the leo on wheels

The Leonardo

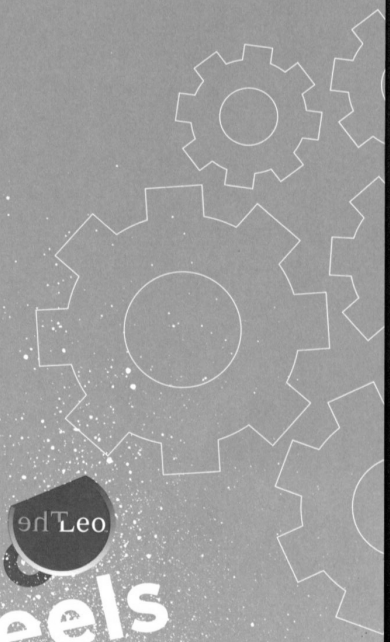
www.theleonardo.org

MY LEONARDO NOTEBOOK

name/nombre _____

school/colegio _____

grade/curso _____



the leo on wheels

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SECTION

1

INTRODUCTION
PRE-VISIT ACTIVITIES

REV 9/09

SECTION 1

Generator Bike – Pre-Visit Activity

1) **VOCABULARY:** Some scientific words and measurements you should know. Use your textbooks and the Internet to find their definitions:

Watt

_____

Kilowatt-Hour

_____

2) Find a hair dryer in your house. Record how many watts it takes to run it (it's usually written on the hair dryer somewhere). If you can't find one, go to a store or shop online for one.

Watts _____

3) Ask your parents to show you a copy of the last electricity bill they received. Record the number of kilowatt-hours used.

Kilowatt-hours _____

NOTES

NOTES

Microworlds – Pre-Visit Activity

SECTION 1

1) **VOCABULARY:** Some scientific words and measurements you should know. Use your textbooks and the Internet to find their definitions:

Magnification

_____

Focal Length

_____

Lens

_____

SECTION 1

Static Electricity – Pre-Visit Activity

1) **VOCABULARY:** Some scientific words and measurements you should know. Use your textbooks and the Internet to find their definitions:

Voltage

_____

Current (or Amps)

_____

Electrical Resistance

_____

2) Create static electricity on a plastic comb by combing your hair. Turn on your bathroom or kitchen faucet so that the water runs slowly but smoothly without breaking up. Bring the comb near the running stream of water without touching it and watch what happens. What do you see?

_____

_____

Try other objects like a metal fork or a wooden spoon. Do they cause the same effect?

_____

NOTES

NOTES

SECTION 1

Velocity Tracks – Pre-Visit Activity

1) **VOCABULARY:** Some scientific words and measurements you should know. Use your textbooks and the Internet to find their definitions:

Speed

_____

Weight

_____

2) You have decided to conduct a "scientific experiment" to figure out which is faster: a minivan, station wagon, or a compact car. Using a stop watch, you time how long it takes the minivan to drive around the block, how long it takes the station wagon to drive to the store and back, and how long it takes the compact car to drive between your house and your school. This is what your data looks like:

Car Type	Time
Minivan	3 minutes 23 seconds
Station wagon	11 minutes 13 seconds
Compact car	5 minutes 6 seconds

Which car is fastest? Can this question be answered?

List 3 variables that could have affected the outcome of your experiment:

SECTION 1

Voiceprint – Pre-Visit Activity

1) VOCABULARY: Some scientific words and measurements you should know. Use your textbooks and the Internet to find their definitions:

Pitch

_____

Amplitude

_____

Harmonic Frequency

_____

Hertz

_____

NOTES

SECTION 3

SECTION 3

Voiceprint – Final Worksheet

Use the data you recorded on the Visit Worksheet for this exhibit to answer these questions. Write your answers in the spaces provided or on the next page.

1) For each tuning fork complete the following calculations. Subtract the base frequency from the 1st harmonic, the 1st harmonic from the 2nd harmonic, and the 2nd harmonic from the 3rd harmonic. Record your results in the table below.

Tuning Fork	1st H - Base	2nd H - 1st H	3rd H - 2nd H
C			
E			
G			

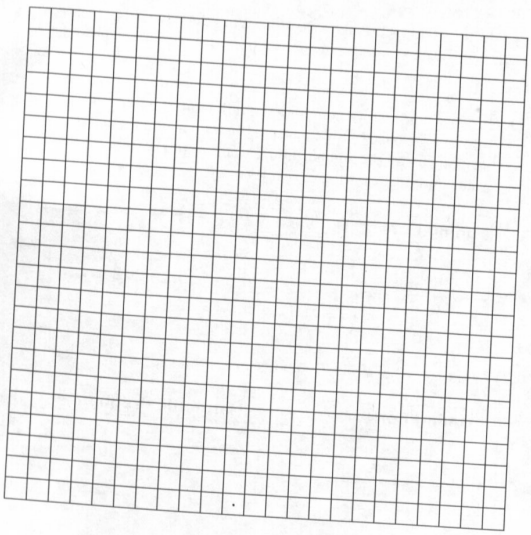
2) What is the harmonic frequency of each of the tuning forks?

