

1. Lesson Plan Information
Subject/Course:
Name: David Darling

Grade Level: 4

Date: February 28, 2008

Topic: Pulleys and Gears: Drawbridges

Time: 4 Periods (4 X 50 mins = 200 mins)

2. Expectations

The Grade 4 learners will:

a) Expectations:

 4s78 Grade 4 PLNR02 Science and Technology Structures and Mechanisms
 Overall Expectations

– design and make pulley systems and gear systems, and investigate how motion is transferred from one system to another;

 4s81 Grade 4 PLNR02 Science and Technology Structures and Mechanisms
 Understanding Basic Concepts

– describe, using their observations, how rotary motion in one system (e.g., a system of pulleys of different sizes) is transferred to rotary motion in another (e.g., a system of various gears) in the same structure;

3. Pre-assessment
a) Students:

- Able to design and make structures that include mechanisms and that can support and move a load, and investigate the forces acting on them.
- Can describe, using their observations, the role of struts and ties in structures under load (e.g., describe the effect of adding a strut to a wooden frame).
- Able to describe, using their observations, systems involving mechanisms and structures, and explain how these systems meet specific needs and how they have been made.
- Can describe, using their observations, the changes in the amount of effort needed to lift a specific load with a lever when the position of the fulcrum is changed

Other Important Considerations:

IEP Students

1. D.A.

- **Accommodated** only for Language, Math, Science & Tech and Social Studies.
- **Strengths** include nonverbal reasoning, oral communication and processing speed.
- **Areas of need** include receptive language (comprehension, decoding and reading) and organizational skills.
- **Instructional accommodations** include: access to calculator/math aids and PC, adaptation of assessment format as necessary, extra time for copying, divide text into smaller parts, highlight/chunk material, provide samples to work from, post timetable, provide opportunities for student choice, .
- **Environmental accommodations:** minimize distractions, proximity to instructor.
- **Assessment accommodations:** clarification of questions or instructions, reduce written input,

dictionary, extra time to respond, read all written instructions, scribe.

2. K.D.

- **Accommodated** only for Language, Math, Science and Tech and Social Studies.
- **Strengths** include general knowledge, independence, receptive language skills (decoding), follows routines and instructions independently, perseverance and attention skills.
- **Areas of need** include expressive language skills (speaking and writing), receptive language skills (comprehension).
- **Instructional accommodations** include access to dictionary/thesaurus, highlight/chunk material, posted timetable, prioritized tasks for completion, provide instructions visually and verbally, provide needed prompts/clues, provide self-checking methods, read written instructions as necessary.
- **Assessment accommodations** include clarification of questions or instructions, extra time to respond and read all written instructions.

b) Learning Environment:

- Classroom 103.
- There are 28 students who are seated according to plan kept in Teacher's desk.
- Student desks are arranged in three groups. Large group learning situation during Introduction. Students will work in pairs for the activity.
- Materials for the activity will be arranged on the counter along the front and backs walls of the classroom.

Special Considerations:

- Situate glue gun stations in room corners, away from high traffic areas.
- Set up mitre boxes for wood cutting on table corners (1 hack saw per mitre box).
- See attached room prep photo for suggested set-up.

c) Resources:

Introduction

- PowerPoint file (Castles and Drawbridges.ppt)
- Video file (synfig_gears.flv)
- Laptop and AV projector
- Drawbridge Assembly Instruction Handout (attached, 1 per student pair).
- Exemplar: assembled drawbridge.

Activity

- Drawbridge materials (per pair of students):
 1. 6 pieces of 'jinx' wood (30 cm X 2cm X 2 cm)
 2. 2 straws (20 cm)
 3. 2 dowels (20 cm, 1 cm diameter)
 4. 1 large gear (5 cm diameter)
 5. 1 small gear (2 cm diameter)
 6. 1 pulley (5 cm diameter)
 7. 1 wooden wheel
 8. Popsicle sticks (4)
 9. Hinge
 10. String (70 cm)

11. Safety goggles
- Additional resources for the activity include:
 1. Hot glue guns
 2. Hacksaws
 3. Mitre boxes
 4. Scissors
 5. 'Dolphin' cutters
 6. Hand drills
 7. C-clamps

Resources for Content

1. http://www.sciencetech.technomuses.ca/english/schoolzone/Info_Simple_Machines2.cfm
2. <http://auto.howstuffworks.com/gears.htm>

4. Content

Gears

Gears are wheels with teeth that can be used to gain force or speed or change direction. Gears are generally used for one of four different reasons:

1. To reverse the direction of rotation
2. To increase or decrease the speed of rotation
3. To move rotational motion to a different axis
4. To keep the rotation of two axis synchronized

The size and number of teeth on a gear determine the kind of work it can do. A force on a large gear will cause a small gear to turn faster, but with less force. A force on a small gear will turn the large gear more slowly, but it will have a greater force. The distance between the teeth of the gear is called the "pitch".

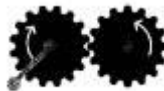
When one gear drives another, the two gears turn in the opposite direction. If it is required that they turn in the same direction, a third gear called an "idler gear" is interposed between them.

Examples of Gears

Clocks, egg beaters, fishing poles, cars, toys, drills.

How to use Gears

- The gear you turn (called the driver) causes the other gear (called the follower) to turn also. The driver and the follower turn in opposite directions.



- A large driver makes a small follower gear turn faster and decreases the force. This is called gearing up.



- A small driver gear makes a large follower gear turn slower and increases the force. This is called gearing down.



- An idler gear makes adjacent gears turn in the same direction. A large driver will make a small follower turn faster, regardless of the idler size.

Pulleys

A pulley is a wheel with a groove that allows a rope, belt or chain to ride securely on it.

