



Balancing and Weighing Pacing Guide¹

Use the information below to assist you in determining the amount of time needed to complete the entire unit. These recommendations assume the **average science class period is 45 to 60 minutes in length**. We recommend teaching science a minimum of three sessions per week in order to maintain consistency and keep students engaged. Many teachers accomplish this by rotating a science unit with a social studies unit, enabling you to teach more science sessions in one week and finish the unit in fewer weeks. We highly recommend that all teachers participate in the Expository Writing and Science Notebooks Program in order to further develop students' science understandings, as well as their scientific thinking and writing skills. To implement the science-writing curriculum requires, for most lessons, a separate 20 to 30 minutes for a science-writing minilesson and independent writing time. These are not included in this pacing guide.

Lesson and Common Assessments (See corresponding lesson in Instructional Guide for lesson planning)	Recommended Number of Periods	GLEs Addressed/Big Idea(s) of Lesson	Considerations for Planning	Recommended Applications and Extensions
<p>Lesson 1: Thinking About Balance. Students balance a symmetrical and asymmetrical object on a pencil or dowel.</p> <p>Note modified sequence of lessons.</p>	1	<p>GLE 2.2.2 Understand that observations/measurement are used by scientists to describe the world. Big Idea: An object can be balanced at the <i>point of balance</i> on a fulcrum (finger tip, dowel, or pencil).</p>	<ul style="list-style-type: none"> It is recommended that you do not <u>only</u> balance the butterfly. After the initial introduction using the butterfly, provide a copy of the giraffe. Students will then have an opportunity to try to balance this new, asymmetrical animal. 	<ul style="list-style-type: none"> Set up a science center to allow students to continue to explore balancing objects. Place dowels and various flat objects that students can cut into various shapes in the science center.
<p>Lesson 6 Part 1: Exploring the Equal Arm-Balance. Students construct their equal arm balance and equilibrate (calibrate) it.</p>	1	<p>GLE 1.2.1 Understand that things are made of parts that go together. <i>Identify the parts of objects, organisms, and materials [equal arm balance]. Describe how the parts of objects, organisms, and materials go together. Construct simple devices to do common tasks using common materials and explain how the parts depend on each other.</i> Big Idea: The equal arm balance is a system that compares the weights (mass) of objects. When two objects have the same weight (mass) the system will be balanced.</p>	<ul style="list-style-type: none"> The sequence of the lessons has been modified. Please follow the order of the lessons in the instructional guide and NOT in the teacher's manual. It is recommended that you do lesson 6 in two parts. This lesson has been modified to construct the understanding of a system with interrelated parts that must work together in order for the system to function properly. 	
<p>Lesson 6 Part 2: Exploring the Equal-Arm Balance. Students engage in an open-ended exploration using the equal arm balance.</p>	1	Same as in Lesson 6 Part 1	<ul style="list-style-type: none"> Do not do the compare and contrast activity. Save this for after the beam balance has been introduced in Lesson 3. This lesson has been modified so students understand the functions of each part of the equal arm balance. 	<ul style="list-style-type: none"> Set up a balancing center in your classroom where students can continue to explore what happens when different objects are placed in the pails.

¹ Pacing Guide for use with the *BALANCING AND WEIGHING* Teacher's Manual, National Academy of Science (1995)

