

CURRICULUM GUIDE FOR

Balancing and Weighing

(Based on the STC Science Kit)

Additional Resources can be found on Wallingford's W drive

Wallingford Public Schools
Second Grade
Science

*Approved by Science Management Team January 8, 2008.
Based on the K-5 Science Scope and Sequence approved by the
Wallingford Board of Education February 25, 2008.
(revised June 2009)*

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UNIT SUMMARY

Balancing and Weighing, a unit for second graders, provides activities that help students explore the relationship between balance and weight. Simple tools are used to guide student learning of how mass, location of the fulcrum and length of a balance beam affect weight and balance. Students have opportunities to use different types of scales to compare the mass of two objects and understand that the weight of an object is dependent upon its mass. Students also investigate the relationship between the weight of an object and its volume. In the unit students are asked to use a bar graph to record the weight of objects. *Balancing and Weighing* addresses the misconception that the weight of an object is not determined by its size.

STAGE 1- STANDARDS/GOALS

What should students understand, know, and be able to do? Stage one identifies the desired results of the unit including the related state science content standards and expected performances, enduring understandings, essential questions, knowledge and skills.

Enduring Understandings <i>Insights earned from exploring generalizations via the essential questions (Students will understand THAT...) K-12 enduring understandings are those understandings that should be developed over time, they are not expected to be mastered over one unit or one year.</i>	Essential Questions <i>Inquiry used to explore generalizations</i>
<p><u><i>Overarching Enduring Understandings:</i></u></p> <ul style="list-style-type: none"> • Science is the method of observation and investigation used to understand our world. (K-12) • Inquiry is the integration of process skills, the application of scientific content, and critical thinking to solve problems. (K-12) <p><u><i>Unit Specific Enduring Understandings:</i></u></p> <ul style="list-style-type: none"> • On a beam, balance is dependent on the relative mass of objects, the location of the fulcrum, and the relative lengths of the arms of the beam. • Various tools can be used to measure, describe and compare different objects. • There is a relationship between balancing and weighing. 	<ul style="list-style-type: none"> • How is inquiry used to investigate the answers to questions we pose? • How do you know something is balanced? • What effects balance? • How does weight effect balance? • How does position of the fulcrum or weight effect balance? • Do objects of equal volume or size weigh the same? Can objects of equal weight differ in size or volume?

Knowledge and Skills

What students are expected to know and be able to do

**The knowledge and skills in this section have been extracted from Wallingford's
K-5 Science Scope and Sequence.**

Knowledge

- K1. Investigate and explain the concept of balance
- K2. Investigate variables that effect balance (mass of objects, location of fulcrum, relative lengths of the beam)
- K3. Explain how these variables effect balance: position of the fulcrum, mass, and arm length
- K4. Compare objects using an equal arm balance
- K5. Record comparisons using binary symbols greater than $>$, less than $<$, and equal to $=$
- K6. Demonstrate how to weigh an object by balancing that object against other objects
- K7. Demonstrate how to weigh objects against the non-standard (cubes) and standard units (gram weights)
- K8. Recognize that the weight of an object is not determined solely by its size.

Skills

- S1. Generate testable questions and questions that need to be answered with print resources.
- S2. Observe and describe commonalities and differences among objects.
- S3. Sort and classify objects based on two or more observable properties.
- S4. Predict what might happen.
- S5. Design an investigation to help answer an investigable question.
- S6. Conduct simple investigations.
- S7. Employ simple equipment and measuring tools, such as:
 - Equal arm balance
 - Scales
 - Rulers/Number lines/Yard Sticks
 - Magnifying glasses
 - Non-standard measuring devises
- S8. Generate rules for safe use of materials and equipment.
- S9. Organize appropriate and accurate measurements and observations using:
 - Graphic organizers
 - Picture and bar graphs
 - Illustrations and diagrams
 - Journaling
- S10. Draw conclusions based on data, observations and findings.
- S11. Communicate results or information in an appropriate manner using:
 - Presentations
 - Visuals
 - Simple reports
 - Journals

