CLASS CRUNCH LABS

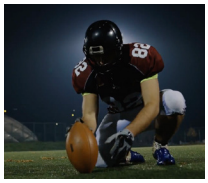
Student Guide

Forces and Motion: Unit 1

NOTICE AND WONDER


Soccer


Baseball


Football


Softball


Cricket


Golf

Notice (What do I notice happening?)	Wonder (What questions do I have?)

SPORTS DATA

SPORT	MASS OF BALL	MASS OF HITTING DEVICE	AVERAGE DISTANCE	FARTHEST DISTANCE EVER RECORDED	AVERAGE SPEED
Golf	45 grams	330 grams (golf club)	600 ft (drive hit)	1,545 ft (drive hit)	223 ft per second
Baseball	145 grams	500 grams (bat)	425 ft (home run hit)	575 ft (home run hit)	122 ft per second
Cricket	160 grams	1,225 grams (bat)	266 ft (boundary 6 or “home run hit”)	416 ft (boundary 6 or “home run hit”)	103 ft per second
Softball	180 grams	765 grams (bat)	245 ft (homerun hit)	576 ft (homerun hit)	103 ft per second
American Football	410 grams	n/a	114 ft (field goal kick)	198 ft (field goal kick)	141 ft per second
Soccer	430 grams	n/a	135 ft (goal kick)	315 ft (goal kick)	107 ft per second

NOTICE AND WONDER

Notice (What do I notice about the data?)	Wonder (What questions do I have?)

SPORTS MODELING

Before we begin... a "model" uses pictures, symbols, words and labels to visually represent our science ideas. You don't need to be a great artist to make a model. Stick figures do the trick just fine!

Step 1: Choose a ball sport from the data set that you are interested in analyzing - pick one you're familiar with.

Step 2: Using the video, data set, and your own experiences, create a model explaining how to get a ball to move in the direction you want it to go when it is struck in your chosen sport.

In your model, explain everything you know about the following questions:

- How does force affect how far a ball travels in your chosen sport?
- Use symbols, words, and images to explain how all of the parts interact to cause a ball to travel a certain distance
- Why doesn't the ball in your sport travel the same distance each time it is hit?

Step 3: Write down any questions that you have if you get stuck while creating your model

SPORTS MODELING

Your sport _____

Draw your model here:

Jot your questions here:

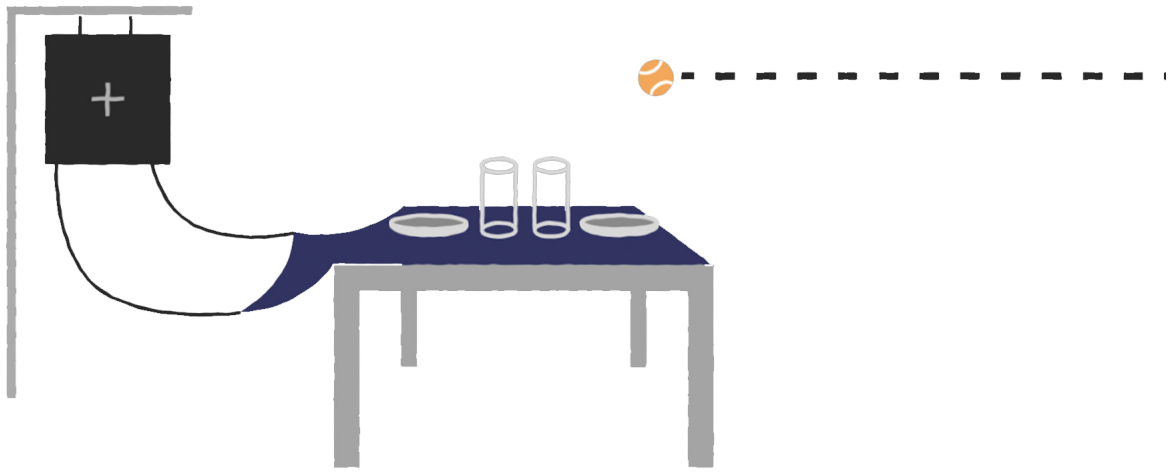
STABILITY AND CHANGE

What stayed the same in the system? (Stability)	What changed in the system? (Change)

Construct an explanation using evidence of why some things changed and why some stayed the same:

TABLECLOTH MODEL

Draw arrows to represent forces



Which objects will likely move when the tablecloth is pulled out? Explain your reasoning.

Which objects will likely not move when the tablecloth is pulled out? Explain your reasoning.

