LETTER TO PARENTS

Cut here and paste onto school letterhead before making copies.

= Science News=

Dear Parents,

Our class is beginning a new science unit using the **FOSS Models and Designs Module.** We will assume the roles of scientists as we try to figure out what hidden systems look like and how they work. Then we will change into engineers as we try to design self-propelled carts from simple construction materials. We have an interesting and exciting couple of months ahead.



In this module, children learn about scientific models. A scientific model explains a natural system or process that is not totally accessible to direct investigation. An example from geology is the ongoing struggle to figure out what our planet is like from crust to core. Each advance in scientific technology provides scientists with more information, and the model for the structure of Earth is refined. But it's still a model—no one knows for sure whether it's correct, because no one has been there for a firsthand look. In class we will be confronting less-imposing systems, but the processes of gathering evidence, sharing ideas with peers, creating models, and modifying them based on additional evidence are the same. We will learn how to think productively about the unknown.

After we tackle models and expand our points of view and ways of thinking about systems, we will become engineers who design and create products. We will be designing and building carts from sticks, paper clips, wire, rubber bands, and the like. With each passing investigation students face more demanding engineering challenges, and I expect to see a lot of creativity brought to bear on the problems.

From time to time I will be sending home/school connection sheets home with your child. These describe activities for the whole family, to share a little bit of the fun we will be having at school with models and designs. If you have any questions or comments, call or come in and visit our class.

Comments ____

MODELS AND DESIGNS JOURNAL

Name

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BLACK-BOX SCHEMATICS



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	Name
	Date
RESPONSE SHEET—BLACK BOXES	5

Ms. Rowe asked her class to make models of the solar system. Below is the work of three of her students.



Which of these students made models? Explain why you think they are models or not models.

Whose work do you think tells the most about the solar system? Explain why you think so.



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HUM-DINGER CONSTRUCTION



NOTE: The numbers indicate the positions of the holes in the board.



Sit down with the construction board and a bag of construction materials. Have the masking tape, a pair of scissors, and the ball of string handy.

1. Set the construction board in the base. Note that hole 10 is closer to the edge than hole 1. Put a short stick in holes 2, 4, 7, and 10.

2. Use masking tape to secure a cell holder to the board as illustrated. Its left and bottom edges should be flush with the edges of the construction board.

3. Start with the paper clip in position a. Bend the *inner* end straight out to the left side. Bend the large loop down and off to the left side. Rotate the loop 90°. The reshaped clip should stand up on the table as in illustration d.



4. Slip the straight end of the paper clip into the Fahnstock clip at the top of the cell holder as illustrated.

5. Lay one motor lead along a long stick so that the bare end of the wire sticks just a little past the end of the stick. Tape it in place with masking tape. Bend the exposed tip of the wire downward.



6. Clip a binder clip onto the long stick about one-third of the way back from the exposed end of the motor lead.

Slide the binder-clip handles on stick 4. Adjust the position of the binder clip on the stick so that the tip of the motor wire *almost* touches the cell holder. The exposed-wire end of the stick should be inside the loop of the paper-clip contact. (See illustration.)

7. Insert the other motor wire into the other Fahnstock clip. Work the lever. When the wire tip comes down into the bottom of the loop of the paper-clip contact, it should complete the circuit and the motor should run. Some adjustment may be necessary.

8. Run two rubber bands through the bell handle. Slip both ends of one band over stick 7 and both ends of the other band over stick 10. Tie a string to the stick as indicated and run it through hole 5.

9. Slip a rubber band around the lever right under stick 2. Slide both ends of the band over stick 2.

10. Remove the construction board from the base. Slip two rubber bands around the base in position so that they are right under the motor. Put the construction board back into the base. Put a small masking tape flag on the shaft of the motor. Slide the motor under the rubber bands. Voilà!



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RESPONSE SHEET-HIIM DINGER	Date
	Date
	Name

Below are two models of a portion of the solar system. Look at each of them carefully.



How is the physical model like the conceptual model?

How is the physical model different than the conceptual model?

Why are different kinds of models created to represent something like the solar system?

Investigation 3: Go-Carts No. 9—Student Sheet

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WHEEL PATTERNS



Name _____

Date

RESPONSE SHEET—GO-CARTS

Explain in detail the process you go through when you are working on a new design or improvement to a design.

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Name

Date

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RESPONSE SHEET—CART TRICKS

One student said,

When you start designing something, the first thing you do is get the equipment you need. Then you start putting things together and before you know it, you've created something new!

Another student said,

You really think it's that easy? I think you have to go through many more steps than that. And you should start with a plan.

Write your comments about what these two students said. Be sure you include all of the steps that you think are necessary when designing projects and working like an engineer.



Name_____
Date_____

Our engineering	goal is to	design a	go-cart	that will
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Draw your planned go-cart.

Describe its design features.

Draw the final design of your go-cart.

What variables did you change?

Describe how your final design improved the performance of the go-cart.