Content Standard(s) <i>Generalizations about what students should know and be able to do.</i>	
CSDE Content Standards (CSDE Science Framework 2004)	CSDE Primary Expected Performances (CSDE Science Framework 2004)
<p><i>Properties of Matter – How does the structure of matter affect the properties and uses of materials?</i></p> <p>K.1 - Objects have properties that can be observed and used to describe similarities and differences.</p> <p>Some properties can be observed with the senses, and others can be discovered by using simple tools or tests.</p>	<p>A1. Use the senses and simple measuring tools, such as rulers and equal-arm balances, to observe common objects and sort them into groups based on size, weight, shape or color.</p> <p>A3. Count objects in a group and use mathematical terms to describe quantitative relationships such as: same as, more than, less than, equal, etc.</p>
<p><i>Science and Technology in Society – How do science and technology affect the quality of our lives?</i></p> <p>1.4 - The properties of materials and organisms can be described more accurately through the use of standard measuring units.</p> <p>◆ Various tools can be used to measure, describe and compare different objects and organisms.</p>	<p>A 17. Estimate, measure and compare the sizes and weights of different objects and organisms using standard and nonstandard measuring tools.</p>
<p><i>Scientific Inquiry</i></p>	<p>A INQ 1 Make observations and ask questions about objects, organisms and the environment.</p> <p>A INQ 2 Use senses and simple measuring tools to collect data.</p> <p>A INQ 3 Make predictions based on observed patterns.</p>
<p><i>Scientific Literacy</i></p>	<p>A INQ 4 Read, write, listen and speak about observations of the natural world.</p> <p>A INQ 5 Seek information in books, magazines and pictures.</p> <p>A INQ 6 Present information in words and drawings.</p>
<p><i>Scientific Numeracy</i></p>	<p>A INQ 7 Use standard tools to measure and describe</p>

	<p>physical properties such as weight, length and temperature.</p> <p>A INQ 8 Use nonstandard measures to estimate and compare the sizes of objects.</p> <p>A INQ 9 Count, order and sort objects by their properties.</p> <p>A INQ 10 Represent information in bar graphs.</p>
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Common Misconceptions Children Have

By identifying misconceptions early, teachers can design appropriate lessons to address and change student misconceptions.

- Balance is affected only by weight.
- The weight of an object is determined by size.
- You can only weigh things using a scale.

STAGE 2 – DETERMINE ACCEPTABLE EVIDENCE

How will we know if students have achieved the desired results and met the content standards? How will we know that students really understand? Stage two identifies the acceptable evidence that students have acquired the understandings, knowledge, and skills identified in stage one.

Performance Task(s) <i>Authentic application in new context to evaluate student achievement of desired results designed according to GRASPS. (Goal, Role, Audience, Setting Performance, Standards)</i>	Other Evidence <i>Other methods to evaluate student achievement of desired results.</i>
<p>See below for several examples (these can also be found on the Wallingford W drive)</p> <p>Comparing the Mass of Two Blocks of the Same Size You slipped and dropped two empty boxes with postage stamps on them (different amounts of postage) and two wrapped present boxes that need to be mailed in the empty boxes to your cousins. Can you compare the two wrapped present boxes by just looking at them? How do you know what box should get mailed with the most postage? What would be the best way to approach this to find the answer? Knowledge and Skills: K2, K4, K5</p> <p>Enrichment Task: You are a toy maker who needs to design a kit for children to create their own balanced mobile. You may use the following materials: 3-6 straws, 4-8 paper cut outs, a balance beam with 4 paper clips taped to it, and 8-30 paper clips.</p> <p>After making a balanced mobile, write a supply list and directions to be included in each kit. Knowledge and Skills: K3, K6</p>	<p><u>Mobile Assessment</u></p> <ol style="list-style-type: none"> Construct a mobile that is balanced and uses counter weights. (draw a picture in the box provided) Describe with words and pictures what you did to make your mobile balance. Use key words <i>First, Next, Then, Finally.</i> <p><u>From STC Balance and Weighing:</u></p> <p>p. 30-31 Assessment Questions for Lessons 3-5 Knowledge and Skills: K2, K3, S4, S7</p> <p>p. 61-62 Assessment Questions for lessons 6-9 Knowledge and Skills: K3, K4, K5, K6, K8, S2, S4, S7, S8, S10, S11</p> <p>p. 95 L.A. extension activity 3. (journal) Knowledge and Skills: K8</p> <p>p. 95 Assessment Questions for lessons 10-11 Knowledge and Skills: K7, K8, S7, S8, S9, S11</p> <p>p. 114 Assessment Questions for Lessons 12-15 Knowledge and Skills: K2, K3, K4, K5, K6, K8, S2, S7, S8, S10, S11</p> <p>p.153 Record Sheet A-1 Fulcrum Position Knowledge and Skills: K3</p> <p>p.130 Record Sheet 14-A Weighing Cupfuls of Food Knowledge and Skills: K7</p>

