Exploring Gear Ratios

AUTOMOTIVE SERVICE TECHNICIAN, HEAVY EQUIPMENT TECHNICIAN, AGRICULTURE EQUIPMENT TECHNICIAN, PARTS TECHNICIAN

GRADES	LEARNING OBJECTIVE	CONCEPTS
• Grade 8	Investigate gear ratios by analyzing the relationship between driven gears and driving gears using interactive gear sets with movable handles.	• Ratio • Gears • Driven Gear • Driving Gear • Gear Ratio • Torque • Force • Work • Rotation • Friction

Curriculum Connections

GRADE 8 SCIENCE

Learning outcome: Students investigate and describe the transmission of force and energy between parts of a mechanical system.

Skills and procedures:

- Analyze mechanical devices to determine speed ratios and force ratios
- Build or modify a model mechanical system to provide for different turning ratios between a driving and driven shaft, or to achieve a given force ratio
- Compare theoretical and actual values of force ratios, and propose explanations for discrepancies

GRADE 8 MATH

Number: Develop number sense.

- 4. Demonstrate an understanding of ratio and rate
- 5. Solve problems that involve rates, ratios, and proportional reasoning

Description

This lesson plan will help students comprehend gear ratios by using interactive gear sets. Students will be introduced to the essence of gear ratios and engage in hands-on exploration of diverse gear sets, their calculation, and the analysis of their mechanical implications.

This activity emphasizes the relevance of gear ratios within the realm of automotive service, heavy equipment and agriculture equipment technicians. Understanding how gear ratios affect torque, speed, and power transmission is essential for diagnosing, repairing, and maintaining vehicles. By fostering practical engagement and reflections on real-world applications, the plan effectively equips students with a thorough grasp of gear ratios' significance in mechanical systems.

TIME	MATERIALS
• 60 minutes	• Interactive gear sets (3D printed gear sets with movable handles and assorted gear ratios) • Gear ratio worksheet • Pencil and paper

Procedure

PREPARATION

- Print enough gear ratio worksheets and check gear sets are in working order.

STEPS

1. Introduction (10 minutes)

- Begin by discussing the concept of gear ratios and their significance in mechanical systems.
- Engage students in a brief discussion about real-world examples of gear systems and their applications.

2. Interactive gear ratio exploration activity (20 minutes)

- Provide each student or group with an interactive gear set, which includes driven gears, driving gears, and movable handles of different sizes and gear ratios.
- Distribute the gear ratio worksheet to each student or group.
- Instruct students to assemble the gear sets by connecting the gears together and attaching the movable handle to the driving gear.
- Have students rotate the handle manually and observe the rotational movement of the driven gears.
- Instruct students to count the number of rotations made by the driving gear and the driven gear(s) and record their observations on the gear ratio worksheet.
- Guide students in analyzing the observed gear ratios and determining the relationship between the driving gear and driven gear(s) based on their rotations.

3. Gear ratio calculation (20 minutes)

- Introduce the concept of gear ratios as a ratio of the number of teeth on the driving gear to the number of teeth on the driven gear(s).
- Instruct students to calculate the gear ratio for each gear set using the following formula: Gear Ratio = Number of Teeth on Driving Gear / Number of Teeth on Driven Gear. Ask students to show their work in the chart.
- Guide students through the calculations, emphasizing the significance of the gear ratio in determining the mechanical advantage and speed of the gear system.

4. Analysis and conclusion (5 minutes)

- Have students complete the 4 questions at the bottom of gear ratios worksheet.
- Facilitate a class discussion to analyze the observed gear ratios and the corresponding mechanical advantages and speeds.
- Encourage students to compare the gear ratios of different gear sets and identify any patterns or trends.
- Guide students in drawing conclusions about the relationship between gear sizes, gear ratios, and the resulting mechanical advantage or speed.

5. Reflection and extension (5 minutes)

- Ask students to reflect on what they've learned about gear ratios and their impact on mechanical systems during the activity.
- Encourage students to think about how gear ratios are relevant in various applications, such as automotive transmissions, bicycles, and industrial machinery.
- Discuss potential extensions, such as designing their own gear sets with specific gear ratios or exploring the practical applications of gear systems in different trades.
    - Show the video Trade Talks: Mechanical Advantage (Gears)

Assessment suggestions

ASSIGNMENT SUGGESTION 1

Understanding of gear ratios

- Assess students' understanding of gear ratios through their completed gear ratio worksheets and calculations.
- Review their worksheets to gauge their comprehension of the relationship between gear sizes, rotations, and speed.
- Evaluate the accuracy and correctness of their calculations, considering the gear ratio formulas and concepts discussed.

ASSIGNMENT SUGGESTION 2

Application to real-world context

- Assess students' ability to apply their knowledge of gear ratios to real-world applications during reflection and extension discussions.
- Encourage students to discuss and provide examples of how gear ratios are used in everyday objects and machinery.
- Evaluate their understanding of how gear ratios impact the functioning and efficiency of mechanical systems.

Web resources

- Gear Ratio Worksheet
- Gears Kit: Activity Guide
- Trade Talks: Mechanical Advantage (Gears)

Contributors

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