

05 Mechanical Advantage in Gears

Content Area: **Technology**
Course(s):
Time Period: **Full Year**
Length: **3 Weeks**
Status: **Published**

General Overview, Course Description or Course Philosophy

This full year honors course continues to emphasize the application of integrated STEM (Science, Technology, Engineering and Mathematics) principles and the design method to invent solutions to real world problems through robotic applications. Students will identify problems, research, design and fabricate solutions. Problem solving, critical thinking and design skills are taught through a variety of activities. Hands-on themes include structural and robotic systems, as well as system control technology. This course provides all students with valuable skills such as: problem solving, design, creative thinking, systems thinking, team work, documentation, programming and computer applications.

OBJECTIVES, ESSENTIAL QUESTIONS, ENDURING UNDERSTANDINGS

Students will understand how gears are used to increase power or speed in a technological system, how to calculate gear ratios for power and speed and how to design and build simple and complex (compound) gear systems.

CONTENT AREA STANDARDS

TECH.8.2.12.D.1	Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review.
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RELATED STANDARDS (Technology, 21st Century Life & Careers, ELA Companion Standards are Required)

MA.K-12.1	Make sense of problems and persevere in solving them.
CCSS.Math.Practice.MP3	Construct viable arguments and critique the reasoning of others.
CCSS.Math.Practice.MP4	Model with mathematics.
MA.K-12.5	Use appropriate tools strategically.
MA.K-12.6	Attend to precision.
MA.K-12.7	Look for and make use of structure.

MA.K-12.8	Look for and express regularity in repeated reasoning.
CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP6	Demonstrate creativity and innovation.
CRP.K-12.CRP11	Use technology to enhance productivity.

STUDENT LEARNING TARGETS

Declarative Knowledge

Students will understand that:

- Gears are used to increase power or speed in a technological system.
- Calculating gear ratios for power and speed is required for designing accurate solutions to problems.
- Designing and building simple and complex (compound) gear systems is a non-linear process..
- They are required to identify different types of gears.
- They are required to define the purpose of different types of gears.
- They are required to explain when and how to utilize different types of gears.
- They must state and apply the formula for calculating mechanical advantage.

Procedural Knowledge

Students will be able to:

- Determine when to increase or decrease mechanical advantage in a system.
- Demonstrate the ability to design, build and apply gears in a system to increase or decrease mechanical advantage in order to solve a problem.
- Calculate the mechanical advantage of simple and complex (compound) gear systems.

EVIDENCE OF LEARNING

Formative Assessments

- Observation of “Do Now” mechanical advantage problems during and after lessons.
- Observation of drivetrains designed and built by students.
- Drawing of project drivetrain and how to calculate its MA.
- Quiz on Mechanical Advantage.
- Quiz on gear types, recognition and definitions.

Summative Assessments

- Design project and engineering log - design and build a drivetrain to solve a real world problem; calculate mechanical advantage and explain rationale. Include sketches, orthographic drawings, rationale, and how to improve.
- Questions on Unit Test following Rover Unit.

RESOURCES (Instructional, Supplemental, Intervention Materials)

- Teacher notes on gears.
- Teacher notes on calculating mechanical advantage.
- Mechanical advantage worksheets.
- Lego gears, axles and structural components.
- Problem solving design brief: Compound drivetrain.

INTERDISCIPLINARY CONNECTIONS

- Modeling with Mathematics and Make sense of problems and persevere in solving them.

ACCOMMODATIONS & MODIFICATIONS FOR SUBGROUPS

See link to Accommodations & Modifications document in course folder.