Name _____ Date _____

Simple Machines

"With Few or No Moving Parts, You Can't Lose!"

Learn more about this topic! Each section gives more detail on one of the lyrics from the song. Read each section, and then respond by answering the question or taking notes on key ideas.

Lyric: When you have a job that's too tough to manage

When you lift a box into a truck, you do work.

Work is the transfer of energy through motion. Whenever you make something move, you do **work**. When you pick up a glass of milk, put down the book you're reading or carry your backpack down the hall, you are doing work. Work is measured in a unit called **joules**. The amount of work is equal to force times distance. It can be written as the following equation:
force (in newtons) × distance (in meters) = work (in joules)

The **force**, or effort, is the push or a pull used on an object. It is measured in **newtons**. The **distance** is how far the object moves. It is measured in **meters**. Carrying a backpack down the hall would be less work than carrying a backpack across the country. That's because the distance the object moves would be much shorter. But carrying a backpack down the hall would be *more* work than carrying a feather down the hall. That's because the force, or effort, would be greater.

Notes

Lyric: Simple machines give you mechanical advantage

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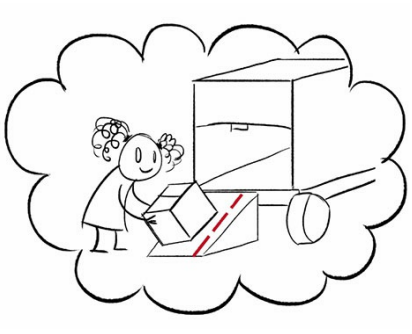

Simple machines make work easier by decreasing the force, or effort, you use.

Simple machines are devices with few or no moving parts. They make work easier. However, the *amount* of work done for a task stays the same with or without a simple machine. Imagine moving a box into a truck. You'd apply 4 newtons (force) to move the box 2 meters (distance). The work can be calculated as follows:

force (in newtons) × distance (in meters) = work (in joules)
4 newtons × 2 meters = 8 joules

In this case, 8 joules of work would be done. This won't change with a simple machine. A simple machine could increase the distance it takes to do that work. This would decrease the force needed. Let's say, a simple machine increases the distance the box will move by 2 meters. The force applied to the box would *have to* decrease by 2 newtons to keep the amount of work at 8 joules:
2 newtons × 4 meters = 8 joules

With a simple machine, the amount of work stays the same, but you use less effort. The effort saved by using a simple machine is called **mechanical advantage**.

Lyric: You could use an inclined plane or a ramp

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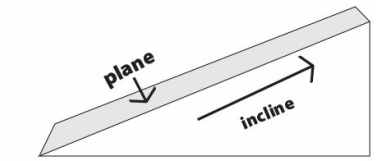

Sink drains, wheelchair ramps and slides are all inclined planes.

An **inclined plane** can be used to lift yourself or an object from one level to another. You may recognize the inclined plane in its most common form: the ramp. Imagine trying to carry a heavy box up a ladder to the roof of your house. It would be really difficult! Now imagine carrying that box up a ramp to your roof; it would be much easier. The ramp is longer than the ladder. To decrease the effort, or force, you have to increase the distance. Other examples of inclined planes include slides and driveways.

Lyric: Now, do you need to chop down a tree? You could use an ax, that's a type of wedge, see?

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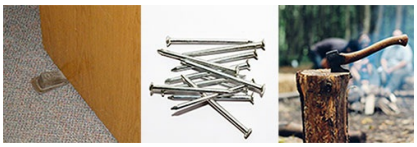

Doorstops, nails and axes are all wedges.

A **wedge** looks like two inclined planes put together and turned on its side. Wedges have a few uses. They can connect things, like a nail holding pieces of wood together. They can tighten things, like a doorstop holding a door open. They can also split things, like an ax splitting firewood. But splitting something apart really wide means pushing the wedge a long distance.