Name _

Date_

PROJECT IDEAS

- Research the Ptolemaic system of the universe and later modifications that brought our model of the solar system to its present form.
- Produce a blueprint of your fantasy house, including precise measurements for all dimensions. Build a three-dimensional model from your drawings.
- Make a model to explain any of the many black boxes in our everyday world, such as a door lock, camera, toy, and toaster. Your model could be a conceptual or a physical model to explain how the black box works or how it looks inside.
- The same materials that were used to make a hum dinger can be used to construct a model doorbell. The doorbell should ring as long as the string is pulled, and turn off when the string is released. Write directions for constructing your doorbell.
- Design and engineer a propulsion mechanism that will allow you to take a short ride on a wagon.
- Choose any household device to study and improve. Does it function the best it could? What other functions could it perform? Would a design improvement make it more appealing? Write a letter to the manufacturer.
- Design a boat that can be self-propelled by a rubber band or something else.
- Design and construct a vehicle that uses the air pressure from a balloon. Make one that flies, slides, rolls, or floats.

- Collect a variety of small springs (available in various sizes and strengths at hardware stores) to use as power sources for your cart. New designs should take advantage of the springs.
- One variable that engineers continually struggle with is the mass (weight) of the vehicle being propelled. Design an experiment to test the relationship between the distance a cart will go with ten winds of the rubber bands and the amount of mass it is carrying. Graph the results.
- Rollers powered by rubber bands can be made from plastic film canisters, empty thread spools, oatmeal boxes, cans, and other cylindrical containers. Investigate roller variables: rubber-band size and number, size of the roller, length or thickness of the rod, lubricants, and so forth.
- There are many branches of engineering. Find out what different engineers do and write a help-wanted ad describing what the job entails.
- mechanical engineer
- electrical engineer
- civil engineer
- mining engineer
- genetic engineer
- chemical engineer
- locomotive engineer
- sanitation engineer

Name_____

Date_____

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1. What is the question or the project that you are proposing?

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_	
2.	What materials or references will you need to complete the project?
_	
_	
_	
3.	What steps will you follow to complete the project?
_	
_	
_	
_	

PROJECT PROPOSAL

Name _____ Date

PRESENTATION GUIDELINES

You will have exactly 3 minutes to present your project to the class. In those 3 minutes you should answer these questions.

- What were you trying to find out (your question)?
- What materials or references did you need to do your project?
- What procedure did you follow to complete your project?
- What did you learn from doing your project?

When you begin speaking, you will see the *green card* held up for 2 1/2 minutes. When you see the *yellow card*, you have 30 seconds left. When you see the *red card*, it means you can finish your sentence, but you must stop within the next few seconds.

Practice your presentation so you will be sure it is at least 21/2 minutes long, but not more than 3 minutes long. Be sure you have included all of the information asked for above.

You will have exactly 3 minutes to present your project to the class. In those 3 minutes you should answer these questions.

- What were you trying to find out (your question)?
- What materials or references did you need to do your project?
- What procedure did you follow to complete your project?
- What did you learn from doing your project?

When you begin speaking, you will see the *green card* held up for 2 1/2 minutes. When you see the *yellow card*, you have 30 seconds left. When you see the *red card*, it means you can finish your sentence, but you must stop within the next few seconds.

Practice your presentation so you will be sure it is at least 2 1/2 minutes long, but not more than 3 minutes long. Be sure you have included all of the information asked for above.

MATH EXTENSION—PROBLEM OF THE WEEK INVESTIGATION 1: BLACK BOXES

A class wanted to make their own black boxes, using small cereal boxes and cardboard shapes, to send to another class. They plan to make 24 boxes.

- One-half of the boxes will have one triangle inside.
- One-third of the boxes will have two rectangles inside.
- The rest of the boxes will have one triangle and one rectangle inside.

How many of each shape will they need? How do you know?

The dimensions of the triangles and rectangles are shown below. Use the centimeter grid to make a drawing to show how you would cut all the shapes from one piece of cardboard. (The shapes and grid are smaller than reality but are drawn to scale.)

What is the smallest piece of cardboard that all of the triangles and rectangles can be cut from?





Centimeter graph paper

Name _

Date_

MATH EXTENSION—PROBLEM OF THE WEEK INVESTIGATION 2: HUM DINGERS

The students in Mr. Sylvester's class wanted to see how
long it would take them to build hum dingers. They
decided that all eight groups would start working on
their hum dingers at the same time, and work until they
all succeeded. At exactly 10:50 they started working.Gro
GroGroGroGroGroGroGroGroGroGroGroGroGroGroGroGroGro

Group 4 got its model hum dinger humming and dinging first and wrote down 11:45. Soon the other groups were having success as well. Here is a chart showing the time at which each group got their hum dinger working.

