

Balance and Equal Gears

Project 2 of 4

The following lesson is part of a series that should be explored in a sequential manner. Students will need the full exploration each concept in order to move from one phase of Levers, Arms and Fulcrum Points to the next. It is more than just play at this level. The purpose of these exercises is to take the concept of play into the field of science. It may not be easy, but it's certainly will be fun!

Overview

This plan introduces skills of collaboration, problem solving, new understanding of mechanical advantage

Level: Advanced

Age Group: 3-5

Time: 40 minutes

Main Goal: Collaboration, problem solving, new understanding of mechanical advantage

Guiding and supporting play:

- Observe, observe, observe!
- Allow children to explore their own Rigamajig play ideas. There is no set formula for “right” or “wrong” outcomes.
- Children may produce a variety of Rigamajig ideas to meet the basic objectives of the lesson plan. No two creations or play sessions are alike. Be comfortable with letting children’s play evolve.
- There are no mistakes, let them explore and problem solve.
- Resist the urge to “fix” things for children and to show or tell children how to do things. Observe, and pay attention to children’s ideas and actions. Support play in ways that focus children on their own ideas. Ask about what students are planning to do, what they are making, and what they can change to make their Rigamajig work better?
- Discover insights into children’s creative thinking, and foster creativity!

Materials needed:

- Rigamajig Basic Builder Kit
- Simple Machines Add-on Kit

Getting started:

This project plan will introduce the concept of force and distance trade-offs in levers and how the same principles relate directly to gears. Students will eventually be able to explore different ratio relationships as they move to experiment with the different sized gears and calculate the mechanical advantage of a simple machine. This project plan starts that journey by examining the mechanics of gears of equal sizes. Don't forget to play with creating your horizontal and vertical planes so that you have the solid foundation!

This exercise will enable students to see the relationship of how beams balance on a fulcrum and how equal size gears move at the same speed.

- Set up fulcrum and balance plank
- (INSERT IMAGE OF FULCRUM AND BALANCED PLANK EXAMPLES)
- Begin by breaking up the class into groups with 3-4 students in each. Then ask students to build a fulcrum point and balance a long plank i.e. something resembling a seesaw. This may look different amongst the various groups. Remind your students that the goal is to balance without making things overly complicated.
- (INSERT IMAGE OF DRAWING ON GEARS EXAMPLES) (Caption: Drawing line of lever arm from axel (fulcrum) on equal gears.)
- Ask students to draw the lever arm on the face of the gears with dry-erase markers. This extends from the center of the gear out to the teeth. As the gears of equal size rotate, students will see how gears with equal size have lever arms of equal length and move at the same speed. This can be compared to how either end of a balanced beam moves up or down at the same rate.
- **HINT:** In the example of the gears, the fulcrum is the axle which is located in the center of the gear that holds the gear in place. The size of the gear determines the length of the lever arm.
- (INSERT IMAGE OF GEARS OF EQUAL SIZE EXAMPLES) (Caption: Gears of equal size.)
- As students play with balancing the long plank, ask them to build a simple vertical plane where gears of equal size are able to move freely. Have students choose two gears that can rotate at the same speed with the same strength.
- **HINT:** As students are working ask them to talk about what they are noticing about the rate of the gears moving and ask them to compare it to the way in which the balance beam moves up and down and then can rest balanced in the middle.

While play is underway:

Observe with an interested and supportive attitude and, as needed, encourage problem solving thinking, creativity, collaboration, discussion, and questions.

Vocabulary

Post some of the following words on a White Board, SmartBoard, sheet of chart paper or have the students make their vocabulary lists or posters of the key words. Encourage children's use of these words as they design and build. Encourage children to label the physical components of their creations.

- Planes
- Vertical
- Fulcrum
- Balance
- Horizontal
- Gears
- Goal
- Design
- Solve Problem
- Evaluate
- Teamwork

What to look for:

- Watch for children's collaborations in their thinking and construction. Offer encouraging words about working together to build something.
- Pay particular attention to how children go about their construction process. Do they seem to have a specific goal? Or, do they seem more focused on learning about the properties of the materials and different things they can do with them?
- Pay attention to the language. What do their words reveal about their knowledge of objects, physical processes, design, and/or social collaboration?
- When children indicate they accomplished something, give them a chance to demonstrate their construction and how it works, and share with other children.

What if the children “stall”?

- Sit with the group and ask them to discuss their ideas for what to build. Can they agree on something?
- Reinforce that any kind of construction is OK, it’s whatever they want to do!
- Pick up a few pieces and put them together for children to see. Don’t be afraid to model taking a risk, exploring, or changing an initial idea.

Wrapping up & reflecting:

- What are you (were you) most curious about?
- What made for good collaboration?
- Tell us about a problem you encountered and your group’s solution.
- Create drawings and descriptions or photographs and descriptions of work, including step by step as preferred
- Share and present work, include discuss about how and why construction decisions were made

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With the help our Captain of Play and Learning Ngina Johnson, we’ve put together a few project plans to get you started.