Models and Designs Pacing Guide[1]

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 50 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 mini-lesson and independent writing time. Time for these mini-lessons is not included in this pacing guide.

Lessons and Common Assessments (See corresponding lesson in Instructional Guide for lesson plan.)	**Recommended Number of Periods**	**GLEs Addressed/Big Idea(s) of the Lesson**	**Considerations for Planning**	**Recommended Applications and Extensions**
Activity 1.1 **Black Boxes: Building a Conceptual Model** Students observe sealed black boxes and develop conceptual models to explain what is in the boxes. They test and revise their explanations as new evidence arises.	2-3	**GLE 1.2.1:** Analyze how the parts of a system go together, and how these parts depend on each other. **GLE 2.1.4:** Understand how to use simple models to represent objects, events, systems, and processes. **GLE 2.2.5:** Understand that scientific comprehension of systems increases through inquiry. **Big Ideas:** The construction of physical and conceptual models allows us to explain how unknown objects are put together and how systems work. Ideas in science change as new scientific thinking, theories, and evidence arise. Evidence is gained through careful, systematic investigation and logical thinking.	The black boxes come pre-made in the kit and should **not** be opened for any reason.	Reading integration (Apply and Extend): Students read "Everyday Mysteries" (pp.1-4) in *FOSS Science Stories: Models and Designs* (multiple copies come in kit). See Instructional Guide (IG) for discussion questions.
Activity 1.2 **Black Boxes: Building a Physical Model** Students construct physical models in order to revise their earlier conceptual models of what is inside the black boxes.	3-4	**GLE 1.2.1:** Analyze how the parts of a system go together, and how these parts depend on each other. **GLE 1.3.5:** Understand that fossils provide evidence of plants, animals, and environments that existed long ago. **GLE 1.3.9:** Understand that plant and animal species change over time. Describe that fossils can be compared to one another and to living organisms according to their similarities and differences. **GLE 2.1.4:** Understand how to use simple models to represent objects, events, systems, and processes. **GLE 2.2.5:** Understand that scientific comprehension of systems increases through inquiry. **Big Ideas:** The construction of physical and conceptual models	Create a class chart of types of black boxes and systems. See Instructional Guide for discussion questions.	• Reading integration (Apply and Extend): Students read "Scientists and Models" (pp.5-10) and "Life on Earth 150 Million Years Ago" (pp.11-16) in *FOSS Science Stories: Models and Designs* (multiple copies come in kit). See Instructional Guide for discussion questions. • Make new mystery boxes for students to observe. See teacher's manual (Black Boxes: p.11).

[1] Pacing Guide for use with the *Models and Designs* Teacher's Manual, The Regents of the University of California (1993)

		allows us to explain how unknown objects are put together and how systems work. Ideas in science change as new scientific thinking, theories, and evidence arise. Evidence is gained through careful, systematic investigation and logical thinking.		• Introduce model-building games to your students. See teacher's manual (Black Boxes: p.11).
Assessment A: Modeling	1	**GLE 2.1.4:** Understand how to use simple models to represent objects, events, systems, and processes.		
Activity 1.3 **The Drought Stopper** Students observe the drought stopper and construct a conceptual model to explain how they think it works.	1		This lesson is considered optional. Directions to construct the drought stopper are on pp.4-5 of the teacher's manual; directions to "prime" it after it is constructed are in the Instructional Guide.	
Activity 2.1 - 2.2 **Humdingers** Students collaborate to create a physical model of a humdinger, comparing the performance of their models to the real device.	4-5	**GLE 1.2.1:** Analyze how the parts of a system go together, and how these parts depend on each other. **GLE 1.1.4:** Understand that energy can come in many forms. **GLE 1.2.2:** Understand that energy can be transferred from one object to another and can be transformed from one form of energy to another. **Big Ideas:** 1. A system is a group of interrelated parts that interact to perform a function. Systems can be found in the natural world or may be put together. 2. A system is made up of parts that work together and do things together that they could not do by themselves. These parts are called subsystems. If one of the parts is removed, the system is incomplete and will not function in the same way, if at all. 3. Energy comes in many forms and energy can be transformed from one form to another. Energy of motion (kinetic), electrical energy, and sound energy are all present in the humdinger system.	See Tips in the Instructional Guide.	• See "Ideas for addressing student frustration" and "Ideas for Engaging Students Who Finish their Humdingers Early" in the Instructional Guide. • Reading integration: Students read "Simulations" and "The Path to Invention" (pp.17-24) in *Foss Science Stories: Models and Designs*. • See "Replicate Simple Devices" and "Make a Doorbell" in the teacher's manual (Hum Dingers: p.11).
Activity 3.1 **Free-wheeling Go-Carts** Students design and build a free-wheeling go-cart that meets specific criteria.	1-2	**GLE 1.1.2:** Understand the relative position and motion of objects. **GLE 1.2.2:** Understand that energy can be transferred from one object to another and can be transformed from one form of energy to another. **GLE 1.3.1:** Understand forces in terms of strength and direction. **GLE 3.1.2:** Understand how the scientific design process is used to develop and implement solutions to human problems. **Big Ideas:** 1. Technology is the application of science to the development of things that benefit society. It is the process of designing solutions to human problems and inventing ways to adapt to the environment. 2. Technology utilizes design and engineering methods in creating new products. Designs need to be evaluated in terms of how well they meet specific criteria. 3. A system is made up of parts that work together and do things that could not be done by themselves. These parts are called subsystems. If one of the parts is removed, the system is incomplete and will not work properly. 4. The force of gravity pulls the go-cart down the ramp.		