<p>Lesson 7: Using the Equal-Arm Balance to Compare Objects. Students use an equal-arm balance to compare objects and use binary symbols to record comparisons.</p>	1	<p>GLE 2.1.3 Understand how to construct a reasonable explanation using evidence. GLE 2.1.5 Understand how to record and report investigations, results, and explanations. Math GLE 1.2.1 Understand and apply attributes to measure objects and time. Big Idea: The equal arm balance is a system that compares the weights (mass) of objects. When two objects have the same weight (mass) the system will be balanced.</p>	<ul style="list-style-type: none"> • Prepare identical sets of six objects for each pair. All students will then be able to compare their results. 	<ul style="list-style-type: none"> • Extension 2 on pg. 68 in the teacher’s manual is recommended. • Math integration: Connect use of heavier than and lighter than symbols with the use of the symbols greater than and less than in math.
<p>Lesson 8: Developing Strategies for Placing Objects in Serial Order. Students use the equal-arm balance to help them place four objects in serial order from heaviest to lightest.</p>	1	<p>GLE 2.2.2 Understand observations and measurements are used by scientists to describe the world. GLE 3.1.1 Understand problems that can be solved or have been solved by using scientific design. <i>Identify and describe a problem in a given situation [placing objects in serial order].</i> Math GLE 1.2.1 Understand and apply attributes to measure objects and time. Big Idea: A balance can be used to compare objects and put them in serial order. The weight of an object is not determined by its size.</p>	<ul style="list-style-type: none"> • It is important for students to hold the four objects before predicting their serial order from lightest to heaviest. 	<ul style="list-style-type: none"> • Extensions 1 and 2 on pg. 77 in the teacher’s manual are highly recommended, particularly for those students who experienced some difficulty with sequencing the four objects.
<p>Lesson 9: Placing Six Objects in Serial Order. Students predict where two new objects will fit in their serial order and then use the equal-arm balance to place all six objects in order.</p>	1	Same as in Lesson 8		<ul style="list-style-type: none"> • Extension 2 on pg. 86 in the teacher’s manual is useful for students who struggle with putting objects into serial order.
<p>Lesson 10: Balancing with Unifix Cubes. Students use Unifix Cubes as units of measure to balance objects on an equal-arm balance.</p>	1	<p>GLE: 2.2.3 Understand that similar investigations and measurements may not produce similar results. GLE 3.2.2 Know that people have invented tools for everyday life. Math GLE 1.2.1 Understand and apply attributes to measure objects and time. Math GLE 1.2.6 Understand how to estimate in measurement situations. Big Ideas: Weighing is the process of balancing an object against a certain number of units.</p>	<ul style="list-style-type: none"> • The word weighing will be introduced at the end of the lesson after students have used the equal-arm balance for this purpose (Read the Background information on p. 89 in the teacher’s manual). 	<ul style="list-style-type: none"> • Extension 1 on manual pg. 94 is recommended.
<p>Lesson 11: Graphing the Weights of the Objects. Students make bar graphs that show the weights of six objects.</p>	1-2	<p>GLE 2.2.3 Understand similar investigations and measurements may not produce similar results. GLE 3.2.2 Know that people have invented tools for everyday life. Math GLE 1.4.3 Understand the organization of a graph. Math GLE 1.4.5 Understand how a display provides information about a question. Big Ideas: A graph helps scientists see and interpret data more easily than when it is written in numerals on a data table.</p>	<ul style="list-style-type: none"> • Math integration: This lesson has been modified to better address the science and math GLEs. Please follow the instructional guide, not the teacher’s manual, for this lesson. 	<ul style="list-style-type: none"> • Extensions 2 and 3, on page 104 in the teacher’s manual, are recommended. This addresses both science and math GLEs. • Language Arts integration: Read, “Weighing Animals at the Zoo” on page 105 in the teacher’s manual.
<p>Lesson 16: Where are the Six Marbles? Students design and conduct an investigation to discover which of the five sealed canisters contains six marbles.</p>	2	<p>GLE 3.1.1 Understand problems can be solved or have been solved by using scientific design. <i>Identify and explain problems that can be solved through investigations and/or with tools.</i> <i>Identify and describe a problem in a given situation [Which canister holds six marbles?].</i></p>	<ul style="list-style-type: none"> • This lesson may take two periods. During the first period, allow students to freely explore and come up with their own theory as to which canister contains 6 marbles. After discussion, most students will need to return to 	<ul style="list-style-type: none"> • Extensions 1 and 2 on pages 142-143 in the teacher’s manual give students more opportunities to apply their strategies to solving problems similar to the one in Lesson 16.

