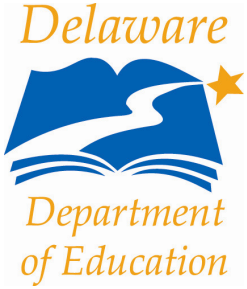
Delaware Science Coalition

Grade 2 Balancing and Weighing Unit Template



Preface: This unit has been created as a model for teachers in their designing or redesigning of course curricula. It is by no means intended to be inclusive; rather it is meant to be a springboard for teacher thought and creativity. The information we have included represents one possibility for developing a unit based on the Delaware content standards and the Understanding by Design framework and philosophy.

Unit Summary:

Students investigate the relationship between balance and mass in the STC *Balancing and Weighing* unit. They do this through building structures that balance, using a balance beam/fulcrum/mass system, building mobiles, and using an equal-arm balance. Students learn that weighing occurs when objects balance against other objects or standard units. They come to realize that balance is affected by the amount of weight and the position of the fulcrum. Lastly, students learn that equal volumes of objects do not mean the objects have equal mass.

Stage 1: Desired Results
Delaware Science Content Standards

Delaware Science Content Standards

This course focuses on the Delaware Science Content Standards and Grade Level Expectations in Standards 1, 2 and 3 found on the following web site: http://www.doe.k12.de.us/programs/ci/content_areas/science.shtml

Standard 1- Nature and Application of Science and Technology
Understanding and Abilities of Scientific Inquiry
Students should know and be able to:

1. Understand that: Scientific investigations, whether conducted by students or scientists, involve asking a question about the natural world.
    - Be able to: Generate questions and predictions using observations and exploration about the natural world.
3. Understand that: The purpose of accurate observations and data collection is to provide evidence. Scientists use tools to enhance their senses in order to obtain more evidence.
    - Be able to: Collect data using observations, simple tools and equipment. Record data in tables, charts, and bar graphs. Compare data with others to examine and question results.
4. Understand that: Scientists use observations from investigations and knowledge that is already known to develop an explanation.
    - Be able to: Construct a simple explanation by analyzing observational data. Revise the explanation when given new evidence or information gained from other resources or from further investigation.
5. Understand that: The purpose of communicating with others is to share evidence and conclusions. Scientists communicate the results

of their investigations to others.

- Be able to: Share simple plans, data, and explanations with an audience and justify the results using the evidence from the investigation.

6. Understand that: The use of mathematics, reading, writing, and technology are important in conducting scientific inquiries.
    - Be able to: Use mathematics, reading, writing, and technology when conducting an investigation and communicating the results.

Standard 2: Materials and Their Properties

Properties and Structures of Materials

Students should know that:

1. Materials can be described and classified according to the following physical properties: Size, shape, mass, texture, color, and material composition. Students can observe materials' physical properties by using tools that include rulers, balances, thermometers and hand lenses.

Students should be able to:

- Use an equal arm balance to weigh and compare a variety of objects and recognize that weighing is the process of balancing an object against a certain number of standard units.
- Predict the serial order for the weights of a variety of objects and test these predictions by weighing the objects.
- Recognize that equal volumes of different materials may have different weights.

Standard 3: Energy and Its Effects

Forms and Sources of Energy

Students should know that:

2. Objects that move (i.e., moving air, moving water) have energy because of their motion.

Students should be able to:

- Identify that objects that move have energy because of their motion. Demonstrate that a hanging mobile has energy because of its motion and the mobile was given this energy by the push of moving air.

Forces and the Transfer of Energy

Students should know that:

1. When balanced forces act on an object it will remain at rest, but if unbalanced forces act on the object it will begin to move.

Students should be able to:

- Demonstrate that when the pushes and pulls acting on an object are balanced, the object will not move. Investigate the conditions necessary for objects to balance. Describe how the object was made to balance.

Big Ideas

- Observation and Evidence (to identify variables that affect balance)
- Reasoning and Explanation (of observations to support predictions about balancing)
- Investigation (variables that affect balance)
- Process Skills (in creating tools that can be used to measure mass)
- Properties of Materials (mass)
- Controlling experiments (the item being measured must be directly related to the balancing of materials)
- Comparison of data and observations to support predictions on a large scale (not just individual results)
- Data Organization to visually represent/present results (graphing)

Unit Enduring Understandings

Students will understand that…

1. Tools and senses are used to ask questions, make predictions, observe, describe, and communicate results about the physical properties (mass, color, size, shape, texture) of materials and can be measured.
2. Balance is affected by the mass, position of the mass, and the position of the fulcrum.
3. Weight is determined by mass and not necessarily by volume or size. Example Cheerios take up more space than split peas but have less mass.

Unit Essential Question(s)

1. How do you know if something is balanced?
2. What tools or technology can you use to determine balance or mass?
3. Why might one object have more mass than another object that takes up the same amount of space?
4. How can you change a balanced structure to make it unbalanced?
5. How can items be arranged using the physical property of mass?
6. How can data be represented to show results and allow comparisons?