Group 1	12:20	
Group 2	1:05	
Group 3	12:40	
Group 4	11:45	
Group 5	12:05	
Group 6	12:50	
Group 7	12:00	
Group 8	11:55	

- 1. How long did it take the *fastest* group to make their hum dinger?
- 2. How long did it take the *slowest* group to make their hum dinger?
- 3. What was the *total* amount of time spent by all eight groups?
- 4. What was the *average* length of time needed to make a hum dinger?

Mrs. Jackson's class also wanted to find out how long it would take to make hum dingers. They timed the hum-dinger activity, too. The total time they spent making hum dingers was 9.5 hours. But Mrs. Jackson had only six groups in her class. Which students were faster, Mr. Sylvester's or Mrs. Jackson's? How do you know?

Name

Date

MATH EXTENSION—PROBLEM OF THE WEEK INVESTIGATION 3: GO-CARTS

How far does a cart go each time its wheel makes one rotation (goes around one time)? It goes a distance equal to the wheel's circumference. Circumference (*C*) is the distance around the outside of a circle (or wheel). You can calculate the circumference of any circle by multiplying the diameter (*D*) of a circle (the distance from one side to the other) by the constant pi (π). Pi (pronounced "pie") can be rounded off to 3.14. So the formula for calculating the circumference of a circle is $C = \pi \times D$.

Engineers often have charts and tables with useful information at their fingertips when they are designing a new product. A graph that shows how far a cart will travel with wheels of various sizes would be just such a convenient table.

Starting with wheels of 4, 8, and 12 cm, make a graph that tells you how far a cart will go when the *wheels rotate ten times*. Then answer the questions below.

- 1. What size wheel will go exactly 2 m on ten winds?
- 2. How far would a cart with 10-cm wheels go in ten rotations?
- 3. What size wheel will go exactly 6 m in ten rotations?
- 4. What size wheel will go exactly 2 m in five rotations?



Name _

Date

MATH EXTENSION—PROBLEM OF THE WEEK INVESTIGATION 4: CART TRICKS

You may have heard about gears. Some bikes have gears, and so do cars and go-carts. But why do vehicles have gears? Let's see if we can figure it out.

A gear is a wheel with knobs sticking out. The knobs are called teeth. When the teeth on one gear interlock with the teeth on another gear, we say that they mesh.

Part 1. When two or more gears are meshed, if one of them turns, they all turn. Each time one tooth on a gear moves, one tooth also moves on all the other gears meshed to it. When gear 2 goes clear around once, how many times will gear 1 go around?

When gear 3 goes clear around twice, how many times will gear 2 go around?

How many times will gear 1 go around?



Part 2. Three students got some big wheels for a cart they built. The wheels had a 150-cm circumference (48-cm diameter). The wheel had a four-tooth gear attached to the hub.

They got an eight-tooth gear to drive the wheel. How far does the wheel roll over the ground each time the eight-tooth gear goes clear around once?

Part 3. When the students got their cart going, they counted the number of times the eight-tooth gear rotated. It went around 250 times in 5 minutes. Can you help them figure out how fast the cart was going in kilometers per hour?



Name

Date

HOME/SCHOOL CONNECTION INVESTIGATION 1: BLACK BOXES

Black box is a general term scientists and engineers use to describe a system that works in mysterious or unknown ways. For most people a color TV is a black box. Electricity goes in and a picture miraculously appears on the screen. Even the telephone is a black box. We dial a number to speak with a person across the continent, never questioning how this is possible.

What black boxes do you have in or around your home, in your neighborhood, in your car? What black boxes have you read about, seen on TV, or in a movie? Make a list with the help of other family members. Be prepared to share your list. Do you think you can come up with any black boxes that no one else will think of?

Black boxes		

Name _

Date ____

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HOME/SCHOOL CONNECTION INVESTIGATION 2: HUM DINGERS

When you made a model hum dinger in class, a motor made the hum. Usually motors do a little more than just hum. For instance, you've probably seen a portable tape player. What do you suppose makes the tape advance so you can hear the music? A motor. See if you can find any motors around your home or in your car. What are they being used for? List locations of motors and what they are doing.

Some students used a lever to make a reliable switch on their model hum dinger. A rod or bar that pivots at one point is a lever. Levers are also found around homes and cars. A pair of scissors is one example of a lever system. A bottle opener is another example. Go on a lever hunt with a family member and list objects that are or that include levers.

Location of motor	Motor function	Location of lever	Lever function

Name_

Date____

HOME/SCHOOL CONNECTION INVESTIGATION 3: GO-CARTS

You know what a toaster is...you put a couple of slices of your favorite bread in the slots, push down on the little plunger handle, and 2 minutes later, up pops hot toast. Not dark enough? Twist the darkness dial and plunge it down again. Perfecto!

How does a toaster work? What holds it down? What actually toasts the bread? How does the darkness gizmo work? What makes toast pop up? How does it know when to pop up?

Try to figure out how a toaster might work. Talk it over with family members. Do you think there are any motors in there? Any levers? Magnets? Draw a model of a toaster. Try to include an explanation in your model for all the features described above.