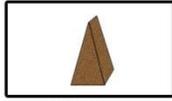




Science: Simple Machines & The USS KIDD



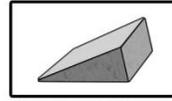
Wedge



Wheel and Axel



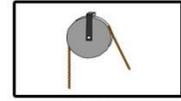
Lever



Inclined Plane



Screw



Pulley

A **simple machine** is a non-powered mechanical device that changes the direction of a force. It uses **mechanical advantage** to multiply force. Six (06) simple machines were identified by scientists during the Renaissance. All six of these simple machines can be found in use aboard the USS KIDD.

The first simple machine is a **lever**. A lever is a beam that pivots on a **fulcrum** and amplifies the amount of force used to help lift or move an object. The location of the fulcrum on the lever—closer to the object lifted or closer to the person exerting the force—determines the amount by which that force is increased. Aboard a ship like the USS KIDD, the most common example of a lever is the **dog**, a lever-type device that is used to secure hatches and doors. A **dogging wrench** is a small length of pipe fitted onto a dog that can extend the length of the lever and thus greater amplify the force applied to seal the hatch.

The wheel-and-axle is next. These two parts rotate together, transferring force from one to the other. The force exerted on the edge of one is transferred to the other to help lift or move an object. The difference in size between wheel and axle determines the **mechanical advantage** (force amplification). An example of a wheel-and-axle found aboard the KIDD is the **anchor windlass**, a machine used to lift the two-ton anchor from the ocean floor.

The **pulley** is a simple machine comprised of another simple machine: the wheel-and-axle. A rope or cable that runs through the pulley changes the direction of the force applied to do the lifting. By linking several pulleys together into an arrangement known as a **block-and-tackle**, a small force can be amplified greatly. Block-and-tackle can be found all throughout a ship like the USS KIDD, but particularly so aboard a sailing ship where these are exceedingly common.

The simple machine known as an **inclined plane** reduces the amount of force needed to ascend a sharp, vertical rise. Examples found aboard the KIDD include the **hawse pipes** which are channels used by the anchor chains to ascend aboard the ship at an angle rather than having to be drawn across a 90-degree angle onto the deck of the ship.

Like the pulley, a **wedge** is a simple machine made up of another simple machine: two inclined planes mounted together in opposite directions. It can be used to separate two objects or

portions of an object, lift up an object, or hold an object in place. It converts the force applied to its blunt end into forces perpendicular (at right angles) to its inclined surfaces. Its mechanical advantage is determined by its length and slope (a short wedge with a wide angle will do a job faster but requires more force than a long wedge with a narrow angle). A **marlin spike**, a tool used in ropework aboard ships for separating rope and untying knots, is a type of wedge.

The final simple machine is called a **screw**. This machine is a cylindrical shaft with grooves, or threads, running along its length. Rotational force—turning the screw—results in the force being applied vertically down the length of the shaft. In a sense, the screw is an inclined plane that is wrapped around a cylinder. Screws are commonly found as fasteners, holding objects together (i.e. wood or metal screws, nuts & bolts). However, they are also tools used to accomplish tasks other than holding objects together. Archimedes' Screw was a pump system used to move water uphill. An important use of a screw aboard a warship like the USS KIDD is the **rifling** found inside the ship's guns which make the projectiles (bullets) spin as they exit and increase their accuracy.

Using the above information, see if you can answer the following questions:

1. If you ride the school bus in the mornings, you see the driver use a lever when a student enters or exits the bus. If you don't ride the bus, but are dropped off in a car, you use the same lever to exit the vehicle. What is it?

2. What simple machine allows sailors to roll heavy equipment aboard ship from the dock or pier without resorting to lifting?

3. A vise uses two jaws that slowly close toward each other to hold a piece of equipment in place without any movement. It uses two types of simple machines: a lever (handle) and another machine that the lever turns. What is the other simple machine?

4. What simple machine does the flagpole outside of your school and the ones at the USS KIDD use to raise and lower the flags?

5. Firefighters aboard the USS KIDD and in your local fire department use an axe to break open doors and cut cable or rope. What type of simple tool does the axe represent?

Teacher's Answer Key

1. If you ride the school bus in the mornings, you see the driver use a lever when a student enters or exits the bus. If you don't ride the bus, but are dropped off in a car, you use the same lever to exit the vehicle. What is it?

The door handle.

2. What simple machine allows sailors to roll heavy equipment aboard ship from the dock or pier without resorting to lifting?

An inclined plane in the form of the ship's gangway.

3. A vise uses two jaws that slowly close toward each other to hold a piece of equipment in place without any movement. It uses two types of simple machines: a lever (handle) and another machine that the lever turns. What is the other simple machine?

A screw.

4. What simple machine does the flagpole outside of your school and the ones at the USS KIDD use to raise and lower the flags?

A pulley.

5. Firefighters aboard the USS KIDD and in your local fire department use an axe to break open doors and cut cable or rope. What type of simple tool does the axe represent?

A wedge.