Jot any additional questions or ideas here:

INVESTIGATION: BALL AND RAMP

Objective: Roll objects of different masses down an adjustable ramp to try to push a "cup mascot" into a "goal zone"

Step 1: Construct your ramp apparatus and design your cup mascots!

Bill of materials:	Set-up
(3) Cups (3) Rolling objects with different masses (1) Ramp (1) Ruler Masking Tape Scissors Decorations (e.g. googly eyes, pom-poms) Weights (e.g. washers, pennies) Clamp Object for raising / lowering ramp	• Prepare each cup by cutting a hole in one side big enough for the rolling objects to enter • Design cup mascots! Add decorations and weights (with glue or tape) to each cup so that they have different masses. • Tape one end of the ramp to the table so it lays horizontal • Raise and lower the horizontal ramp by sliding an object underneath it (ex. large roll of tape) • Measure the height of the ramp with the ruler (Optional: attach a clamp to the base of the ruler so it stays upright) • Create the "goal zone" by placing 1 strip of masking tape about 10 inches from the base of the ramp and a parallel strip of tape about 5 inches from the first strip (make sure the cup just barely fits between the two pieces of tape) • Place a cup mascot at the bottom of the ramp and get ready to conduct an investigation and record the results!

Draw your investigation set up and label the parts:

Name your cup mascots:

_____ Smaller Mass

_____ Larger Mass

Step 2: Conduct Your Investigation

Independent Variable *This is what we are going to CHANGE to CAUSE a difference*	**Dependent Variable** *This is what we are going to MEASURE to observe what is different*
What will we change about the independent variable?	**How will we measure the dependent variable?**

	Independent Variable *Keep a record of what you changed each time*	**Dependent Variable** *Record your measurements of the results each time*	**Result** *Did your cup mascot land in the goal zone?*
Trial 1			
Trial 2			
Trial 3			
Trial 4			
Trial 5			

Step 3: Making sense of the investigation

Is there a pattern in the data you collected? If yes, describe the pattern.

Based on what you observed, which of your trials do you think involved the MOST amount of force (push or pull)? Use your data to explain why you think so.

Based on what you observed, which of your trials do you think involved the LEAST amount of force (push or pull)? Use your data to explain why you think so.

If you had time to do a different investigation with the same supplies what would you want to test?

MAPPING EXERCISE

Ball & Ramp Investigation

Slingshot Experiment

Select an independent variable (one that was changed) from the Ball & Ramp Investigation:	Which variable from the Slingshot Experiment best relates to this variable?
Explain your reasoning:	

Select another independent variable (one that was changed) from the Ball & Ramp Investigation:	Which variable from the Slingshot Experiment best relates to this variable?
Explain your reasoning:	

Select another independent variable (one that was changed) from the Ball & Ramp Investigation:	Which variable from the Slingshot Experiment best relates to this variable?
Explain your reasoning:	

EXPLANATION WORKSHEET

Constructing an Explanation about your chosen sport:

1. What sport did you choose?

2. Use your model, the data set, and what you have learned in this unit to construct an explanation of how you would get a perfect hit in your sport of choice every time.

a. In your explanation include information about how you could optimize the hit using forces in the sport.

b. Use your model that you have been revising as evidence to support your thinking.

ENGINEERING DESIGN CHALLENGE

Objective: Design and decorate a "homerun machine" that can fling 3 objects of different masses the same distance each time.

Part 1: Set-up

Bill of materials:	Quick set-up
4 rubber bands 6 popsicle sticks Tape 12" yarn 2 plastic spoons 2 clothespins 1 binder clip 12" x 12" cardboard 4 straws 4 brads 4 paper clips (other materials with teacher's permission) Provided by Teacher: (3) Pucks of varying mass	• Use the materials to invent your own machine to fling pucks across the floor. • Give your machine a name and decorate it. • Remember: there is no single correct design in this design challenge! Use your creativity and what you've learned about force and mass to build something fun and original.

Criteria:	Constraints:
• The target will be 6 feet from the starting point. • The machine should be able to fling objects of different masses while not taking longer than 1 minute between shots to modify the device. • You need to be able to pick your device up so that it can move to another location.	• You may only use the materials provided (or other materials with teacher permission) • Your # of days to design and develop your solution

What's your machine's name:

Draw your machine with notes about how it functions:

Describe your building process:
What did you adjust on your device to change for pucks with different masses?
Were you able to adjust how much force your machine exerted? If so, how?
How did force affect the pucks' movement in your design?
Describe your process, what didn't work, how you chose your approach.
Observe other devices in the class, what features would you consider adding to your device to improve it?