Name: KEY

1.1 Improving Serving

GRADES 3-5

Part 1:

Question: How do you improve your serve?

Answers may vary among students.

Example response: I can improve my serve by using an underhand serve instead a torque serve.

Hypothesis: Which of the following will improve your serve: position, person serving, serve type or volleyball?

Answers may vary among students.

Example hypothesis: If I change the serve type from torque to underhand, more serves will make it over the net.

Data Collection: Record the distance and location of each serve.

Results may vary among students. Example data below.

	Partner 1	Partner 2	Position 1 (1 foot behind line)	Position 2 (on the line)
Underhand Serve	**30 feet, net serve**	**40 feet, near attack line**	**25 feet, before the net**	**45 feet, near the attack line**
Torque Serve	**42 feet, left near the attack line**	**20 feet, before the net**	**30 feet, net serve**	**30 feet, net serve**
First Touch Ball	**53 feet, center near the end line**	**43 feet, right near the attack line**	**30 feet, net serve**	**42 feet, just over the net, near attack line**
Light Touch Ball	**55 feet, near the end line**	**30 feet, net serve**	**53 feet, near the end line**	**63 feet, past the end line**

Conclusion: What variable improved your serve? How do you know?

Answers may vary based on student results.

Name: KEY

Example response: My serve got better when I used the Torque serve and the First Touch volleyball and stood closer to the line. Each of the data for that hit was higher for me and my partners.

Part 2:

Question: How do you improve your serve?

Answers may vary among students.

Example response: I can improve my serve by changing my foot position with my forward foot.

Hypothesis: Will a change in foot position increase the distance of a serve?

Answers may vary among students.

Example response: If I point my front foot forward and my back foot at 45 degrees, my serves will go further.

Data Collection: Collect distance in feet.

Results may vary among students. Example data below.

	Trial 1	Trial 2	Trial 3	Average
Both feet forward	**35 feet**	**37 feet**	**30 feet**	**34 feet**
Back foot at 45 degrees & front foot forward	**33 feet**	**38 feet**	**43 feet**	**38 feet**
Both feet at 45 degrees	**29 feet**	**36 feet**	**31 feet**	**32 feet**

Conclusion: Which foot position improved the distance of the serve? How do you know?

Answers may vary based on student results.

Example response: My hypothesis was supported because the average for my back foot at 45 degrees and front foot forward was the highest.

What are the similarities and differences between the two experiments?

Answers may vary based on student results.

Name: KEY

Example response: In both experiments, we were testing how to improve the serve. In the second experiment, it was easy to tell if I was doing better. In the first experiment, I was confused as I was trying more ways to improve my serve at the same time

What would a coach more likely use to change/improve their player's serve? Explain.

Answers may vary among students.
Example response: The second experiment because it is more clear the change made a difference on the player's serve.

Name: KEY

2.1 Probability and Penalty Kicks

GRADES 3-5

X - Shot Made **O - Shot Missed**

	1	2	3	4	5	6	7	8	9	10	Total Made
Partner 1	**X**	**X**	**0**	**0**	**0**	**X**	**0**	**X**	**0**	**0**	**4**
Partner 2	**0**	**0**	**X**	**X**	**X**	**0**	**X**	**X**	**0**	**X**	**6**

Predict who would win a shootout: you or your partner? Justify it with evidence.
Example: I believe “Partner 2” will win the shootout. He/she made an additional two shots out of the 10.

Write a mathematical expression that shows who has a lower chance of winning the shootout.
Partner 1: 4 / 10 = .40
Partner 2: 6 / 10 = .60

Name: KEY

2.1 Probability and Penalty Kicks

GRADES 3-5

Shoot Out

X - Shot Made **O - Shot Missed**

	1	2	3	4	5	TOTAL Made
Partner 1	x	o	o	x	o	2
Partner 2	x	o	x	o	x	3

Who won the shootout? How was your prediction different from the actual results?

Partner 2: My prediction that Partner 1 had a lower chance of winning the shootout was accurate based on results from the penalty kicks.