		<p>GLE 3.1.2 Understand how to construct and test a solution to a problem. Big Ideas: Weighing is the process of balancing an object against a certain number of units. When two objects have the same weight (mass) the system will be balanced.</p>	<p>the equal arm balances to revise their thinking. The second period will give students a chance to try out these ideas.</p>	
<p>Lesson 2: Building Structures (Systems) That Balance. Students build systems that balance and share their observations about balancing.</p>	1	<p>GLE 1.2.1 Understand that things are made of parts that go together. GLE 3.1.1 Know and understand problems that can be solved by using scientific design. Big Idea: In order for a structure (system) to be balanced, it must be able to pivot or move freely on the point of balance. Balance is affected by the amount of weight (mass) and the position of the weight (mass).</p>	<ul style="list-style-type: none"> • Students are just beginning to explore the concept that in order for systems to be balanced, they must be able to pivot or move freely on the point of balance. They are also just beginning to understand that balance is affected by the amount of weight and the position of the weight. Full understanding of these concepts will be constructed slowly in the next few lessons. 	
<p>Lesson 3 Part 1: Exploring the Beam Balance. Students are given an opportunity for open-ended exploration of the beam balance to explore how the amount of weight and the position of weight affect balance. Students compare the equal-arm balance and the beam balance.</p>	1	<p>GLE 1.2.1 Understand that things are made of parts that go together. Math GLE 1.2.4 Understand and apply procedures to measure with standard or non-standard units. Big Idea: Balance is affected by the amount of weight (mass) and the position of the weight (mass) on a beam balance.</p>	<ul style="list-style-type: none"> • Follow the instructional guide rather than the teacher’s manual for this lesson. This lesson has been divided into two parts to give students more opportunities to explore the effect the amount of weight and the position of weight has on balance. • Students compare and contrast the equal-arm balance and the beam balance. 	<ul style="list-style-type: none"> • Language Arts Integration: Read, “Julie’s Balancing Act” on pages 33-34 in the teacher’s manual and discuss. • Extensions 1 and 2 on page 30 in the manual are worth spending time on.
<p>Lessons 3 Part 2: Finding Patterns with the Beam Balance. Students will practice using the beam balance and will explore the relationship between the amount of weight and the position of the weight in a more systematic way.</p>	2	Same as in Lesson 3 Part 1	<ul style="list-style-type: none"> • Part 2 replaces Lesson 4, which is not recommended. • Students are not expected to master the concept of the relationship between the amount of weight and the position of the weight in this lesson. 	<ul style="list-style-type: none"> • Look for other patterns with the beam balance. For example, place five cubes close to the fulcrum on one side. Try to balance it with one, two and five cubes. • Revisit balancing the butterfly on the pencil/dowel, which students did in lesson 1.
<p>Assessment A: Position of Weight.</p>		Same as in Lesson 3 Part 1	<ul style="list-style-type: none"> • This assessment may be implemented at the end of Lesson 3, Part 2. 	
<p>Lesson 5: Building Mobiles. Students build simple and more complex mobiles that balance.</p>	2	<p>GLE 1.2.1 Understand that things are made of parts that go together. GLE 3.1.1 Know and understand problems that can be solved or have been solved by using scientific design. <i>Identify and describe a problem in a given situation [how can I balance a mobile].</i> GLE 3.1.2 Understand how to construct and test a solution to a problem. Big Idea: Balance is affected by the amount of weight (mass) and the position of the weight (mass).</p>	<ul style="list-style-type: none"> • This is a longer lesson and will take a longer period or two periods to complete. Make sure to give students time to create a more complex mobile after they’ve created a simple mobile. 	<ul style="list-style-type: none"> • Language Arts integration: Read, “Alexander Calder: The Mobile Man” on pages 51-53 of the teacher’s manual and discuss. • Leave leftover mobile materials out at a center for students to use to create a larger class mobile.

