SIMPLE MACHINES : MOTION CONVERTOR

CAT NO. WDMS16

Experiment Guide

GENERAL BACKGROUND :

There are six simple machines that all other machines are made out of. Even complex machines like an automobile really consist of simple machines that all convert energy in order to do work. Machines are used to make work easier. Here work is defined as a force applied over a given distance. The force applied and the distance traveled must be in the same direction.

Simple machines can either change the direction the force is applied, or increase the mechanical advantage by doing the same amount of work over a longer distance and therefore decreasing the amount of force needed.

Mechanical advantage is a way of measuring how much easier it is to do work or how much less force is required. Written as a formula:

$$\text{Mechanical Advantage} = \frac{\text{Output force (load)}}{\text{Input force (effort)}}$$

The load is the amount of force or weight that is being lifted
The effort is the amount of force or weight being applied to the rope in order to move the load.

The six simple machines are pulleys, levers, wedges, inclined planes, screws and wheels & axles. Compound machines have two or more simple machines that when used together make work easier.

The motion converter is a compound machine used to change rotational motion into translational motion or translational motion into rotational motion.

The motion converter is made up of two gears in this case, which are variations of a wheel and axle along with a lever arm.

PRACTICAL APPLICATIONS

There are several examples of everyday machines that convert rotational motion into translational motion or vice versa. Let's explore a few compound machines that exploit this type of transfer of motion.

You can see that the two gears and the post look very similar to the wheels on trains. Here is a diagram of how a steam engine works.

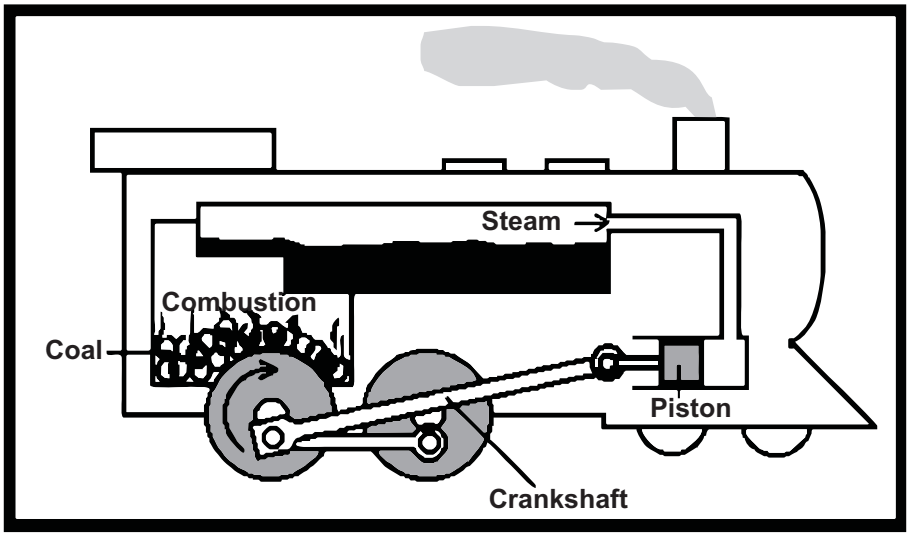

Diagram 2

In this diagram the steam pushes the piston back and forth using steam power. The piston then pushes the crankshaft which turns the wheels. In this case the translational motion is converted to rotational motion.

The pistons in a car work similarly. The combustion of the gasoline pushes the piston in and out and turns the crankshaft which then drives the car. Diagram 3 is a picture of a four stroke engine.

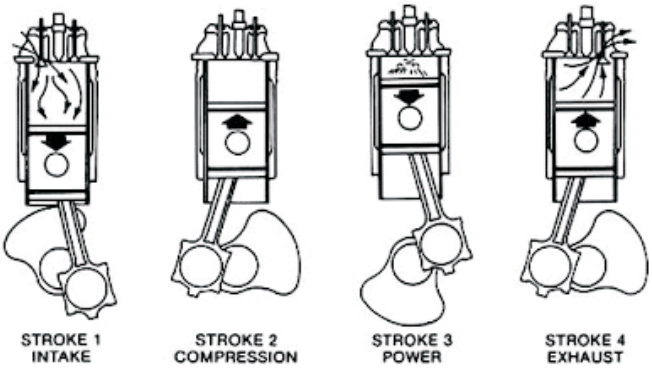

Diagram 3

REQUIRED COMPONENTS (INCLUDED)

Name of Part	*Quantity*
Motion Convertor Base	1

ACTIVITY 1: THE BASICS (TEACHER ANSWERS)

1. A machine made up of one or more simple machines is called a compound machine. Can you identify the two simple machines at work in this device?