Write a mathematical expression that shows who won the shootout.

Partner 1: 2 / 5 = .40

Partner 2: 3 / 5 = .60

Name: KEY

3.1 Properties of a Football and Foam Football

GRADES 3-5

Behaviors Results may vary among students. Example data below.

	How does it bounce?	How far can you throw it?	How far can you kick it?	Is it easy to catch?	Is it easy to squish?
Foam Football	Poorly; Low bounce	20 feet	22 feet	Very	Very
Youth Football	Randomly; depends what part of the ball hits the ground first.	30 feet	44 feet	Sometimes	When it's flat, a little

Properties Results may vary among students. Example data below.

	Color	Shape	Texture	Length, Height and Circumference	Mass	Materials
Foam Football	White Yellow	Triangle Oval Cylinder	Smooth Spongy	L- 9.5 inches H- 5.5 inches C- 17.5 inches	5.6 ounces	Foam Air
Youth Football	Brown White	Triangle Oval Cylinder	Rough Firm	L- 11 inches H- 6.5 inches C- 19.25 inches	12.5 ounces	Rubber Plastic Air

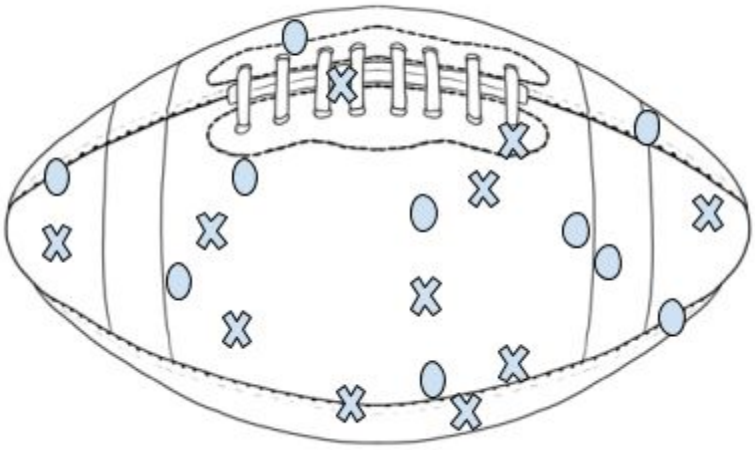
Name: KEY

3.1 Properties of a Football and Foam Football

GRADES 3-5

Draw dotted lines that divide the football into four equal parts. Bounce the ball 10 times. Put an 'X' on the diagram where the ball hits the ground for the regular football and an 'O' on the diagram where the ball hits the ground for the foam football.

Answers will vary based on student results. Example data below.



Drop	Height: Foam	Direction: Foam	Height: Youth	Direction: Youth
1	9 inches	Right	8 inches	Spin
2	1 foot 8 inches	Straight up	2 feet	Left
3	3 inches	Spin	2 feet 6 inches	Left
4	5 inches	Left	3 feet 2 inches	Straight up
5	1 foot 1 inch	Straight up	1 foot 7 inches	Away from me

Name: KEY

6	**2 feet 2 inches**	**Left**	**2 feet 10 inches**	**Spin**
7	**1 foot 4 inches**	**Toward me**	**2 feet 6 inches**	**Right**
8	**2 feet**	**Away from me**	**11 inches**	**Toward me**
9	**3 inches**	**Right**	**1 foot 3 inches**	**Away from me**
10	**1 foot 6 inches**	**Away from me**	**2 feet 8 inches**	**Left**

Why do the balls behave differently? Use your data tables to give examples.

Answers may vary based on student results.

Example: The balls are made of different materials. Because they are made of different materials, they have different properties.

Where does the ball bounce the most? Explain why?

Answers may vary based on student data collection.

Example: Based on the data above, the ball bounces on the quadrant of the ball depending on how it's dropped, when dropped straight down it hit on the bottom but the location of the bounce did not influence the direction of the bounce.

Name: KEY

4.1 Advancements In Shoe Technology

GRADES 3-5

Results may vary among students.

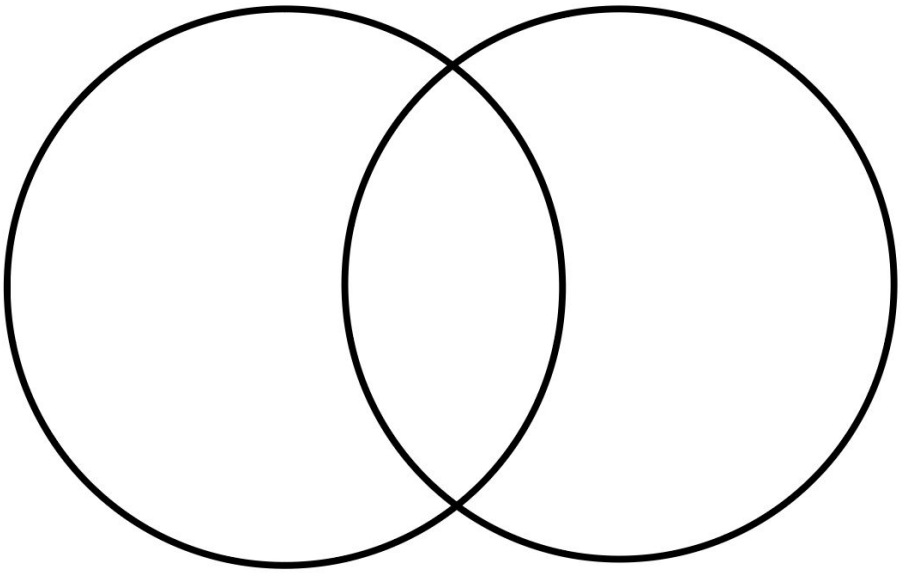
Diagram your shoe	Measurements of your shoe	Observations (texture, shape, color, etc)

What is the difference between an Inference and an Observation?

Observation is carefully watching or examining a person or object.

Inference is drawing logical conclusions from known facts or circumstances.

Example: Detailed “observations” of your shoes can provide good scientific data to make “inferences”.



Name: KEY

4.1 Advancements In Shoe Technology

GRADES 3-5

Results may vary among students.

Shoe	Observations with numbers	Observations with words	Inference about why there was a design change
	1 material	Thin sole Flat Made of leather	Needed more comfort
	12 eyelets 2 or more materials	Made of cotton/fabric Flat	Needed more sole support
	Multiple (3+) materials	Shaped foot bed (rise in the toe) Thicker material	Needed more ankle support
	Multiple (3+) materials	Thicker material Thicker heel support Lower ankle support	Need better jumping/landing absorption
	Multiple (3+) materials 9 eyelets	Made of synthetics Thinner material Taller ankle support Flexible foot bed	Lighter and better material

Name: KEY

5.1 Adaptive Technology

GRADES 3-5

Create a device that will help adaptive players retrieve the ball after a play.

Brainstorm ways to help adaptive players.

Results may vary among students.

Name: KEY

5.1 Adaptive Technology

GRADES 3-5

Select a Design (draw in detail, label materials and provide measurements)

Results may vary among students.

Name: KEY

6.1 Calculating Calories and Heart Rate

GRADES 3-5

Answers may vary based on student results. Example data below.

Beats per minute (bpm)	Partner 1	Partner 2
Resting Heart Rate	**91 beats per minute**	**86 beats per minute**
Maximum Heart Rate	**210 beats per minute**	**209 beats per minute**
Heart Rate after 5 minute game (manual measurement)	**110 beats per minute**	**104 beats per minute**

CALCULATING CALORIES:

Step 1: Convert your weight in pounds to kilograms by dividing by 2. Round to the nearest whole number, if needed.

Step 2: Multiply the MET value by your weight in kilograms. Use the MET value of 8.5.

Step 3: Multiply the product by the time you performed the activity in hours to get the number of calories you burned. *(May need to use a fraction if under 1 hour).*

Equation: (Weight/2) x 8.5 x number of hours.

