Garden Lesson G7-6

Levers Lab

Communication
Students are warned of the potential dangers of working with levers, which makes listening and following directions key. They communicate effectively and respectfully in order to complete the lab, and are able to explain how positioning the fulcrum closer to the load allows for easier lifting.

Academics
This lesson fulfills Next Generation Science Standards for analyzing data from tests; science and engineering practices; Common Core State Standards for following a multistep procedure; translating quantitative or technical information; collaborative discussion; speaking and listening; language; and acquiring words and phrases.

Life Skills
Students focus on listening and following directions and participate in class routines. The RIG poster still hangs in the Ramada for reference.

Sustainability
Machines that have levers make work easier for us, we rely on them every day to help us work smarter, not necessarily harder.

Nourishment
Students have a seasonal fruit, vegetable or herb tasting in the Closing Circle.
Levers Lab Abstract

Summary
In this 7th grade science lesson, students learn about levers and use them to make work easier.

Objectives
After this lesson, students will be able to:
- Define lever and fulcrum and identify examples
- Understand that the longer the lever, the easier work becomes

Assessments
During this lesson, students will:
- Discover the purpose of levers using different examples and recognize the fulcrum in different examples (including their own joints)
- Evaluate differing lever lengths to determine which lever makes work easiest

Communication is strengthened by being warned of the potential dangers of working with levers, which makes listening and following directions key. Students communicate effectively and respectfully in order to complete the lab, and are able to explain how positioning the fulcrum closer to the load allows for easier lifting. Sustainability is highlighted by learning that machines that have levers make work easier for us, we rely on them everyday. Nourishment is offered by having a seasonal fruit, vegetable or herb tasting in the closing circle. Life Skills are sharpened as students focus on listening and following directions and participate in class routines. The RIG poster still hangs in the Ramada for reference.

Academics fulfill Next Generation Science Standards for analyzing data from tests; science and engineering practices; Common Core State Standards for following a multistep procedure; translating quantitative or technical information; collaborative discussion; speaking and listening; language; and acquiring words and phrases. See Connections to Academic Standards below for details.
**Edible Schoolyard** curriculum emphasizes developing community and personal stewardship, along with skills that will help students navigate different situations throughout their lives.

This lesson follows the BEETLES Project’s **Learning Cycle** (Invitation→ Exploration → Concept Invention → Application → Reflection) and uses their **Discussion Routines** (Think-Pair-Share, Whip-Around). All are highlighted in **Green*** with an asterisk for easy identification. See the documents BEETLES_Discussion_Routines.pdf and BEETLES_Learning_Cycle.pdf included in **Resources** below for more information. Games and activities from other sources are also identified in **Green**, without an asterisk.

**Connections to Academic Standards**
Next Generation Science Standards, Middle School
Science and Engineering Practices:
- **Asking Questions and Defining Problems**
  - Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.
  - Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. (MS-ETS1-1)
- **Analyzing and Interpreting Data**
  - Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.
  - Analyze and interpret data to provide evidence for phenomena.
- **Obtaining, Evaluating, and Communicating Information**
  - Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information.
  - Read grade-appropriate texts and/or use media to obtain scientific information to describe patterns in the natural world.

Performance Expectations:
- **MS-ETS1-3.** Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
Common Core State Standards, English Language Arts and Literacy, Grade 7

- RST.7.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
- RST.7.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
- SL.7.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 7 topics, texts, and issues, building on others’ ideas and expressing their own clearly.
  - SL.7.1.b Follow rules for collegial discussions, track progress toward specific goals and deadlines, and define individual roles as needed.
  - SL.7.1.c Pose questions that elicit elaboration and respond to others’ questions and comments with relevant observations and ideas that bring the discussion back on topic as needed.
  - SL.7.1.d Acknowledge new information expressed by others and, when warranted, modify their own views.
- SL.7.2 Analyze the main ideas and supporting details presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how the ideas clarify a topic, text, or issue under study.
- SL.7.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with pertinent descriptions, facts, details, and examples; use appropriate eye contact, adequate volume, and clear pronunciation.
- SL.7.6 Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when indicated or appropriate. (See grade 7 Language standards 1 and 3 on page 53 for specific expectations.)
- L.7.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
  - L.7.1.a Explain the function of phrases and clauses in general and their function in specific sentences.
  - L.7.1.b Choose among simple, compound, complex, and compound-complex sentences to signal differing relationships among ideas.
  - L.7.1.c Place phrases and clauses within a sentence, recognizing and correcting misplaced and dangling modifiers.*
- L.7.3 Use knowledge of language and its conventions when writing, speaking, reading, or listening.
  - L.7.3.a Choose language that expresses ideas precisely and concisely, recognizing and eliminating wordiness and redundancy.
- L.7.6 Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases; gather vocabulary knowledge when considering a word or phrase important to comprehension or expression.