Assessment B: Building Mobiles		GLE 1.2.1 Understand that things are made of parts that go together. <i>Identify the parts of objects, organisms, and materials [mobiles]. Describe how the parts of objects, organisms, and materials go together.</i>	<ul style="list-style-type: none"> This assessment may be implemented at the end of Lesson 5. 	
Lesson 12: Describing the Four Foods. Students observe and describe the properties of four different foods.	1	GLE 1.1.1 Understand simple properties are used to identify, describe, and categorize substances, materials, and objects. Big Idea: Foods have different properties that affect weight (mass) and volume.	<ul style="list-style-type: none"> The science GLEs use the word “properties” for physical objects. Remind students that the describing words are the properties of the foods. 	<ul style="list-style-type: none"> Have equal-arm balances available in a center for students to review how to calibrate the balance, and how to use it for comparing and weighing objects.
Lesson 13: Comparing Cupfuls of Food. Students predict the serial order for a cupful of each of the four foods, from lightest to heaviest, and then compare the weights of each.	1	GLE 1.1.1 Understand simple properties are used to identify, describe, and categorize substances, materials, and objects. GLE 2.1.2 Understand how to plan and conduct simple investigations following all safety rules. GLE 2.1.3 Understand how to construct a reasonable explanation using evidence. GLE 2.1.5 Understand how to record and report investigations, results, and explanations. Big Ideas: Equal volumes of different foods will not all have equal weights. Size, shape, and how porous a food is affect how the food fits in the cup.	<ul style="list-style-type: none"> Emphasize the importance of doing a <u>fair</u> comparison. See Procedure 2 and 3 on p. 119 in the teacher’s manual. Read the teacher Background information on p. 117 in the teacher’s manual. 	
Lesson 14: Weighing Cupfuls of Food. Students weigh an equal volume (cupful) of each of the four foods and record the weights on a class line plot.	1	GLE 1.1.1 Understand simple properties are used to identify, describe, and categorize substances, materials, and objects. GLE 2.1.2 Understand how to plan and conduct a simple investigation following all safety rules. GLE 2.1.5 Understand how to record and report investigations, results, and explanations. GLE 2.2.3 Understand that similar investigations may not produce similar results. Math GLE 1.2.6 Understand how to estimate in measurement situations. Big Ideas: Weighing is the process of balancing an object against a certain number of units. Equal volumes of different foods will not all have equal weights.	<ul style="list-style-type: none"> Math integration: Students are creating and interpreting line plots. Students will discuss the range of the weights and the mode for each food. 	<ul style="list-style-type: none"> Math integration: Extension 1 in the teacher’s manual is an excellent activity. Use the line plots to answer questions, which will strengthen both math and science skills.
Assessment C: Weighing Cupfuls of Food.		GLE 1.1.1 Understand simple properties are used to identify, describe, and categorize substances, materials, and objects. Math GLE 1.2.6 Understand how to estimate in measurement situations.	<ul style="list-style-type: none"> This assessment may be implemented at the end of Lesson 14. 	
Lesson 15: Which Food Occupies the Most Space? Students measure out equal weights of four foods and compare their volumes.	2	GLE 1.1.1 Understand simple properties are used to identify, describe, and categorize substances, materials, and objects. GLE 2.2.1 Understand that all scientific observations are recorded accurately even when the observations contradict expectations. GLE 2.2.3 Understand that similar investigations may not produce similar results. Big Ideas: Size, shape, and how porous a food is affect how the foods fit in the cup. Equal weight (mass) of different foods will not all have equal volume.	<ul style="list-style-type: none"> This is a very difficult lesson because it takes quite a bit of time and students have trouble expressing their thinking, even if they understand the concept. Not all students will understand at a deep level. Set aside plenty of time for students to think about and discuss their ideas as a class. 	
Assessment D: Using Balances to Solve Problems.	2	GLE 3.1.1 Know and understand problems that can be solved or have been solved by using scientific design. GLE 3.1.2 Understand how to construct and test a solution to a problem.	<ul style="list-style-type: none"> This assessment gives students the opportunity to come up with testable questions that can be answered using one of the balancing tools. 	