

Group Color: \_\_\_\_\_



## How Science Works

Grade 3

Module 2

*Class Question:*

**What variables affect ball motion?**

Scientist (Your Name): \_\_\_\_\_

Teacher's Name: \_\_\_\_\_

SciTrek Volunteer's Name: \_\_\_\_\_

# VOCABULARY

**Science:** The study of the material world using human reason. The scientific method is the way humans reason and apply logic to data to help gain knowledge of the world.

- **Observation:** A description using your five senses. This could include contents, mass, size, color, temperature, smell, texture ...
- **Opinion:** Something you believe or feel. Not a fact or observation.
- **Inference:** A guess based on past experiences.
- **Testable Question:** A question for which an experiment can be designed to answer.
- **Non-Testable Question:** A question for which an experiment cannot be designed to answer. For example, questions involving things that cannot be measured/observed, or things that are not well defined/opinions.
- **Experimental Set-Up:** The materials, changing variable, and controls that are needed for an experiment.
- **Experiment:** A test or trial to discover something unknown.
- **Procedure:** A set of steps to conduct an experiment.
- **Controls:** The variables that are not changed in an experiment.
- **Changing Variable (Independent Variable):** The variable that is purposely changed in an experiment.
- **Results/Data (Dependent Variable):** The measurements/observations of the experiment, which are influenced/determined by the changing variable.
- **Prediction:** What you expect to happen based off of previous measurements/observations.
- **Scientific Practices:** A series of activities that scientists participate in to both understand the world around them and to communicate their results with others. (The specific practice worked on in this module is identifying testable questions.)
- **Technique:** A method for a specific task.
- **Reproducibility:** The ability to duplicate data from one trial to the next.
- **Median:** The middle number of a given set of numbers listed in increasing order.
- **Maximum:** The largest value in a given set of numbers.
- **Minimum:** The smallest value in a given set of numbers.
- **Circumference:** The distance around a sphere.
- **Motion:** When something is moving or changing position.
- **Speed:** How far something moves in a certain amount of time.
- **Gram (g):** A unit of mass (weight).
- **Centimeters (cm):** A unit of length.
- **Friction:** A resistance that slows objects down.
- **Run:** The complete distance the ball travels.
- **Ramp:** The sloped part of the run.

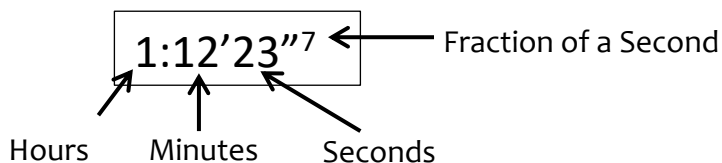
## TECHNIQUE

### Timers

Timers are used to measure an amount of time.

*How to read a timer:*

The diagram below shows what each number on a timer stands for



The above timer has gone for 1 hour, 12 minutes, 23 seconds and  $\frac{7}{10}$  fraction of a second.

1. If 3:00'45''<sup>3</sup> is seen on your timer how much time has passed?

Hours: \_\_\_\_\_ Minutes: \_\_\_\_\_ Seconds: \_\_\_\_\_ Fraction of a Second: \_\_\_\_\_

2. If 0:01'07''<sup>2</sup> is seen on your timer how much time has passed?

Hours: \_\_\_\_\_ Minutes: \_\_\_\_\_ Seconds: \_\_\_\_\_ Fraction of a Second: \_\_\_\_\_

*How to use a timer:*

1. If timer is off, push the blue button to turn it on.
2. If you do not see 0:00'00''<sup>00</sup>, push the blue button again to reset the timer.
3. To start the timer, push the yellow button.
4. To stop the timer, push the yellow button again.
5. Record time to the nearest fraction of a second.

Example: 0:00'12''<sup>8</sup> would be recorded as  $12 \frac{8}{10}$  s.

6. To reset to 0:00'00''<sup>00</sup>, push the blue button.
7. Repeat.



Practice recording the amount of time it takes to do the following activities.