Connections to Edible Schoolyard Standards

Edible Schoolyard 3.0
In the Edible Schoolyard Program
1.0 Students work with each other and teachers to develop community and personal stewardship, along with skills that will help them navigate different situations throughout their lives.

1.1.1 – 1.3.12 This lesson fulfills all Edible Schoolyard Program standards, numbers 1.1.1 through 1.3.12. See *The Edible Schoolyard Berkeley Standards* for details.
Levers Lesson

Materials
- 3 Examples of levers used in garden (shovels of different lengths, wheelbarrow)
- 3 Large beams
- 3 Fulcrums on which to place the beams

Before you begin
- Collect all the materials and create the lever station by following the next two steps
- Set up three see saws, each with the fulcrum in a different location
- Gather examples of levers from the garden (for example, shovels and wheelbarrows)

Timeline Overview
Total Duration: 90 minutes
1. Invitation* (5 minutes)
2. Application* (60 minutes)
3. Concept Invention (20 minutes)
4. Reflection* (5 minutes)

Procedures
At the Opening Circle
1. Invitation*: (5 minutes)
   a. Welcome students and introduce the lever as a way to make work easier.
   b. Divide the class into 4 groups for garden jobs.
   c. Rotate each group through the Lever Station during garden work time.

In the Field (80 minutes total)
Garden Work Rotation
2. **Application**: (60 minutes)

Students think about and discuss levers and other simple machines while they work in the garden.

a. Each group rotates through the **Levers Lab** as the other groups work in the garden.
   i. The first group jumps to **At the Lever Station Levers Lab** step 3. **Concept Invention** while the other three groups begin their garden work.
   ii. When the first group is done with step 3. **Concept Invention** they return to (or begin) their Garden Work Rotation and the next group starts the Levers Lab.
   iii. It takes a total of 80 minutes of class time to get all groups through steps 2 and 3.

**At the Lever Station**

**Levers Lab**

3. **Concept Invention**: (20 minutes)

Students learn about levers in the garden.

a. Ask students what a lever is and why it might be used.
   i. Point out that **leverage** helps people do **work** with less **effort**.

b. Remind students that **work** means moving an object over a distance.

c. Explain some simple machines that help us do less **work**:
   i. The **lever**
   ii. The wheel
   iii. The inclined plane

d. Define the 3 basic parts of a lever:
   i. The **load**
   ii. The **fulcrum**
   iii. The place where **effort** is applied

e. Ask students how many people they think they can pick up at one time using no tools.
   i. Begin at the beam with the most **leverage** and have several students stand on the opposite side.
   ii. Challenge one student to lift the other students on the beam with one hand, by simply pushing down on the other end of the **lever**.
   iii. Identify the **load** *(students standing on beam)* and the **effort** *(student pushing down on lever)*.
   iv. Discuss what happens.

f. Repeat the demonstration with the next beam where the **fulcrum** is closer to the center.
   i. Ask students why it is harder to lift students on this **lever** *(because the **lever** is shorter)*.
g. Repeat on the third lever where the fulcrum is moved to create the least leverage.
   i. Experiment with different loads and effort by varying the number of students on each end of the lever and observe the results.

h. Switch focus to the garden tools.
   i. Using shovels of three different lengths, have students try moving dirt with each one.
   ii. Ask students to identify the fulcrum.
   iii. Ask students which shovel has the most leverage.

i. Demonstrate how the wheel of a wheelbarrow acts as a fulcrum.

j. Demonstrate how to lift something by bending your arm, using your elbow as the fulcrum.
   i. Ask students to compare the elbow and other joints to levers in the garden.
   ii. Guide them towards identifying:
      iii. The load (hand)
      iv. The effort (bicep)
      v. The fulcrum (where elbow rests on hand)

k. Quote Archimedes: “Give me a lever long enough and a fulcrum on which to place it, and I shall move the world”.
   i. Prompt students to think about the meaning of this quote (the longer the lever, the more you can lift).

At the Closing Circle
   4. Reflection*: (5 minutes)
   a. Have students serve a seasonal fruit, vegetable or herb tasting.

Vocabulary
Lever
Fulcrum
Work
Load
Effort

Contributors
All lessons at the Edible Schoolyard Berkeley are developed in collaboration with the teachers and staff of the Edible Schoolyard and Martin Luther King Jr. Middle School.
Learning Cycle and Think-Pair-Share discussion routine © The Regents of the University of California. All materials created by BEETLESTM at The Lawrence Hall of Science.

Resources
BEETLES_Learning_Cycle.pdf (See lesson G6-0)
BEETLES_Discussion_Routines.pdf (See lesson G6-1)