Knowledge & Skills

Knowledge:

- Balancing and weighing are used in everyday experiences (see-saws, bike riding, mobiles, food shopping, doctor's appointments etc.)
- Color, size, shape, texture, and mass are observable physical properties.

- Balancing is a process that can be used to determine mass.
- An equal arm balance, and a beam with a fulcrum are tools used to investigate, balance and collect data
- An equal arm balance can be used to put objects in serial order based on differences in mass.
- With equal masses placed symmetrically on a beam the fulcrum needs to be centered between the masses to balance the beam.
- A fulcrum needs to be closest to the greatest mass in order to balance a beam with two different masses at each end.
- Holding two objects in separate hands can be one way to compare relative mass of objects.
- Objects with different size, mass, texture and shape can occupy different amounts of space.
- Size of an object can not always be used to predict mass.
- Tables, charts, and graphs can be used to communicate data.

Skills:

- Perform simple experiments with an equal arm balance and a beam with fulcrum.
- Investigate balancing by applying strategies for comparing masses and moving a fulcrum to affect balance in a system.
- Use an equal arm balance to compare masses of objects.
- Predict the serial order for the mass of objects and foods (i.e. Lightest to heaviest).
- Record results using record sheets, bar graphs, line plots, data tables and Venn diagrams.
- Communicate ideas, observations and experiences through writing, drawing, and discussions**.**

Stage 2: Assessment Evidence

Suggested Performance Task(s)

Balancing and Weighing assessment for Grade Two can be found at:
http://www.doe.k12.de.us/programs/sci_assess/default.shtml

Key Transfer Ideas:

1. **A balance can be used to weigh objects.**
2. **Weighing is the process of balancing objects against other objects or standard units of measure.**
3. **The amount of weight, the position of the fulcrum, and the position of the weight affect balance.**
4. **Objects can be placed in serial order according to mass.**

Students are expected to:

1. **Select appropriate tools to find the mass of objects.**
2. **Use an equal arm balance and Unifix cubes to determine the mass of objects.**
3. **Make a graph.**
4. **Place objects in serial order according to mass.**
5. **Balance a beam that has a fixed fulcrum.**
6. **Identify the center of gravity of a fulcrum/balance beam/weight system.**
7. **Generate a rule to identify how two objects balance on a balance beam.**

Rubrics/checklists for Performance Tasks (This should include holistic or analytic-trait rubrics used as a scoring guide to evaluate student products or performances.)

Balancing and Weighing rubrics for Grade Two can be found at:
http://www.doe.k12.de.us/programs/sci_assess/default.shtml

Other Evidence

Formative Assessment:

Lesson 4: Record Sheet 4-A (Beam Balances) from Balancing and Weighing (See attached)

Lesson 5: Use mobiles and create a checklist to assess student understanding. Say: "What would happen if I move the paper clips? How did you make your mobile balanced? Demonstrate what your mobile would look like if it was not balanced."

After Lesson 6: Show balanced and unbalanced equal arm balance.

Record Sheet 13 A: Students should make a prediction about the serial order of the objects. They should then use the equal arm balance to place the objects in the correct serial order.

Stage 3: Learning Plan
Key learning events needed to achieve unit goals
Resource; STC *Balancing and Weighing*, National Science Resource Center, Washington DC Lesson 1: Thinking about Balancing In this lesson, students are asked to observe a symmetrical object as it is balanced on a pencil. Over time, students continue their observations as varying masses are added to opposing sides of the object. From these observations, students formulate focused questions and generate informed predictions regarding the process of balancing. Lesson 2: Building Structures that Balance Students engage in a free exploration exercise using a balance beam, a fulcrum and Unifix Cubes™. Observations are recorded and shared as students discuss balancing and weighing in every day experiences. Lesson 3: Exploring the Beam Balance In another free exploration, students manipulate Unifix Cubes™ to investigate how the mass and position of objects on a balance beam can affect its ability to become level. Lesson 4: Moving the Fulcrum Systematic observations are used to investigate the role of a fulcrum in balancing. Students manipulate the position of the fulcrum to identify how its position changes a beam's ability to balance two objects of varying masses. Observations are detailed on a standardized record sheet. Lesson 5: Building Mobiles Students apply their knowledge to a real world experience as they build mobiles with various fulcrum points and different masses. Comparisons of technique are shared in classroom discussions. Lesson 6: Exploring the Equal-Arm Balance

Students construct and equilibrate an equal arm balance and use their knowledge of mass, position of masses and position of fulcrums to discover what happens when they place a variety of objects in the pails of an equal-arm balance. Observations are recorded, and Venn Diagrams are used to compare new observations with those from the balance beam activities.

Lesson 7: Using the Equal-Arm Balance to Compare Objects

Students use an Equal-Arm balance to determine whether two objects have masses that are greater than (>), less than (<), or equal to (=) one another. In relating these data sets, students are using mathematical concepts to communicate results to fellow students.

Lesson 8: Developing Strategies for Placing Objects in Serial Order

Students predict the serial order of four objects and generate a simple plan for investigating the mass of each object. Once masses are established, students use their data to determine if their predictions were correct. Students share and compare their strategies with fellow students in a classroom discussion.