A pulley is a circular lever, with the wheel rotating freely on the axle. A fixed pulley is fastened to one spot, and does not move around. It provides no gain in force, distance or speed, but it changes the direction of the force. A fixed pulley acts as a first class lever. The fulcrum is the axle (the point at which the pulley is supported).

The force arm is the radius of the pulley - that is, the distance from the fulcrum (axle) to the side of the rope on which we pull. The load arm is also the radius of the pulley - the distance from the fulcrum (axle) to the load-carrying side of the rope. Examples of fixed pulleys can be seen on flag poles, drapes, or on a sail mast. In each case, the pulley changes the direction of the applied force, to enable work to be accomplished.

Examples of Pulleys

Flag poles, cranes, water pumps, air conditioners, automobile engines, sewing machines.

How to Use Pulleys

- The pulley you turn (called the driver) causes the other pulley (called the follower) to turn also, because they are connected by a belt. The driver and the follower turn in the same direction.



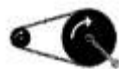
- The driver and the follower turn in the opposite direction when connected by a crossed belt.



- A small driver makes a large follower turn slower (referred to as gearing down), which decreases the speed of rotation but increases the force.



- A large driver makes a small follower turn faster (referred to as gearing up), which increases the speed of rotation but decreases the force.



- A belt drive can be used to change the direction of rotation by 90 degrees.



- A fixed pulley can change the direction of a lifting force to a more convenient angle.



- A moveable pulley can be used with a fixed pulley to lift a load with less effort than with a fixed pulley alone.



5. Teaching / Learning Strategies

a) Teacher's Role

1) Introducing the Activity

(10 min)

- Teacher will discuss castles, drawbridges, gears and pulleys with students using PowerPoint slideshow (Castles and Drawbridges.ppt) and animated file (synfig_gears.flv).
- Teacher will introduce project and show exemplar (finished product).
- Teacher will demonstrate how to use the saw, vice, dolphin cutter and glue gun, emphasizing safety concerns.
- Students will be told they are working in pairs.
- Teacher will distribute Drawbridge Assembly Handout and will describe each step to students as they follow along with the document.

2) Consolidation of Learning (Check for understanding / student review)

(5 min)

- Teacher will ask students why pulleys and gears were used in drawbridges.
- Teacher will ask students to repeat the safety considerations and the important steps in constructing the drawbridge.
- Teacher will ask if there are any questions before beginning the application.

b) Student Routines and Procedures (What the students do after the instructions and a review)

(185 min)

1. Students will obtain the Jinx wood for the Base. They will cut and glue the pieces for the Base (per p. 1 of their handout).
2. Students will obtain the Jinx wood for the Tower. They will cut and glue the pieces for the Tower (per p. 2 of their handout).
3. Students will obtain the materials listed on p. 3 of their handout.
4. Students will cut the dowelling and straws as indicated on p. 3 of the handout.
5. Students will assemble the Tower as directed on p. 4 of the handout. Students are encouraged to consult with the exemplars and the teacher to ensure proper assemblage of the Tower.
6. Students will assemble the handle and large gear as directed on p. 5 of the handout.
7. Students will ask the teacher for assistance with assembling the small gear (and associated straw and dowel) when they reach p. 6 of the handout.
8. Students will attach the Tower to the Base.
9. Students will construct the Bridge as directed on p. 6 of the handout.

10. Students will attach the plastic hinge to the base and connect the other side of it to the Bridge.
11. Students will consult the exemplars and ask the teacher for assistance to attach the string.
12. Students will test their drawbridge and troubleshoot as necessary.
13. Students will clean up their workspace upon successful completion of their drawbridge.
14. Teacher will select students to help clean up the equipment and gluing centres.

6. Assessment / Evaluation

1. Teacher will make anecdotal notes about comprehension of pulley and gear concepts while assisting students during drawbridge construction.
2. Teacher will assess whether the drawbridge was assembled per plan and if it functions properly.

7. Student Teacher's Reflections on the Lesson

a) Student Learning Related to Lesson Expectation(s)

- Students were very engaged throughout the introduction and activity. They seemed to really enjoy working with the materials and tools to create the drawbridge.
- Students acquired an understanding of the function of gears and pulleys as they constructed their drawbridges. This was most apparent when they encountered difficulty (missed a step or performed a step incorrectly) and had to troubleshoot and make corrections.

b) Next Steps

- Consider adding a conclusion to the lesson, where student groups who wished to present could demonstrate their bridge, explaining how the gears and pulley work.
- Perhaps extra diagrams on p. 6 of the Drawbridge construction guide would help students at this stage of the project. Extra diagrams could include:
 - 1) Illustration of how the small gear is attached to Frame #2 and its relationship with the large gear.
 - 2) Diagram of Frame 3 (the bridge).
 - 3) Illustration of all three components after assembly, including the hinge placement.
 - 4) Diagram of the string, showing where it's attached.

c) Effectiveness of Student Teacher

- The introduction (PowerPoint show and discussion) was engaging for the students and got them interested in the activity.
- Students were focussed during the discussion of using the tools, safety and how to assemble the bridge.
- The students were able to build their bridges with minimal complications and mistakes.
- I was able to help as needed and guide where necessary.

d) Next Steps

- Towards the end of the activity, certain students (some of whom had finished their drawbridges, and a few that hadn't) became mildly disruptive. I'd asked groups who had finished to clean up their workspace and then help others who were still working. And I had asked others who were finished to begin helping to clean up the cutting and gluing stations.
- Nevertheless, I should have brought the class back together when some students began to be disruptive. I should have reminded them that they had worked very well, produced some excellent bridges, but that now they should all help to clean up. This may have encouraged more acceptable behaviour.
- I should have told the students before starting the activity what they should do (silent read, sketch, etc.) if they finished early.