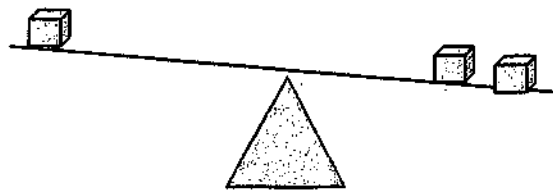
Balancing and Weighing Assessment

Directions: Draw a line from each word to its meaning.

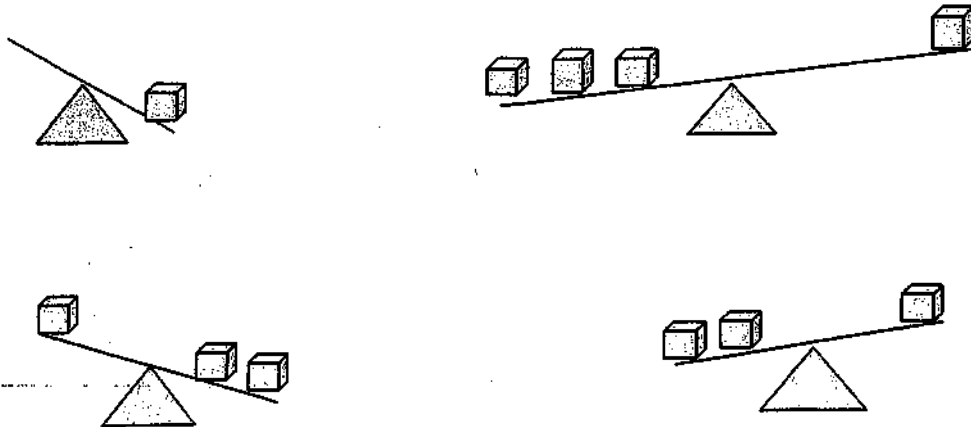
1. heavier than
2. lighter than
3. equal to

- a. weighs the same
- b. weighs more than
- c. weighs less than

Directions: Draw a circle around the fulcrum in this picture.
Color the beam red.

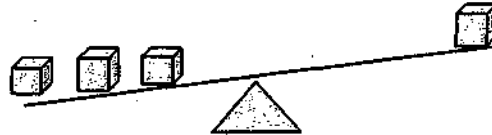
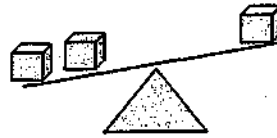
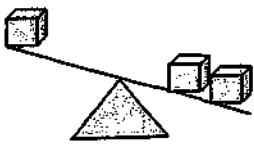


Directions: Put an "X" on the side of the beam that is heavier.



I know which one is heavier because _____

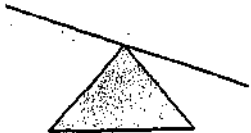
Directions: Put an “X” on the side of the beam that is lighter.



