

Design Challenge

Students will imagine they are the owners of a car recycling business. Their mission is to improve a mechanical system that moves cars to be recycled from the drop-off area to a platform. At the platform, reusable parts will be removed from the cars before they are dropped into a crusher below. The challenge is to design and build a working model of this mechanical system. Students will work in teams and use their engineering skills to create the best model possible. The team with the most effective and efficient model will have the chance to redesign the system for the real recycling plant. It's a fantastic opportunity for our students to become car recycling engineers and showcase their creativity and problem-solving abilities.

Learning Goal:

Students will

- Design and build a model of a transporting sled
- Use their knowledge about rotary motion (chain and sprocket, wheel and axle, pulley and string, screw thread, etc.) to incorporate into their mechanical system that can move a car onto a target

Science and Technology Expectations (Overall & Specific):

Overall:

A1: use a scientific research process, a scientific experimentation process, and an engineering design process to conduct investigations, following appropriate health and safety procedures

D2: demonstrate an understanding of the basic principles and functions of machines and their mechanisms

Specific:

A1.3 use an engineering design process and associated skills to design, build, and test devices, models, structures, and/or systems

A1.4 follow established health and safety procedures during science and technology investigations, including wearing appropriate protective equipment and clothing and safely using tools, instruments, and materials

D2.2 identify the parts of various mechanisms and describe the purpose of each part

D2.3 describe how different mechanisms transmit various types of motion, including rotary motion, from one system to another

D2.4 describe how mechanisms transform motion, including how they can change the geometric plane in which the motion occurs and the speed and/or direction of motion

Prior Knowledge and Skills

- Safe handling of hand tools and materials
- Understanding different mechanisms of rotary motion (chain and sprocket, wheel and axle, pulley and string, screw thread, etc.)
- Practice making mechanisms to change direction, speed and force

Equipment & Materials

- Commercial pulleys and gears

Personal Protective Equipment (PPE)

- Safety goggles

- Wooden or plastic wheels
- Bolts or screws with threads
- Nuts that fit the threads
- 1 cm by 1 cm bass wood
- wooden dowelling
- Gussets
- String
- carpenter's glue
- low temperature glue sticks
- plastic straws
- paper clips
- paper/cardboard
- Popsicle sticks
- elastic bands
- masking tape
- Hacksaw
- mitre box
- Joiners
- Toy vehicle (or other object weighing at least 200 g)

- Safety gloves
- [Safety posters for hand tools](#)

Minds On

- Begin with a brief discussion or review about mechanisms that change direction, speed and force
- Show real world examples of mechanisms of rotary motion (chain and sprocket, wheel and axle, pulley and string, screw thread, etc.) and have students match the mechanisms
- Share interesting facts about car recycling and importance of reducing waste and preserving resources

Action

- Introducing the activity to the students by providing a real-world context for the design challenge by explaining that they are the owners of a car recycling business. A suggested design challenge for the students could be:
 - *"You are the owner of a car recycling business. You are going to hire an engineer to improve a mechanical system that moves cars, on sleds, from the area where they are dropped off to a platform where reusable parts can be removed from the car, prior to dropping it into a crusher below. The engineering company that comes up with the best working model will be chosen to re-design the system for the recycling plant."*
- Describe the current car recycling system and its limitations, emphasizing the need for improvements to make it more efficient and effective.
- Present the design criteria and constraints, such as the requirement to move the sled with a car, using only the provided materials, and adhering to the maximum height and length limitations. The following can be a suggested list of specifications:
 - You will be working in teams of 2 to design and construct a model of a transporting sled and a mechanical system that will pull/push the sled with the car onto the crusher platform.

- Your device must move the sled with a car at least a distance of 50 cm onto a target.
- You must use only the supplied materials to construct your device.
- Provide each team with design planning sheets or worksheets where they can sketch their ideas and outline the components of their device
- Discuss with students the importance of planning and testing their designs before building the final model
- Once the models are built, have each team test their devices to see if they meet the design criteria.
- Encourage students to reflect on their initial designs, identify any areas for improvement, and iterate on their models to make them more efficient.

Consolidate

Conclude the activity with a reflection session, where students discuss what they learned from the design challenge and how they can apply these skills in other real-world engineering projects.