Tuning Fork	Harmonic Frequency
C	
E	
G	

NOTES

SECTION 1

Velocity Tracks – Final Worksheet



Velocity Tracks – Final Worksheet

Use the data you recorded on the Visit Worksheet for this exhibit to answer these questions. Write your answers in the spaces provided or on the next page.

1) Calculate the speed of the balls on all three tracks.

Ball Type	Track 1 speed (cm/s)	Track 2 speed (cm/s)	Track 3 speed (cm/s)
Steel			
Wood			
Plastic			

Is the shortest track the fastest?

Is the longest track the slowest?

What makes the fastest track so?

2) Pick one track. On the next page, plot the speed of the three different balls running on that track on the Y axis, and the weight of the balls on the X-axis. What effect does weight have on the speed of the ball?

3) Simply defined, a scientific experiment is to run a test and measure the outcome. Then to change something, run the test again, and measure how the outcome is different. In a good scientific experiment, only one variable is changed at a time. Why?

SECTION

2

DATA COLLECTION

Generator Bike – Visit Worksheet

1) Sit on the generator bike. Adjust the seat, and start pedaling. Get up to speed, then switch on the 15, 25, and 50 watt bulbs one at a time. Now turn on the 100W bulb and start the stopwatch at the same time. Keep the stopwatch running until the wattmeter drops below 100W, then stop the stopwatch. Record your time, and your team members' times below.

Name	Time

Pedaling can be tiring. Do not push yourself too hard.

Pull up on the knob to adjust the seat on the bike.

Static Electricity – Final Worksheet

3) Electrical current flows in a circuit according to Ohm's Law:

Voltage (Volts) = Current (amps) Resistance (ohms)

The resistance of the human body is about 3 million ohms. Calculate the current in a spark that passed through your human chain. Voltage must be in Volts, current in Amps, and resistance in Ohms.

Current in spark (A)	

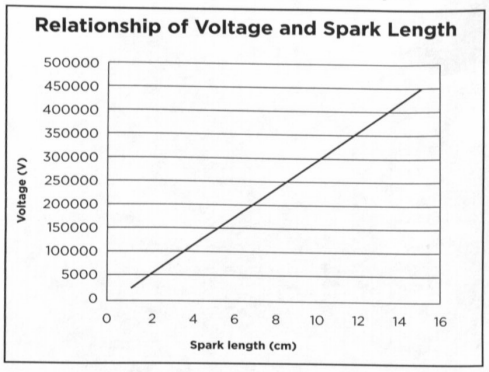
SECTION 3

Static Electricity – Final Worksheet

1) From the 5 spark length measurements you recorded, calculate an average spark length.

Average Spark Length	

Using the graph below, estimate the voltage of the spark.



Voltage in the spark (V)	

2) Using the graph above, estimate the voltage in a lightning strike. Hint: Lightning strikes usually travel about 3 Kilometers.

Voltage of Lightning Strike (V)	

Microworlds – Visit Worksheet

1) Choose one object from your group and sketch it twice; once while looking at it with your eyes and once while looking at it under the microscope.
(Include ALL the details you can see!)

Object drawn with your eyes:

Object drawn with microscope:

SECTION 2

SECTION 3

Microworlds – Final Worksheet

Describe the differences between the drawings you did without the microscope and the ones you did with the microscope.

1) What details of the object could you see with the microscope that you couldn't see with your eyes?

2) What else could you see with the microscope that you couldn't see with you eyes? Is the object irregular in any way?

3) What have you learned about the things you look at with your eyes? (are you seeing everything possible about the things around you?)

Static Electricity – Visit Worksheet

2) Holding hands, make a human chain of everyone in your group except for one person. That person should put one hand on the Van de Graff.

Charge up the generator for 10 seconds, then have the person touching the Van de Graff touch hands with the first person of the human chain.

Did the person at the other end of the chain feel the spark?

Count the number of people that felt the charge and record it. Repeat two more times.

	# of people that felt the spark
1	
2	
3	

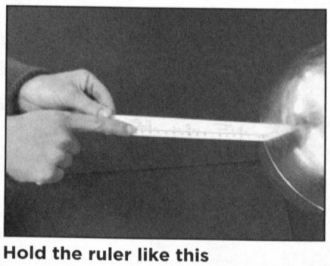
Caution! Electrical discharges can disrupt electrical devices such as pacemakers, cellular phones, and your heart! If you or your family has a history of Delayed QRS complex, or Ventricular Fibrillation you might want to sit this one out. (If you don't know what those are, you don't need to worry about it).