I know which one is lighter because _____

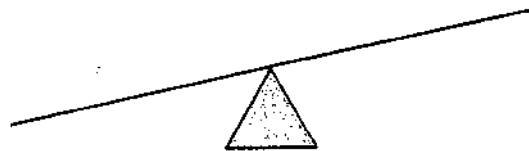
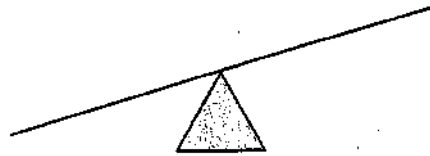
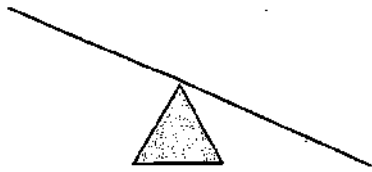
Directions: One of these balance scales shows “equal to” in weight.

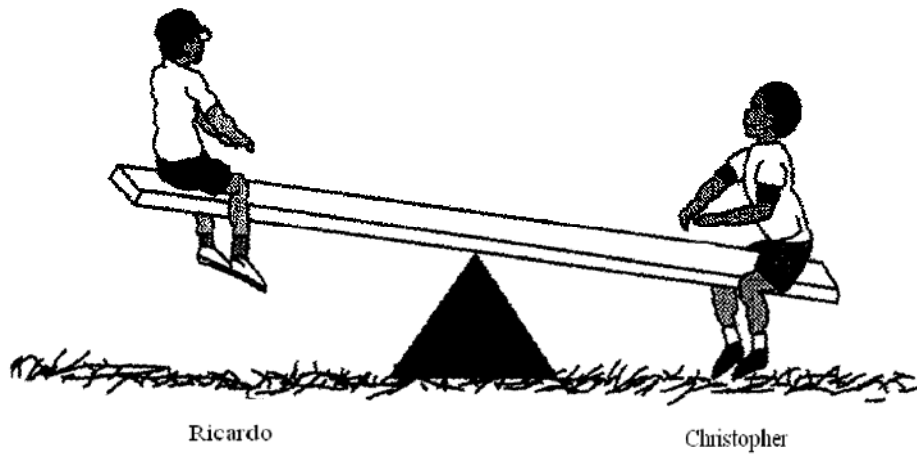
Circle that one.



I know it is balanced because _____

Directions: Draw blocks on these equal arm balances that will show heavier than, lighter than, or equal to.





Ricardo and Christopher are sitting on a seesaw that is not balanced. Christopher is heavier than Ricardo. What changes can be made so that the boys are balanced and may use the seesaw?

You can only move what is in the picture. You may not add anything or anyone.

- 1.
- 2.
- 3.

STAGE 3 – LESSON ACTIVITIES

What will need to be taught and coached, and how should it best be taught, in light of the performance goals in stage one? How will we make learning both engaging and effective, given the goals (stage 1) and needed evidence (stage 2)? Stage 3 helps teachers plan learning experiences that align with stage one and enables students to be successful in stage two. Lesson activities are suggested, however, teachers are encouraged to customize these activities, maintaining alignment with stages one and two.

The suggested lesson activities are not sequenced in any particular order. Teachers may select which lesson activities will best meet the needs of their students and the unit objectives. Each lesson activity is coded with the corresponding knowledge (K) and/or skill (S) objectives that are found in stage one.

THINKING ABOUT BALANCE

STC Balancing and Weighing, Lesson 1

Students use simple materials to observe and explore the relationship between weight and balance.

Time: **20-25 minutes**

Knowledge and Skills: **K1, K2, K3, S10**

EXPLORING THE BALANCE BEAM

STC Balancing and Weighing, Lesson 2

Students build structures that balance using a beam, a fulcrum and cubes.

Students build and use a balance beam scale to explore how the amount of weight and position of weight affect balance.

Lesson 2, STC is best used as introductory exploration for Lesson 3

Time: **35-40 minutes**

Knowledge and Skills: **K1, K2, K3, S4, S7, S9, S10**

OPTIONAL Reading Selection, Julie's Balancing Act

MOVING THE FULCRUM

STC Balancing and Weighing, Lesson 4 (note: Time permitting, may be combined effectively with previous lesson)

Students observe the amount of weight and the position of weight affect how the beam balances on the fulcrum.