1. How long does it take the SciTrek lead to unsnap/snap their lab coat? \_\_\_\_\_
2. How long does it take the SciTrek lead to jump three times? \_\_\_\_\_

## SCIENTIFIC PRACTICE

### Questions

Circle TESTABLE if the question can be tested by science. Circle NOT TESTABLE if the question cannot be tested by science.



- |     |  |                 |                     |
|-----|--|-----------------|---------------------|
| 1.  | How much does an astronaut's suit weigh?               | <i>Testable</i> | <i>Not Testable</i> |
| 2.  | Do dogs like Astronaut Ice Cream?                      | <i>Testable</i> | <i>Not Testable</i> |
| 3.  | Is Venus prettier than Saturn?                         | <i>Testable</i> | <i>Not Testable</i> |
| 4.  | How many moons orbit Jupiter?                          | <i>Testable</i> | <i>Not Testable</i> |
| 5.  | Which planet, other than Earth, is the most habitable? | <i>Testable</i> | <i>Not Testable</i> |
| 6.  | How fast does Luke Skywalker fly his spaceship?        | <i>Testable</i> | <i>Not Testable</i> |
| 7.  | How many telescopes are there in the United States?    | <i>Testable</i> | <i>Not Testable</i> |
| 8.  | Is the space shuttle big?                              | <i>Testable</i> | <i>Not Testable</i> |
| 9.  | Is studying the solar system valuable?                 | <i>Testable</i> | <i>Not Testable</i> |
| 10. | What color light do stars give off?                    | <i>Testable</i> | <i>Not Testable</i> |

Circles are your initial thought and boxes are the correct answer.

## Experimental Considerations:

1. You will only have access to the materials on the materials page.
2. You will run four trials.
3. For each trial you must measure the time the ball travels (time from ball release to ball hitting the board) three times.

Changing Variable (Independent Variable): \_\_\_\_\_

Discuss with your group how you think your changing variable will affect ball motion.

## QUESTION

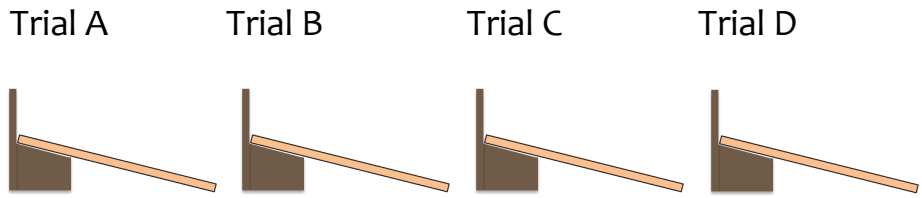
Question our group will investigate:

- If we change the \_\_\_\_\_,  
insert changing variable (independent variable)  
what will happen to the \_\_\_\_\_  
insert what you are measuring (dependent variable)  
\_\_\_\_\_?

Fill out the materials page with your SciTrek volunteer before moving onto the experimental set-up.

## EXPERIMENTAL SET-UP

Write your changing variable (Ex: ball mass) and the values (Ex: 15 g) you will use for your trials under each set-up.



**Changing Variable:**

:

\_\_\_\_\_

**Controls** (variables you will hold constant):

Write your controls and the values you will use in all your trials (control/value, Ex: object type/ball).

Object Type	/	Ball	/
_____	/	_____	/
_____	/	_____	/
_____	/	_____	/

**Predictions**

I predict that when the \_\_\_\_\_ is \_\_\_\_\_  
changing variable value of changing variable

the ball will hit the board in the least amount of time.

I predict that when the \_\_\_\_\_ is \_\_\_\_\_  
changing variable value of changing variable

the ball will hit the board in the most amount of time.

## TECHNIQUE

### *Median*

When running multiple trials in an experiment it is necessary to find one number to represent all of the data. The middle number, also known as the median number, is sometimes used to represent all the data. To find the median, first place all of the numbers from each trial in increasing order, second circle the middle number.