Lesson 9: Placing Six Objects in Serial Order

Extending upon concepts in lesson 8, two items are added to the experiment and students collect data to determine where the two new items fit in the serial order of all six objects. Serial order data is again recorded and discussed as a class.

Lesson 10: Balancing with Unifix Cubes™

Students discover the relationship between balancing and finding mass of an object. Students learn that by balancing an object with a standardized number of Unifix Cubes™ they are able to determine the relative "mass" of the object. A number of readings are collected and recorded on a class data table. Data is then compared to determine the "average" mass of a given object.

Lesson 11: Graphing the Weights (Mass) of the Objects

After reviewing the class data table, students work to graphically represent data in bar graphs. These bar graphs visually depict the relationships in mass from one object to another. Students compare their bar graphs with serial data strips and identify similarities and differences between them. This investigation is meant to help students visualize, internalize and interpret the data represented in bar graphs.

Lesson 12: Describing the Four Foods

Students observe, describe, record and share observations regarding the physical properties of sunflower seeds, split peas, oat cereal and

macaroni.

Lesson 13: Comparing Cupfuls of Food

Students use all prior concepts in a culminating transfer activity. In this lesson students predict the serial order of mass for one cupful of each food. The Equal-Arm Balance is then used to compare the mass of each of the cupfuls of food. The investigation is developed by first determining how to make the investigation a "fair test." Students discuss the need to have all cups filled to the same level and to make sure that the balance is equilibrated prior to each measurement. During these discussions, students share their understanding of the need to control all variables in a "fair test." After students have gathered their data and developed their results they compare their data with fellow classmates. It is from this lesson that students begin to understand that the space taken up by an object(s) is not necessarily a predictor of the mass of the object.

Lesson 14: Weighing (Finding the Mass) Cupfuls of Food

Students find the mass of each cup of food (sunflower seeds, split peas, oat cereal, and macaroni) using Unifix Cubes™ as comparators. Data is recorded on a class line plot to determine the average (mode) mass of each cup of food. Students compare the mass measurement data to their serial order comparison data to support their results.

Lesson 15: Which Food Occupies the Most Space

Students reverse the measurement process when instead of using Unifix Cubes™ to measure the mass of each cup of food, they will use the food to balance a certain amount of Unifix Cubes™. With the mass of the food constant, they observe that the amount of food in each cup is different. Students compare the serial order of least to most mass to the serial order of least to most "space taken." The concept that the amount of space taken by an object does not predict the mass of the object is directly addressed at this point.

Lesson 16: Where are the Six Marbles?

Students investigate the masses of five sealed canisters to determine which contains six marbles. In this lesson, students must follow a simple plan to observe, and explore questions and predictions. They must then test their predictions by gathering mathematical data and comparing the mass of six marbles and a container to the masses of the different containers. Students use their data to conclude which canister contains six marbles.

Resources & Teaching Tips

Julie's Balancing Act (Lesson 3)

Alexander Calder: The Mobile Man (Lesson 5)
Weighing Animals at the Zoo (Lesson 11)

Lesson 1:

- Butterfly cut out needs to be fairly accurately cut. Teacher should cut for those students with poor fine motor skills.

Lesson 2:

- Free exploration – Keep materials confined to a specific space. Have students illustrate or write about different ways to balance and weigh (p. 11 in Teacher's Manual).

Lesson 4:

- Make a chart or transparency of Record Sheet 4A. Students should draw the fulcrum for each picture. They should then describe any patterns that exist in the fulcrum placement in each picture. After this the students can make a rule – "The fulcrum should always be placed closer to the heavier weight."
- Balancing at the Circus – Encourage students to find something balanced and unbalanced and explains why. (Note: None of the parts of the picture are unbalanced.)

Lesson 5:

- Consider splitting this lesson into two sessions. Day 1 – Build the mobile. Day 2 – Creatively design the mobile.
- Save larger scraps of construction paper in a box.
- Students could practice their descriptive writing skills by writing descriptions of their mobile. Students could then be challenged to find which mobile matches which written description from a group of mobiles.

Lesson 6:

- If the attachment pin doesn't fit in the holes, unwind a large paperclip and cover it with masking tape.
- The "Student Instructions for Assembling the Equal-Arm Balance" should be revised so that the students are building the apparatus from the bottom up.

Lesson 7:

- Use symbols on chart (<, >, =).

Lessons 8 and 9:

- Consider combining lessons 8 and 9.

Lessons 9 and 10:

- Repeat lessons as they are in the Teacher's Manual with gram weights after having done them with Unifix cubes.

Lesson 11:

- Stress the importance of using all of the conventions of graphing. (Title, axis, interval, labels, etc.)

Lesson 13:

- Set boxes of food inside a large box lid to catch food that spills.

Lesson 14:

- Weigh the cupfuls of food using both Unifix cubes and gram weights.

Lesson 16:

- Have students place each canister on the base of the balance as a signal to the teacher to move on.