Time: **15-20 minutes**

Knowledge and Skills: **K2, K3, S4, S9, S10**

OPTIONAL Master p. 43, Balancing at the circus

BUILDING MOBILES

STC Balancing and Weighing, Lesson 5 Teacher demonstrates creating a simple mobile (figure 5-1) Students will then build a simple mobile. Students describe and compare how their mobiles balance It is important to guide this discussion using the questions in the teacher guide.

Note: Teacher's preparation includes taping a chain of paper clips to a support beam for each student.

Time: **50 minutes**

Knowledge and Skills: **K6, S10, S11**

OPTIONAL Reading Selection, Alexander Calder: the Mobile Man

BUILDING AND USING THE EQUAL ARM BALANCE

STC Balancing and Weighing, Lesson 6 p.55-63 & Lesson 7

Students assemble an equal-arm balance. Students observe and describe how the equal-arm balance reacts when they place objects in the pails. Students compare and contrast the equal-arm balance and the beam balance and record their observations. Students use the equal arm balance to compare objects. Students discuss using prompts found on p.68, section 2. Students record comparisons using binary symbols greater than $>$, less than $<$, and equal to $=$. Students discuss the concept of fair comparisons.

Time: **45-50 minutes**

Knowledge and Skills: **K3, K4, K5, K6, S2, S4, S7, S8, S10**

DEVELOPING STRATEGIES FOR PLACING OBJECTS IN SERIAL ORDER

STC Balancing and Weighing, Lesson 8, p.55-63 & Lesson 9

Students predict the serial order, from lightest to heaviest, of four objects and then six objects. Students use the equal-arm balance to help them. Students record the serial order and discuss their relationships. Students describe the strategies they devised to place the objects in serial order. After students work with four objects have students describe the order of the objects using the prompts on p.76, section 4. After students work with six objects have students describe the order of the objects using these same prompts.

Time: **45-50 minutes**

Knowledge and Skills: **K3, K4, K5, K6, K8, S2, S4, S7, S8, S10, S11**

Note: Black line masters can be found on the W drive for these activities or they can be found and copied from the teacher's manual on pages 80, 87, & 107.

BALANCING WITH NON-STANDARD UNITS

STC Balancing and Weighing, Lesson 10

Students use Unifix Cubes to balance objects on the equal-arm balance. Students record their results. Students compare and discuss these results. Note: Results are more consistent if students place cubes in bucket one by one.

Assessment questions:

- What strategies do students apply to balance each object with Unifix Cubes?
- What ideas do students suggest to explain any variations in results?

Time: **20-25 minutes**

Knowledge and Skills: **K7, K8, S7, S8**

OPTIONAL Reading selection, Weighing animals at the zoo

BALANCING AND WEIGHING WITH STANDARD UNITS

Teacher introduces rocker arm balance and gram units. Teacher uses gram units to balance objects in the rocker arm balance. Students record these results on page 7 of student journal. Students compare and discuss these results. Students compare rocker arm balance with the equal arm balance.

Time: **20-25 minutes**

Knowledge and Skills: **K7, K8, S7, S8**

GRAPHING WEIGHTS OF OBJECTS

STC Balancing and Weighing, Lesson 11

After reviewing data from balancing with non-standard units, students make bar graphs that show the weights of the six objects. Students compare their bar graphs with their serial order strips and discuss the similarities and differences between them.

Time: **30-35 minutes**

Knowledge and Skills: **S9, S11**

OPTIONAL – Lesson Comparing the Mass of Different Materials of the Same Size

An outline for this lesson can be found on the W drive at W:\SCIENCE - ELEMENTARY\Balancing and Weighing gr 2.

Explore the essential question: Do objects of equal volume or size weigh the same?

Materials for this lesson (3 different materials of the same size w/ different masses) are included in the kit and a sample outline can be found on the W drive.

Time: **35 minutes**

Knowledge and Skills: **K2**

DESCRIBE THE FOUR FOODS

STC Balancing and Weighing, Lesson 12

Students observe and describe the properties of four different foods. Students record their descriptions of the four foods. Students share their observations of the foods and create a class chart. Students compare and contrast their observations of the foods.