<b>Ball Material:</b>	<b>Time Ball Travels (s): (In Increasing Order)</b>	<b>Median (s):</b>
Styrofoam Ball	$5\frac{6}{10}$ , 7, $6\frac{7}{10}$	
Metal Ball	$2\frac{3}{10}$ , $1\frac{2}{10}$ , $2\frac{7}{10}$ , $1\frac{4}{10}$ , $1\frac{9}{10}$	
Wooden Ball	$2\frac{7}{10}$ , $2\frac{6}{10}$ , $2\frac{9}{10}$	
Plastic Ball	$4\frac{1}{10}$ , $3\frac{9}{10}$ , $4\frac{2}{10}$ , $4\frac{1}{10}$ , 4	
Velcro Ball	$21\frac{4}{10}$ , $21\frac{7}{10}$ , $21\frac{9}{10}$ , $20\frac{6}{10}$ , $22\frac{3}{10}$	

# PROCEDURE

1.

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2.

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3.

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4.

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5.

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6.

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## RESULTS

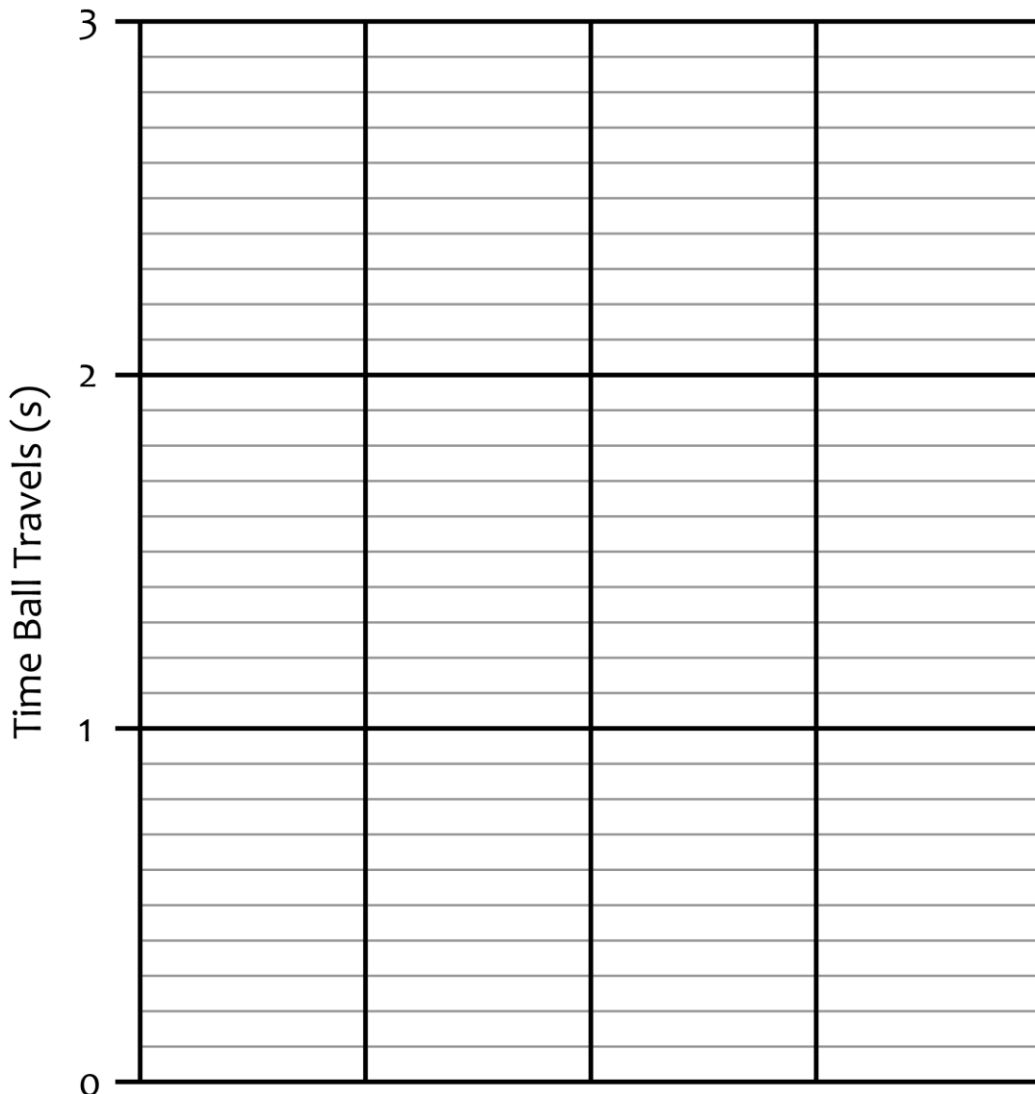
*Table*

Fill out the table for each of your trials. For the variables that remain constant, write the value in *Trial A*. Then, draw an arrow through each box to indicate the variable is a control.