SECTION 2

Static Electricity – Visit Worksheet

1) Put the 1cm end of a ruler against the ball. Hold it at the 20cm end.

With your other hand, put a fingertip at the 20cm mark and point it at the ball (see photo).



Hold the ruler like this

Have a teammate charge up the generator for 5 seconds. Keep the generator running, and slowly move your finger closer to the ball until you get sparked. Write down the measurement where you were sparked. All members of your team should measure the spark length.

Name	Spark length (cm)

(continued on next page)

NOTES

Velocity Tracks – Visit Worksheet

1) Using the flexible fabric measuring tape, measure the length of each of the tracks (in centimeters, not inches) from start to finish. You might need some help from your teammates to get the tape to lay down along the curved sections of the tracks.

Track #	Length (cm)
1	
2	
3	

2) Using the spring scale, weigh each ball.

Ball Type	Weight (N)
Steel	
Wood	
Plastic	

(continued on next page)

Generator Bike – Final Worksheet

1) How long would you have to pedal the generator bike to power your house for one day? Divide the number of kilowatt-hours used at your house on the last bill by 30 (assume 30 days in a month). Multiply your answer by 1000 to convert the kilowatts into watts.

Watt-hours used in one day at my house:	

Now divide that number by 190 to find out how many hours you would need to pedal the bike with all the lights on to power your house for one day (190 is the number of watts of power it takes to light all the incandescent lights on the cart).

Number of Hours	

2) How long would you have to pedal the generator bike to dry your hair after a shower using the hair dryer at your house?

Number of Hours	

3) When all four bulbs are on, everyone's time on the generator bike comes to a stop. What could be changed in order to keep it moving longer? Are there ways in your home or your school to achieve the same result? List 3. Are you willing to do them? Why or why not?

Velocity Tracks – Visit Worksheet

1) Using the flexible fabric measuring tape, measure the length of each of the tracks (in centimeters, not inches) from start to finish. You might need some help from your teammates to get the tape to lay down along the curved sections of the tracks.

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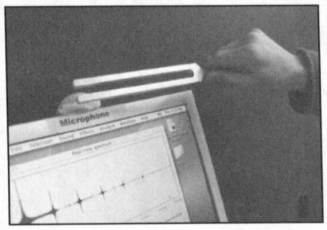
Voiceprint – Visit Worksheet

1) Gently tap one of the tuning forks on the sole of your shoe and hold the end up to the microphone (see photo). Once you see the same pattern as in the photo, click on the "Freeze Screen" button.



Hold the tuning fork with the end in front of the microphone.

The vertical height of the waves on the screen indicates the volume. The horizontal distance indicates the frequency (measured in kilohertz, kHz).

The largest (left most) peak is the fork's base frequency. The other major peaks are its harmonics. View the scale underneath the peaks and record the base frequency and the first three harmonics for each fork.

Tuning Fork Name	Base Frequency (kHz)	First Harmonic (kHz)	Second Harmonic (kHz)	Third Harmonic (kHz)
C				
E				
G				

(continued on next page)

Voiceprint – Visit Worksheet

2) Whistle or hum into the microphone at the lowest pitch you can make. Freeze the screen and record the frequency of the tallest peak. Record the values for your team members as well.

Now whistle or hum at your highest pitch. Repeat the experiment with all of your team members.

Name	Lowest Frequency	Highest Frequency

These measurements represent each of your personal frequency ranges.

SECTION

3

DATA
COLLECTION

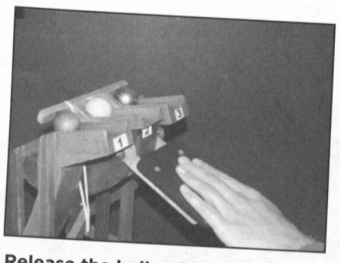
Velocity Tracks – Visit Worksheet

3) Load all three balls onto the tracks in the order specified in the table below. Record the time it takes for each ball to get to the bottom of each track. Repeat until the table is filled.

	Track	Ball Type	Time (sec)
Run #1	Track 1	Steel	
	Track 2	Wood	
	Track 3	Plastic	

	Track	Ball Type	Time (sec)
Run #2	Track 1	Plastic	
	Track 2	Steel	
	Track 3	Wood	

	Track	Ball Type	Time (sec)
Run #3	Track 1	Wood	
	Track 2	Plastic	
	Track 3	Steel	



Release the balls with your hand. Don't hit the release lever with your fist!

Microworlds – Final Worksheet

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