Lyric: And what kind of job would call for a screw? It holds things together and can raise or lower 'em, too

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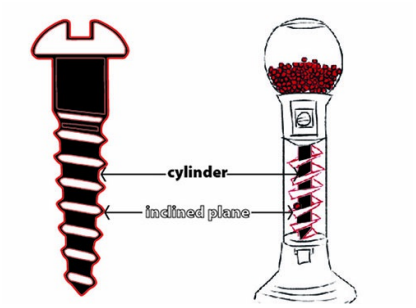

A gumball machine and a metal screw are both screws.

A **screw** is an inclined plane wrapped around a cylinder. It has two main uses. The first is to lift or move objects, like the inside of the gumball machine in the video. The second is to hold objects together. If you twist a screw through two objects, it holds them in place. But there is a tradeoff between distance and force. The tighter the inclined plane is wrapped around the cylinder, the more you'll have to turn the screw. The looser the inclined plane is wrapped around the cylinder, the harder it is to turn, but the less you have to turn it. Jar lids and lightbulbs are both examples of screws.

Lyric: And if you're ever using a lever, Well, that's just a kind of stick that's real clever

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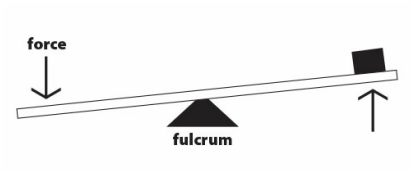

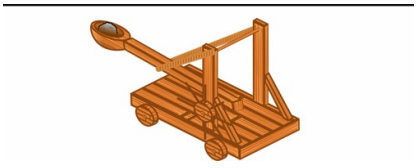

A lever is a bar that pivots at a point called a fulcrum. A catapults is a lever.

A **lever** is a bar that pivots, or moves back and forth, on a point. That point is called a **fulcrum**. Levers are used to lift, move and change the direction of objects. Lifting objects can require less effort depending on where the fulcrum is. But, again, there is a tradeoff. Less effort means a longer distance to lift the object. Some examples of levers are catapults, seesaws and even your own forearm (your elbow is the fulcrum)!

Lyric: That's a wheel, for real, you know how it rolls. It's connected to an object by an axle

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Wheels can be connected to objects with an axle. Cars and roller skates both have wheels and axles.

An **axle** is a rod that fits through the center of a circular **wheel**. The axle can attach the wheel to an object. Together, they help move objects more easily. Wheels and axles can work like levers that pivot all the way around. The larger the wheel is, the easier it is to move an object. But larger wheels also mean the wheel needs to be turned a greater distance. Out of all the simple machines, wheels and axles may be the easiest to recognize. They are on cars, roller skates and office chairs.

Lyric: But there's another simple machine we must discuss: A pulley!

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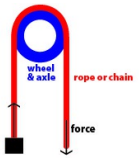
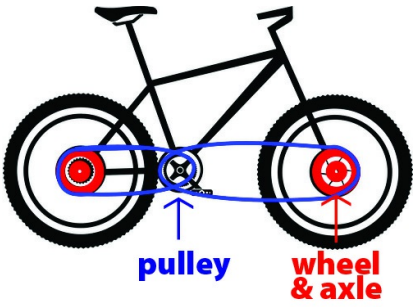


A pulley is made of a wheel with a rope or chain attached to it. A crane is an example of a pulley.

A **pulley** is made of a wheel with a rope or chain wrapped around it. One end of the rope is attached to an object. You pull down on the other end of the rope. This raises the object. Pulleys decrease the force your muscles need to do. Instead of just using your muscles to lift something, pulleys allow you to use your bodyweight and gravity. The more rope you have, the easier it is to lift the object. However, it also means you need to pull a greater distance. Some common pulleys are flag poles, clothes lines and cranes.

Lyric: But what about when you put two simple machines together? Then you get a compound machine, like all of these right here



A bicycle is a compound machine that has pulleys and wheels and axles.

A **compound machine** is made up of two or more simple machines put together. A compound machine uses the mechanical advantage from all of its simple machines to accomplish a task. A bicycle is a compound machine. It has two wheels and two axles that allow it to roll. The wheels are connected to the pedals with two pulleys. When you push down on the pedals, the pulleys spin the wheels. Scissors are another compound machine.The handles act as levers, and the two blades are wedges that cut through materials.

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