Time: **30 minutes**

Knowledge and Skills: **S2**

COMPARING CUPFULS OF FOOD

STC Balancing and Weighing, Lesson 13

Students predict a serial order for a cupful of each of the four foods, from lightest to heaviest. Students compare the weights of the four cupfuls of food. Students discuss the results of their comparisons.

Time: **30-35 minutes**

Knowledge and Skills: **K2, K3, K4, K6, S4, S7, S8, S9, S10**

WEIGHING CUPFULS OF FOOD USING NON-STANDARD UNITS

STC Balancing and Weighing, Lesson 14

Students weigh a cupful of each of the four foods using an equal-arm balance and Unifix Cubes. Students record the weight of a cupful of each food on a class line plot. Students identify the weight obtained by the most members of the class for each cupful of food (mode weight).

Time: **20-25minutes**

Knowledge and Skills: **K4, K7, S7, S8**

WEIGHING CUPFULS OF FOOD USING STANDARD UNITS (optional)

Students weigh a cupful of each of the four foods using a rocker arm balance and grams. Students record the weight of a cupful of each food on a class line plot. Students identify the weight obtained by the most members of the class for each cupful of food (mode weight).

Time: **20-25minutes**

Knowledge and Skills: **K4, K7, S7, S8**
(optional)

WHICH FOOD OCCUPIES THE MOST SPACE USING NON-STANDARD UNITS?

STC Balancing and Weighing, Lesson 15

Students measure out equal weights of the four foods using an equal-arm balance. Students observe which of the four foods occupies the most space. Students explain the reasons for their observations.

Time: **30 minutes**

Knowledge and Skills: **K2, K3, K4, K7, K8, S7, S8**

Be sure to discuss the questions in final activities

WHERE ARE THE SIX MARBLES?

STC Balancing and Weighing, Lesson 16

Students apply a strategy to discover which of five sealed canisters contains six marbles. Students discuss the importance of the weight of the empty canister in solving this problem.

Time: **40-45 minutes**

Knowledge and Skills: **K3, K4, K6, K6, K7, S5, S6, S7, S8, S10, S11**

Be sure to discuss the questions in procedure.

Suggestion: Let pairs of students verbally design this investigation and begin. After a short time, the teacher may want to have some pairs share their strategy to the rest of the class. The teacher may also need to work with some students to guide their approach. It is important to close this lesson with a student sharing or teacher guidance to highlight effective strategies.

Materials List

Balancing and Weighing – Grade 2

June 2009

(Based on the STC Kit)

1	Teachers Guide
25	Student Science Journals (original found on W drive)
25	Butterfly on cardstock
200	Drinking straws
20	#1 paper clips boxes
30	Jumbo paper clips
1pkg	Plasti tac
2	Post it notes
1pkg	Colored round labels (1/2")
390	Marbles
75	Film canisters
150	Red unifix cubes
100	Each of blue, green, yellow Unifix Cubes
1	Plastic knife
1	Stick of Clay in Ziploc
1	Rocker Balance
4	Sets of gram weights in 2 bags
1	Platform scale
120	4 x 4" squares of red construction paper
50 pack	Red 9 x 12" construction paper
50 pack	Green 9 x 12" construction paper
50 pack	Blue 9 x 12" construction paper
50 pack	Yellow 9 x 12" construction paper

25	Unsharpened pencils w/erasers
15	Beam boards
15	Fulcrums w/sand
15	Equal arm balance support posts
15	Equal arm balance attachment pins
15	Equal arm balance bases
15	Equal arm cross beams
30	Equal arm balance S hooks
30	Equal arm plastic pails
15	Ping pong balls
15	Spoons
15	Wooden blocks
30	10oz plastic cups
60	4 oz soufflé cups w/lids
15	Metal cubes
15	Acrylic cylinders
2	Tubs oat cereal
1	Tub macaroni
1	Tub split peas
1	Tubs sunflower seeds
1 set	6 objects for lessons 8-11 on cardstock, laminated w/magnetic back
15 sets	3 different materials, same size
1	Curriculum guide

The following non-fiction books may be found in the library to support this unit:
Mirette on the High Wire (6 pack) Emily Arnold McCully

Teachers - Please discard or clearly mark damaged materials.