Introduction to Simple Machines

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Agenda

• Hands-on learning with K’NEX Education
• Introduction to Simple Machines Sets
• Alignment to National Standards
• Making work easier
• Building and Investigating
Introduction to Simple Machines Levers and Pulleys Set

- 178 pieces to build 8 real world models of:
  - 1st, 2nd, and 3rd class levers
  - Fixed, movable and combination pulleys
- Supports 2 – 3 students working as a team.
- Teacher Guide on CD
Introduction to Simple Machines: Wheels & Axles and Inclined Planes Set

- 178 K’NEX Pieces to build 7 real world models
- Instruction Booklet
- Supports 2 - 3 students working as a team
- Teacher Guide on CD
Introduction to Simple Machines Gears Set

- 198 pieces to build 7 real world models
- Instruction Booklet
- Supports 2 – 3 students working as a team.
- Teacher Guide on CD
Key Concepts

- Making work easier
- \( W = Fd \) (Work equals force times distance)
- Effort Arm, Resistance Arm, and Fulcrum
- Classes of levers
- Ideal Mechanical Advantage
- Actual Mechanical Advantage
- Fixed Pulley
- Movable Pulley
- Block and Tackle
- Mechanical Systems
- Changing the direction of force
- Wedge
- Screw
- Measurement, data organization, data analysis
- Energy Transfer
- Gear Ratios
- Spur Gears
- Crown Gears
- Chain Driven Systems
NSES Science Content Standards Alignment

- **Unifying Concepts and Processes**
  - Systems, order, and organization
  - Evidence, models, and explanation

- **Science as Inquiry**
  - Understandings about scientific inquiry

- **Physical Science**
  - Position and motion of objects
  - Motions and forces

- **Science and Technology**
  - Abilities of technological design
Next Generation Science Standards

• Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

• Make observations and/or measurements of an object’s motion to provide evidence that a pattern can be used to predict future motion.

• Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

• Support an argument that the gravitational force exerted by Earth on objects is directed down.
ITEEA Technological Literacy Standards

The Nature of Technology
Core Concepts of Technology
• Systems, Processes and Requirements

Design
Engineering Design
• Engineering design process
• Creativity and considering all ideas
• Models
The role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving
• Invention and innovation
• Experimentation

Abilities for a Technological World
Apply design process
• Test and evaluate solutions
• Improve a design
NCTM Standards and Expectations

• Algebra
  ▪ Analyze change in various contexts

• Data Analysis and Probability
  ▪ Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them
Common Core - Mathematics

• Operations and Algebraic Thinking
  • Write and interpret numerical expressions.
  • Analyze patterns and relationships.

• Number and Operations in Base Ten
  • Perform operations with multi-digit whole numbers and with decimals to hundredths.

• Measurement and Data
  • Convert like measurement units within a given measurement system.
  • Represent and interpret data.
Q: Why do we use simple machines?

A: Because they make work easier.
How do simple machines make work easier?

- by changing the direction of a force
- by multiplying force
- by multiplying the distance something moves
Building Levers

- The wheelbarrow is an example of a second class lever.
- Follow the directions in the Instructions Booklet to build the wheelbarrow.
Investigating the Wheelbarrow

• All levers have a fulcrum, load, and an effort force. Draw a diagram of your model and label each of these parts.
• Does your model multiply force, multiply distance (speed), and/or change the direction of force?
Design Challenge

• How can you modify the model to demonstrate how the wheelbarrow could multiply force even more?

• Make the change to your model with other pieces in your set.

• Be prepared to demonstrate your design modification to the entire group and explain the science behind the change.
Analyze the Models

• Various models from the Introduction to Simple Machines Sets will be demonstrated.

• Your challenge is to name the models, name the simple machine they demonstrate, and describe whether the model multiplies force, multiplies distance (speed), and/or changes the direction of force.

• You will receive plenty of support and many suggestions from the other workshop participants.