   (There are two gears, which are variations of a wheel and axle, and then there is a lever attached to the follower gear which does work on a post.)

2. Turn the blue knob on the gear clockwise, observe what happens to the rest of the apparatus and record your observations below.

   (As the knob rotates clockwise, the follower gear rotates counterclockwise pushing the lever arm up and down, which in turn pushes post in and out between the two wooden brackets.)

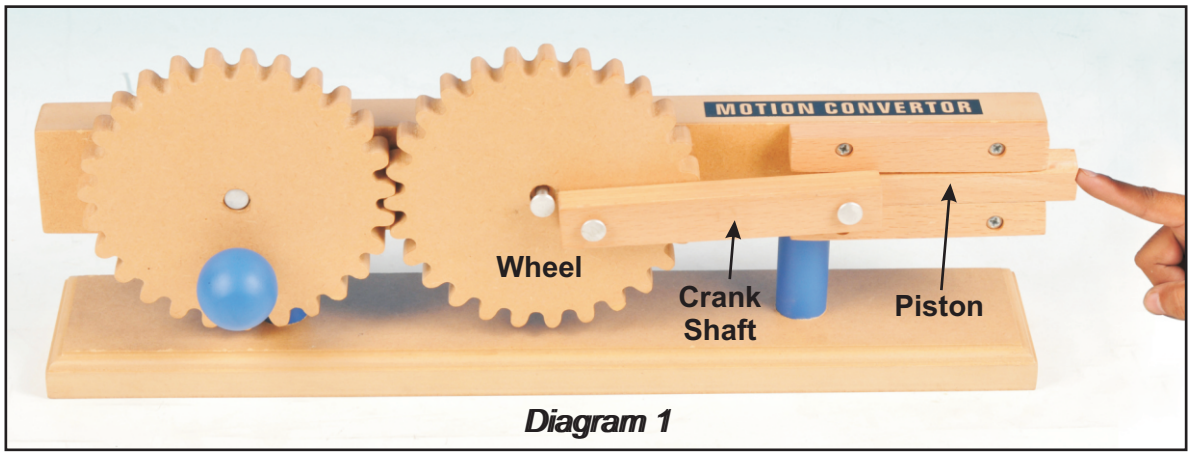

Diagram 1

3. Now look at diagram 1. Set up the apparatus as shown in the diagram and push on the post to the left. What happens to the rest of the apparatus? Record your observations below.

   (The post pushes the lever arm to the left, which then rotates the (now) primary gear, which rotates the follower gear. When the post is pushed in all the way to the left, then the motion stops.)

4. Is there any part in the rotation where the motion gets stuck when using the post to create circular motion?

   (Yes the rotation stops when the lever arm is parallel to the post.)

5. When using a lever arm, describe how the direction of the effort on the lever arm must be applied in relation to the lever arm. Are there any times when the force applied to the lever arm is not in this direction?

   (The force on the lever arm must be perpendicular to the lever arm. When the post and the lever arm are parallel to each other, the lever arm does not have any force perpendicular to the lever arm.)

6. How does the gear continue to rotate even when the lever arm doesn't experience any force?

(In order to continue rotating, the inertia of the rotating gear must carry the lever arm past the point where the lever arm and the post are parallel to one another.)

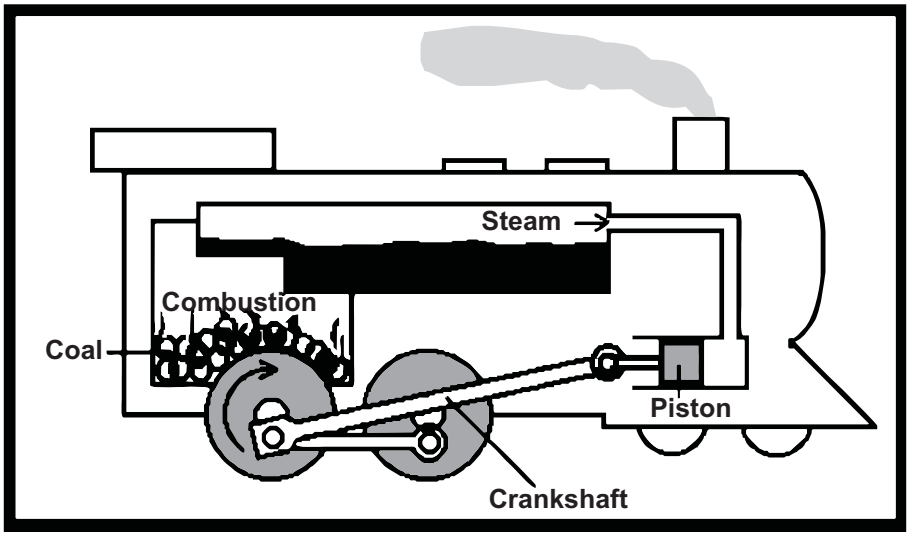

Diagram 2

7. Look at diagram 2 of this steam engine with his piston, crankshaft, and wheels. Can you identify each of these parts of the steam engine in your apparatus? Label them in diagram 1.

