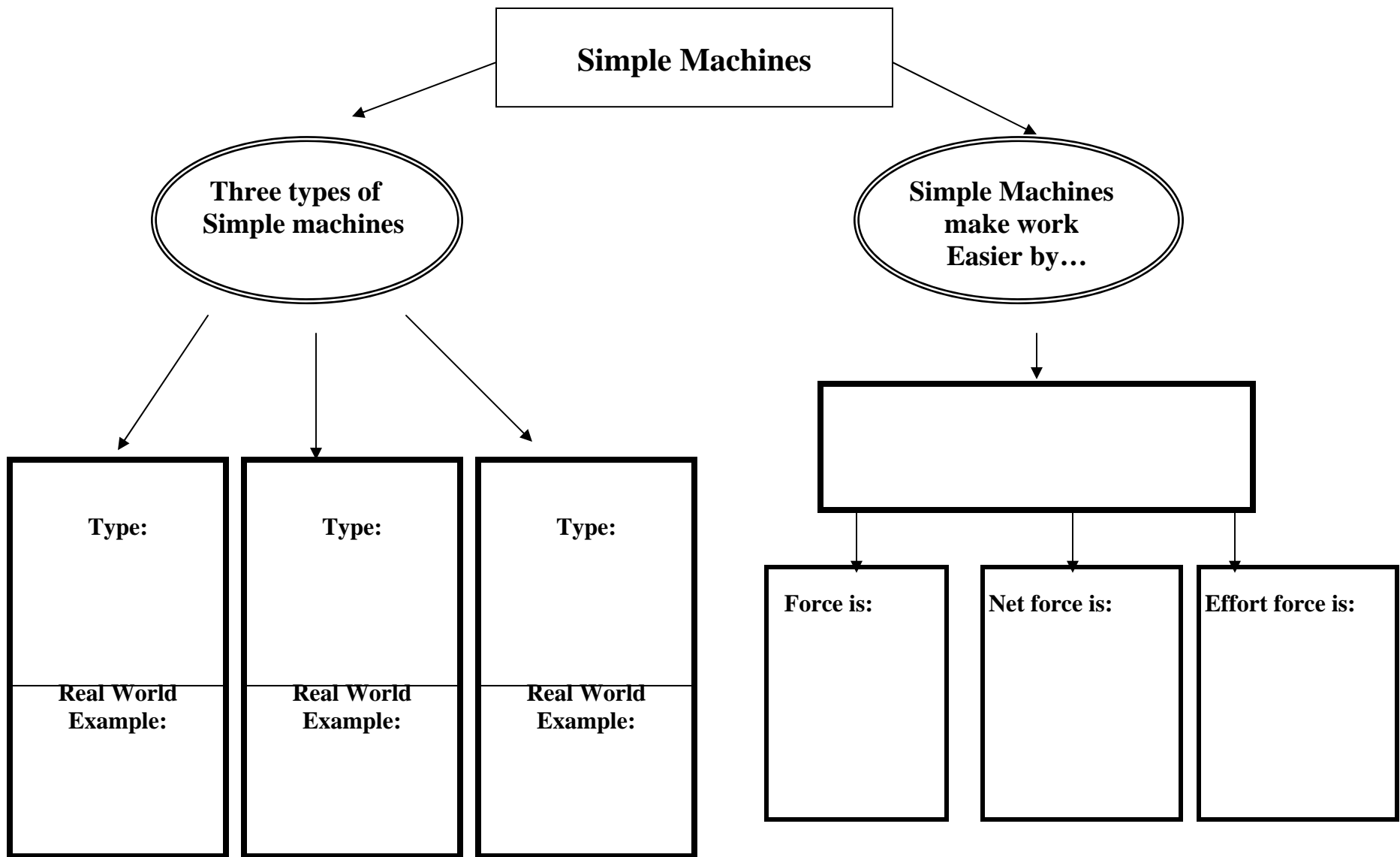
An **inclined plane** is a simple machine that is made up of a slanted surface or a ramp. An example of this is a driveway. By going up the inclined plane (driveway), the car is lifted up to the house, thus changing the size of the force needed to lift the car.



Finally, a **lever** is a simple machine that is made up of a bar that is free to turn about a fixed point. An example of a lever is a see saw, where the board is rotating around the triangle. When one child goes down, the other child will go up.



There are three other types of simple machines: wheel and axle, wedge, and screw. It is interesting to note that all of the six simple machines are variations of just two simple machines – the inclined plane and the lever.



**Directions:** Match the word with the definition

- |  |                   |
|--|-------------------|
| 1. _____ A push or pull one body exerts on another.                                | A. Inclined plane |
| 2. _____ The force applied multiplied by distance                                  | B. Force          |
| 3. _____ Simple machine made up of a rope and a wheel.                             | C. Net force      |
| 4. _____ Simple machine made up of a slanted surface or ramp.                      | D. Pulley         |
| 5. _____ Simple machine made up of a bar that is free to turn about a fixed point. | E. Effort force   |
| 6. _____ Force applied to a machine when a machine is used to do work.             | F. Work           |
| 7. _____ The sum of all the forces acting on an object                             | G. Lever          |

**Directions:** Decide which simple machine, a **pulley, lever or an inclined plane** would make the work easier.

7. Lifting a vending machine to the top of a building. \_\_\_\_\_
8. Launching water balloons out a window. \_\_\_\_\_
9. Moving a chair off the back of a truck to the ground. \_\_\_\_\_

**Directions:** Circle the picture below that shows work being done. (Use the scientific definition.)