Activity 3.2 **Self-propelled Go-carts** Students design and build self-propelled go-carts, relating structures to functions as they test and improve them.	1-2	**See Activity 3.1 for GLEs.** **Big Ideas:** See Activity 3.1 for Big Ideas 1-3. 4. Stored energy in the twisted rubber band is transferred to the wheel-axle subsystem of the go-cart, causing it to move.	Follow the lesson as written in the teacher's manual (pp.7-9); **however, omit numbers 22 and 23**. These are done in Activity 4.1.	See "Self-Propelled Toys" in the teacher's manual (Go Carts: p.11).
Activity 3.3 **The Two-Meter Run** Students investigate variables that affect the distance their self-propelled go-carts travel.	1-2	**See Activity 3.1 and 3.2 for GLEs and Big Ideas.**		Reading integration: Students read "Early Autos" and "Henry Ford and His Model T" (pp.25-32) in *Foss Science Stories: Models and Designs*.
Classroom-Based Assessment B	1	**GLE 1.2.1:** Analyze how the parts of a system go together, and how these parts depend on each other.		
Activity 4.1 **The Standard Go-Cart** Students collect and interpret data, comparing the distance their go-carts travel with different-sized wheels.	4-5	**GLE 2.1.1:** Understand how to ask a question about objects in the environment. **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 report investigations and explanations of objects, events, systems, and processes. **GLE 2.2.3:** Understand why similar investigations may not produce similar results. **GLE 2.2.4:** Understand how to make the results of scientific investigations reliable. **Big Ideas:** 1. Anything that can be changed on the go-cart that might affect the distance it travels is a variable. 2. One rotation of a large wheel covers more ground than one rotation of a small wheel. Therefore, a go-cart with large wheels will travel farther than the same go-cart with small wheels, if all other variables are kept the same. 3. Energy sources, such as the rubber band, give energy to energy receivers, the go-cart.	This activity has been added to the unit to give students an opportunity to plan and conduct a controlled investigation. It is not in the teacher's manual. Make wall charts of the "Planning Your Own Scientific Investigation" template using the sample charts in the Instructional Guide. Use these wall charts as you plan the investigation with your students and keep them posted in the classroom throughout the investigation.	Math integration: Make a class scatter plot of student data in order to strengthen students' understanding of the results. See "Apply and Extend" in the Instructional Guide. Reading integration: Students read "On the Line" and "Smart Cars and Space Planes" (pp.33-40) in *Foss Science Stories: Models and Designs*.
Assessment C: Evidence and Explanation and Dealing with Inconsistencies	1	**GLE 2.1.3:** Understand how to construct a reasonable explanation using evidence.		

Activity 4.2 **The Run-Around Cart** Students modify their self-propelled go-carts to perform various maneuvers, while investigating the relationship among go-cart variables.	1		This activity is optional.	
Activity 4.3 **Advanced Tricks** Students evaluate their go-cart solutions to the advanced trick challenges in relation to specific criteria.	1		This activity is optional.	See “Extensions and Applications” in the teacher’s manual (Cart Tricks: pp.10-11) for possible extensions.