Variables		Trial A		Trial B		Trial C		Trial D		
Object Type:		<b><i>Ball</i></b>								
Ball Mass:										
Ball Circumference:										
Run Material:										
Run Length:										
Ramp Height:										
Ramp Length:										
Data		Trial A		Trial B		Trial C		Trial D		
Measurements:	Time:	1		1		1		1		
		2		2		2		2		
		3		3		3		3		
	Put Times 1-3 in Increasing Order:									
	Median:									

The independent variable is the changing variable and the dependent variables are the measurements.

**RESULTS**  
*Graph and Summary*



\_\_\_\_\_

\_\_\_\_\_

My experiment shows \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

I acted like a scientist when \_\_\_\_\_

\_\_\_\_\_

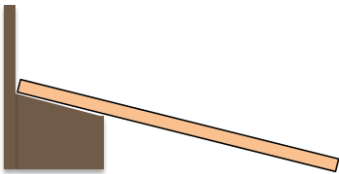
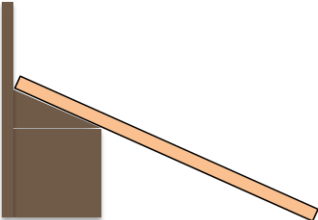
\_\_\_\_\_

### TIE TO STANDARDS

- What two measurements do you need to get the speed of an object?  
 \_\_\_\_\_ and \_\_\_\_\_
- If all distances are equal, the ball that hits the board first has a ( **faster / slower** ) speed.  
 circle one

#### Ramp Height

- Fill out the following chart. Predict which set-up will cause the ball to hit the board first and circle your answer in the prediction column. For each of the trials write the set-up that hit the board first, or T if the two balls tied.

Set-Up 1	Set-Up 2	Prediction	Data
 <p>Ramp Height: 13 cm</p>	 <p>Ramp Height: 22 cm</p>	Which set-up will cause the ball to hit the board first? (Circle One) 1 2 Tie	Trial 1
			Trial 2
			Trial 3

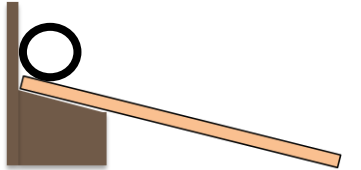
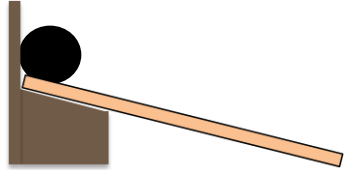
- Does the ramp height affect the speed of the ball? YES NO
- Explain how ramp height affects the speed of the ball.

\_\_\_\_\_

\_\_\_\_\_

**Ball Mass**

6. Fill out the following table with the same directions as question 3.

Set-Up 3	Set-Up 4	Prediction	Data
		Which set-up will cause the ball to hit the board first? (Circle One)	Trial 1
Ball Mass: ~265 g	Ball Mass: ~360 g	3	Trial 2
		4	Trial 3
		Tie	

7. Does the ball mass affect the speed of the ball?      YES      NO

8. Explain how the ball mass affects the speed of the ball.

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9. Which ball do you think will hit the wooden run first when dropped from the same height?