8. In our model, we use two gears to turn the piston. What would go wrong if we used two gears instead of wheels to run the steam engine in diagram 2?

(The gears would rotate in opposite directions so the wheels would not move forward and steam engines are so heavy, it would put a lot of pressure on the teeth of the gears, they would probably snap off or dig into the rails.)

NAME:_____ DATE:_____

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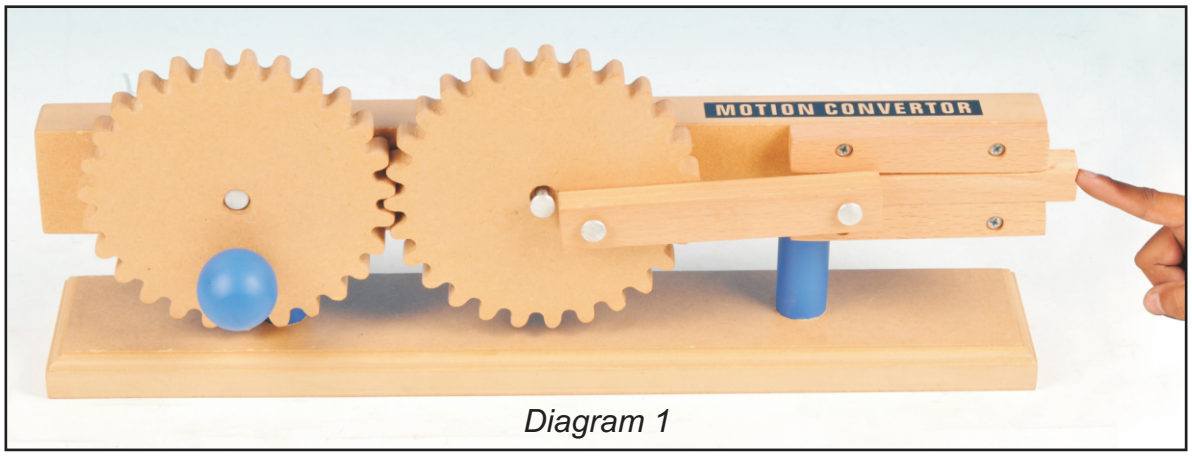

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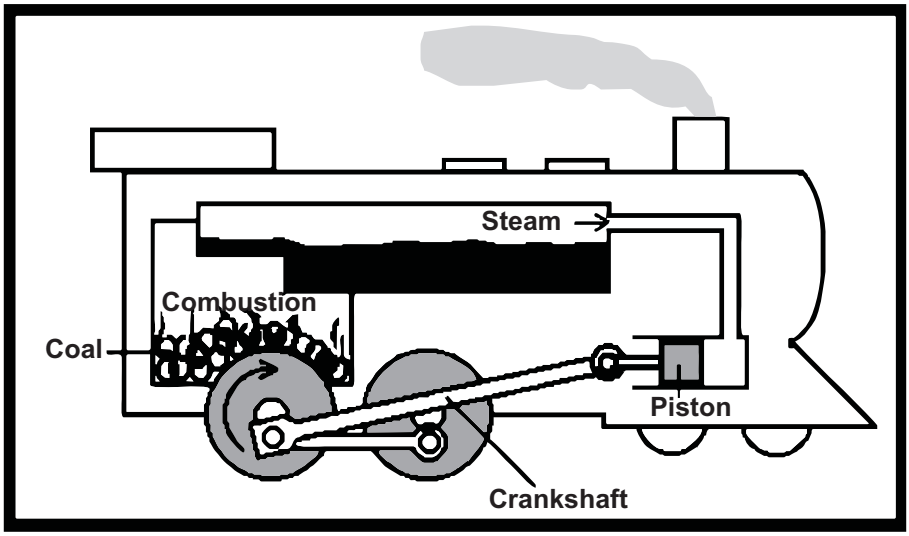

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