Lesson Plan

Description

Machines are everywhere and there are many jobs associated with each. This lesson explores various machines used in daily life, the people who use them, and provides an understanding of the mechanisms that make them work.

Learning Outcomes

- Simple machines and mechanisms are the building blocks for more complex machines
- Mechanisms transfer or transform force from one form or direction into another
- Mechanical linkages, gears and gear trains, cam and followers, and belt and chain drives are the most common forms of mechanisms

Specific Expectations

A3.1 describe practical applications of science and technology concepts in various occupations, including skilled trades, and how these applications address real-world problems
D2.1 identify machines that are used in daily life and describe their purposes
D2.2 identify the parts of various mechanisms and describe the purpose of each part
D2.5 explain how forces are changed in a variety of machines

Introduction

Simple machines and mechanisms can be considered the building blocks of more complex machines. Within complex machines such bicycles, cranes, cars or lawn mowers are at least two simple machines that reduce the force required to perform a task. Renaissance scientists were the first to define simple machines as one of the following six components:

- Lever
- Wheel and axle
- Pulley
- Inclined Plane
- Wedge
- Screw

Mechanisms are typically built from combinations of the six simple machines. Their primary purpose is to transfer or transform force from one form or direction into another, specifically converting input motion and force/torque into output motions and force/torque. Some examples of mechanisms include linkages, gears and gear trains, cam and follower, and belts and chain drives. Fasteners, springs, bearings, clutches, brakes, belts and chains are all elements that may be found in mechanisms to help facilitate movement and the transfer of force.

In this lesson, students will explore where linkages, gears and gear trains, cam and follower, and belt and chain drives are found in machines and how they are used to perform everyday tasks.

Materials

There are four activities in this lesson. Here are the materials needed for each:

Linkages

- 6 popsicle sticks
- Drill
- Wooden dowels
- Beads
- Hot glue gun

Gears and Gear Trains

- Two small Lego gears
- Two large Lego gears
- Lego Technic axle rods
- Lego Technic bricks with holes

Cam and Follower

- Shoebox (or similar sized box)
- Cardboard
- Wire cutters/garden sheers
- Scissors
- Popsicle Stick
- Skewers
- Straws
- Pencils
- Lids (to draw circles)
- Beads
- Hot glue gun

Belt and Chain Drives

- Shoebox (or similar sized box)
- Wire cutters/garden sheers
- Scissors
- Skewers

- Straws
- Pencils
- Small and large lids
- Thick elastic
- Beads
- Hot glue gun

Action

There are four activities in this lesson, associated with each of the previously listed mechanisms.

Mechanical Linkage

The first activity uses a mechanical linkage. The simplest form of a linkage is a lever, which is used to amplify an input force to provide a greater output force. Linkages are usually designed to transform a given input force and movement into a desired output force and movement.

To learn about linkages in everyday machines and to build your own, refer to the *Linkages - Scissor Lifts* handout.

Gears and Gear Trains

Gears are a combination of a wheel and axle with wedges for linkage. Gears have a number of purposes, including changing the direction of motion, changing the speed or changing the torque (force) of a machine. The size of the input and the output gear make these changes:

- If the output gear is larger than the input gear, the output gear will have more torque but move more slowly.
- If the output gear is smaller than the input gear, the output gear will have less torque but move more quickly

To learn about gears and gear trains in everyday machines and to build your own, refer to the *Gears – Electric Drills* handout.

Cam and Follower

A cam and follower mechanism combines a wheel and axle with a lever to convert rotary motion into linear motion. It is taking a given input movement and transforming it into a different output movement. There are numerous different types of cams, which is the driving member and numerous types of followers which is the driven member. Their shape and how they are combined affect how they are used.

To learn about cam and follower mechanisms in everyday machines and to build your own, refer to the *Cam and Follower – Printing* handout

Belt and Chain Drives

Belt and chain drives are two types of mechanical drives that are used to transmit motion, torque and power from a driver shaft to a machine part, the driven shaft. They can be used for transmissions as well as to change the direction of rotation or alter the speed. Belt drives transmit power and motion by means of friction force between a pulley and a belt. A chain drive transmits power and motion by successive engagement and disengagement between a gear and a chain.

To learn about belt drive mechanisms in everyday machines and to build your own, refer to the *Belt Drive – Washing Machines* handout

Consolidation/Extension

Students will have built and experimented with four unique mechanisms. To gauge their level of understanding, ask them to identify other tools or machines that contain each of the mechanisms. Here are some examples:

- Mechanical Linkage: Garage doors, car wipers, gear shifts, etc.
- Gears and Gear Trains: Clocks, bicycles, elevators, blenders, etc.
- Cam and Follower: Diesel engines, weaving machines, locks, paper cutting, etc.
- Belt and Chain Drives: Conveyor belts, record players, washing machines, etc.

As a further extension, students can also be challenged to build their own machines that incorporate one, or multiple, of the mechanisms they learned about in this lesson.

Accommodations/Modifications

- It is recommended that the lesson be completed in smaller sections to give students the time they need to succeed
- Assign students a partner or into groups to facilitate the activities
- Consider pre-fabricating some of the materials, such as drilling the holes in the linkage, ahead of time. This can also be something left to the students to promote hands-on practical skills

Assessment

Teachers can monitor the student work as Assessment *for* Learning. Gather information from the students throughout the activity to gauge their level of understanding.