Blue Ball (~265 g)

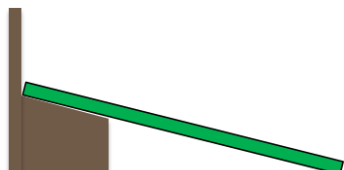
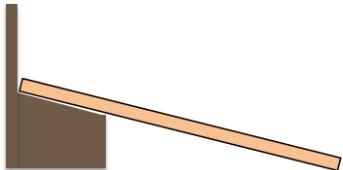
Purple Ball (~360 g)

The Balls will Tie

10. Which ball hit the ground first? \_\_\_\_\_

**Run Material**

11. Fill out the following table with the same directions as question 3.

Set-Up 5	Set-Up 6	Prediction	Data
		Which set-up will cause the ball to hit the board first? (Circle One)	Trial 1
Run Material: Turf	Run Material: Wood	5	Trial 2
		6	Trial 3
		Tie	

12. Does the run material affect the speed of the ball?    YES                                    NO
13. Explain how run material affects the speed of the ball.



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***Is motion predictable?***

14. Circle the values below that would cause a ball to travel at the **fastest speed**. If the variable does not affect the speed of the ball, then circle either. Assume a ramp length of 50 cm and a run length of 150 cm.

Variable	Option 1	Option 2	Option 3
Ramp Height:			Either
Ball Mass:	100 g	1,000 g	Either
Run Material:	Sand Paper	Plastic	Either

15. Circle the values below that would cause a ball to travel at the **slowest speed**. If the variable does not affect the speed of the ball, then circle either. Assume a ramp length of 50 cm and a run length of 150 cm.

Variable	Option 1	Option 2	Option 3
Ramp Height:			Either
Ball Mass:	1 g	10 g	Either
Run Material:	Tar	Card board	Either

## EXTRA PRACTICE

### Questions

Circle TESTABLE if the question can be tested by science. Circle NOT TESTABLE if the question cannot be tested by science. If the question is NOT TESTABLE change (revise) the question to be something that is testable.

1. How much time does it take to walk three miles?      *Testable*      *Not Testable*

Revision: \_\_\_\_\_?

2. Is a bird loud?      *Testable*      *Not Testable*

Revision: \_\_\_\_\_?

3. Is drinking eight glasses of water a day a good idea?      *Testable*      *Not Testable*

Revision: \_\_\_\_\_?

4. How many songs does the radio station play in one hour?      *Testable*      *Not Testable*

Revision: \_\_\_\_\_?

5. Which type of juice is the most refreshing?      *Testable*      *Not Testable*

Revision: \_\_\_\_\_?

6. Do bees land on bright colored flowers?      *Testable*      *Not Testable*

Revision: \_\_\_\_\_?

7. Is ice cream more delicious than cookies?      *Testable*      *Not Testable*

Revision: \_\_\_\_\_?

## WORD SEARCH

U X D W Q V L Y P R W V E Q N L  
E N C S P E E D C P Y C H O O E  
I J Q E W M L F R A N T X H I O  
A Q R E N N B O A E H E V Q T W  
L L V T O T C X R A N E G X S E  
E U P I I E I E G Y G J R I E E  
K L T B D E F M N U R B A B U X  
Q O B U A M F W E D K O M J Q P  
M N R A U L N O I T C I R F E E  
B E G C I I L M M E E A N H L R  
O U R E W R P S J Q M R A P B I  
Z I W I G C A Q A P B B I S A M  
C W N Y M T T V Z I L E D O T E  
O B S E R V A T I O N Q E Z S N  
N X U E D N R N N N G C M B E T  
K N C A V N I V C W A Q J J T X

Ball	Gram	Ramp
Centimeter	Median	Run
Circumference	Motion	Speed
Experiment	Observation	Testable Question
Friction	Procedure	Variable



SciTrek is an educational outreach program that is dedicated to allowing 2<sup>nd</sup> - 12<sup>th</sup> grade students to experience scientific practices firsthand. SciTrek partners with local teachers to present student-centered inquiry-based modules that not only emphasize the process of science but also specific grade level NGSS performance expectations. Each module allows students to design, carry out, and present their experiments and findings.

For more information, please feel free to visit us on the web at [chem.ucsb.edu/scitrek/](http://chem.ucsb.edu/scitrek/) or contact us by e-mail at [scitrekelementary@chem.ucsb.edu](mailto:scitrekelementary@chem.ucsb.edu).

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