

Exploring Pulleys and Joints Through a Robotic Hand

Objective: Students will be able to explain how pulleys and joints work together to create movement in a robotic hand.

Assessment:

Students will demonstrate mastery by designing and building a simple robotic hand using pulleys and joints, followed by a short presentation explaining their design choices and the physics behind the movement.

Key Points:

- **Pulleys:** A pulley is a wheel on an axle or shaft that is designed to support movement and change the direction of force.
- **Joints:** Joints are points where two body parts meet, allowing for movement and flexibility in structures.
- **Mechanical Advantage:** Using pulleys can increase the force applied, making it easier to lift or move objects.
- **Robotic Hand Mechanics:** Understanding how pulleys and joints mimic human hand movement to grasp and hold objects.
- **Engineering Design Process:** Steps involved in designing and building a functional model.

Opening:

- Begin with a brief video showcasing various robotic hands in action.
- Pose the question: "How do you think these robotic hands are able to move and grip objects?"
- Engage students in a think-pair-share discussion to explore their thoughts and ideas.

Introduction to New Material:

- Introduce the concepts of pulleys and joints:
 - **Pulleys:** Show a simple demonstration using a rope and a pulley to illustrate how direction and force change.

- **Joints:** Use a model of a hand to discuss the different types of joints (hinge, ball-and-socket) and their functions.
- Common misconception: Students may believe that more pulleys always mean more strength, but it's important to clarify that pulley systems can also change the direction of force rather than just increasing it.

Guided Practice:

- In groups, students will experiment with a pulley system using classroom materials (string, paper cups).
- Set expectations for collaboration and communication.
- Provide scaffolded questions:
 - What happens when you pull the string?
 - How can you change the direction of the force?
 - How do the joints in your hand help you grip objects?
- Monitor student performance by circulating the room and providing feedback.

Independent Practice:

- Students will design their own robotic hand using provided materials (straws, string, paper, etc.) incorporating at least one pulley and two joints.
- Behavioral expectations: Work quietly and collaboratively while following the design process.
- Students will document their design process and prepare to present their robotic hand to the class.

Closing:

- Each student will share one feature of their robotic hand and explain how it uses pulleys and joints.
- Conduct a quick review quiz asking students to identify key terms discussed in the lesson.

Extension Activity:

- For students who finish early, provide additional materials to create a more complex robotic hand with multiple joints and pulleys, encouraging them to think about how to improve grip strength.

Homework:

- Research a real-world application of robotic hands or prosthetics and write a short paragraph explaining how pulleys and joints are utilized in that context.

Standards Addressed:

- Next Generation Science Standards (NGSS) 5-PS1-3: Make observations and measurements to identify materials based on their properties.
- International Society for Technology in Education (ISTE) Standard 5: Computational Thinker - Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods.