

## 72. Medieval Castle Drawbridge

**Classroom Activity:** Design and build a drawbridge-lifting device using simple machines (gears and pulleys) to work with a medieval castle, on an individual basis.

**Grade:** 4

**Strand(s):** Understanding Structures and Mechanism

This task addresses the following overall expectations:

- investigate ways in which pulleys and gears modify the speed and direction of, and the force exerted on, moving objects;
- demonstrate an understanding of the basic principles and functions of pulley systems and gear systems.

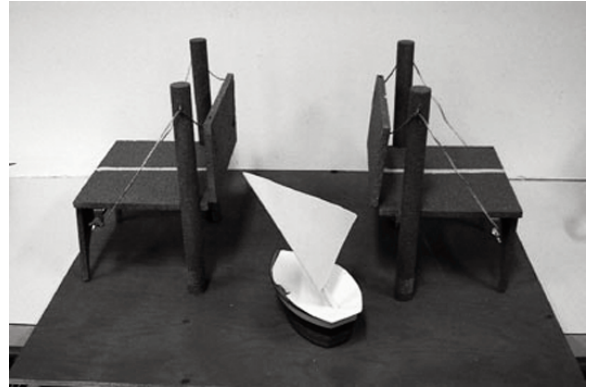
and the following specific expectations:

- follow established safety procedures for working with machinery;
- use scientific inquiry/experimentation skills to investigate changes in force, distance, speed, and direction in pulley and gear systems;
- use technological problem-solving skills to design, build, and test a pulley or gear system that performs a specific task;
- use appropriate science and technology vocabulary, including pulley, gear, force, and speed, in oral and written communication;
- use a variety of forms (e.g., oral, written, graphic, multimedia) to communicate with different audiences and for a variety of purposes;
- describe the purposes of pulley systems and gear systems;
- describe how one type of motion can be transformed into another type of motion using pulleys or gears.

**Assessment Categories:**

- Knowledge and Understanding
- Thinking and Investigation
- Communication
- Application

**Type of Activity:** Classroom



Time needed to complete activity: 10-12 hours (including design, construction and painting)

Cross Disciplines:

- Social Studies, History and Geography
- Mathematics

**Materials/Resources for teachers:**

- Cardboard box(es)
- Popsicle sticks
- Plastic gears (2)-any size
- Plastic or paper pulleys (2)
- Cord or heavy string
- White glue and carpenters glue
- 1/4 inch dowel (36inch long)

**Activity Description**

Procedure (Please note that the teacher or EIR does all cutting of the cardboard and dowels to ensure student safety) It is also important that sufficient time be allowed for the glue to dry, otherwise students end up having to redo their work.

- Cut a 15inch by 15 inch square as a base for the castle assembly
- Sketch out the shape of the castle front and sides (triangular) as well as the tabs across the bottom (for gluing the castle front to the base). Then cut out the castle including front, sides, tabs and doorway.
- Glue castle to the base.

## 72. Medieval Castle Drawbridge

- Using the Popsicle sticks, construct the draw-bridge
- Cut out two dowels that are approximately 2 inches longer than the width of the drawbridge and glue one at the end of the drawbridge and one approximately 2 inches from the other end. Note: dowels are best located on the underside of the drawbridge.
- Make 2 hinges using cardboard (1 inch wide and 2 inches long, bent in the middle) and make a hole using a 3 inch nail in one side of the L of the hinge
- Slip the hinges over the end of the dowel located at the end of the drawbridge and glue the assembly on the front of the castle at the bottom of the door. Once glued the drawbridge should rotate up on the hinge to act as a door to the castle.
- Rotate drawbridge to vertical position and create 2 holes in the front of the castle in line with the drawbridge dowel farthest from the hinges.
- Prepare pulley assembly using hinges similar to f), gluing the hinges on the outside of the holes made in the front of the castle and inserting a dowel cut to suit the space between the 2 hinges on which placed 2 pulleys have been placed.
- Prepare the gear assembly by cutting 2 pieces of cardboard (approx. 4 inches square), folded in the middle.
- Prior to gluing the gear assembly onto the base, using the plastic gears, mark the centre of each gear on the 2 pieces of cardboard, ensuring that the gears mesh properly and make a hole. Then glue the hinges to the base approximately in line with the pulleys.
- Using carpenters glue, glue the plastic gears on to 2 dowels cut to suit the space between the L shaped hinges (gear assembly). Note that the dowels must be parallel once inserted into both sides of the assembly. It is also important to ensure that the gears are perpendicular to the dowel.
- Cut 2 lengths of cord measured to suit the distance between the front dowel of the draw-bridge and the front dowel on the gear assembly, tying one end on the front dowel of the draw-bridge, running the cords through the holes in the front of the castle, OVER the pulleys and tying (and gluing) them on to the front dowel of the gear assembly.

To operate, with the drawbridge flat, turn the rear dowel in the gear assembly. This will turn the front gear of the assembly, raising the drawbridge.