MEASURING CALORIES

Results may vary among students. Example data below.

	Partner 1	Partner 2
Heart rate after first half- 5 minutes of playing (from heart rate monitor)	**112 beats per minute**	**108 beats per minute**
Heart rate after 10 minutes of playing (from heart rate monitor)	**106 beats per minute**	**102 beats per minute**

Name: KEY

Heart rate after 10 minutes of sitting (from heart rate monitor)	**93 beats per minute**	**89 beats per minute**

Answers may vary based on student results. Example data based on a *70 pound student.*

	10 minutes (1/6 of an hour)	30 minutes (½ hour)	60 minutes (1 hour)	90 minutes (1 and ½ hours)
Calories burned using MET 8.5 (Soccer)	**50 calories**	**149 calories**	**298 calories**	**447 calories**
Calories burned using MET 1.5 (Sitting)	**9 calories**	**26 calories**	**53 calories**	**79 calories**

Explain how your heart rate and calories burned changes when you are playing compared to sitting.

The disparity of calories burned through sitting vs. playing among students may vary. To ensure accurate results, review the "Explain" section and apply steps 1, 2 and 3.

Example response: I was burning more calories when my heart rate was higher. When I was sitting, I was burning less calories and my heart rate was lower.

Name: KEY

7.1 The Evolution of the Football Helmet

GRADES 3-5

No Helmet	HELMET 1 
HELMET 2 	HELMET 3 
HELMET 4 	HELMET 5 
HELMET 6 	HELMET 7 

Name: KEY

Interpretations and results may vary among students. Examples below.

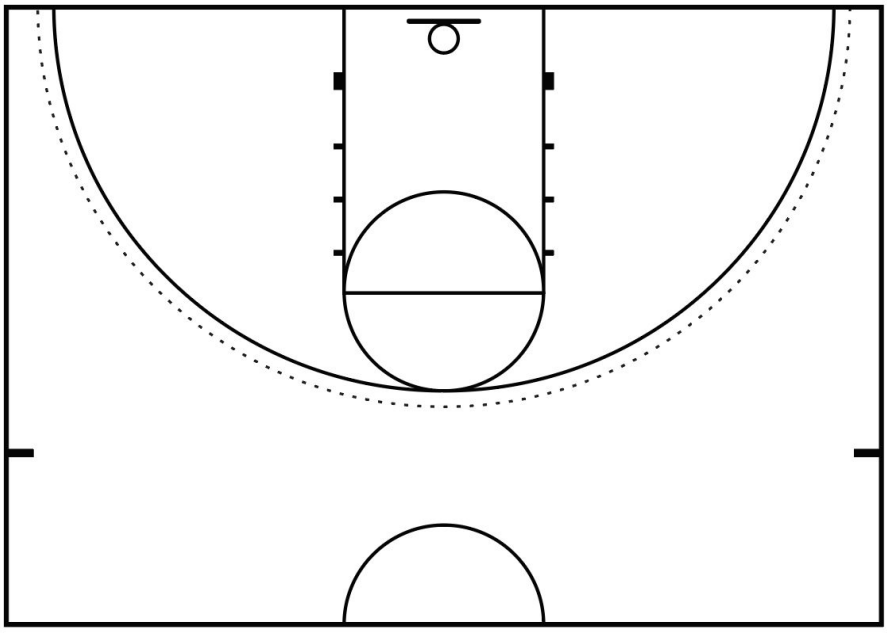
Helmet	Observations	Rating
NO HELMET	No protection playing without a helmet	0
H1	Leather, thin, worn out, two materials (inside and outside).	1
H2	Thicker than helmet number 1, leather, smooth, wool or fabric lining, more shape.	2
H3	Hardened leather, shaped, black, chin strap.	4
H4	Looks like soft plastic; includes chin strap, smooth ear holes, leather inside material.	5
H5	Made of hard plastic, little to no padding, smooth and no chin strap.	3
H6	Face guard, hard plastic with some inside padding.	6
H7	Full face guard, hard plastic, thick with foam padding on the inside.	7

Name: KEY

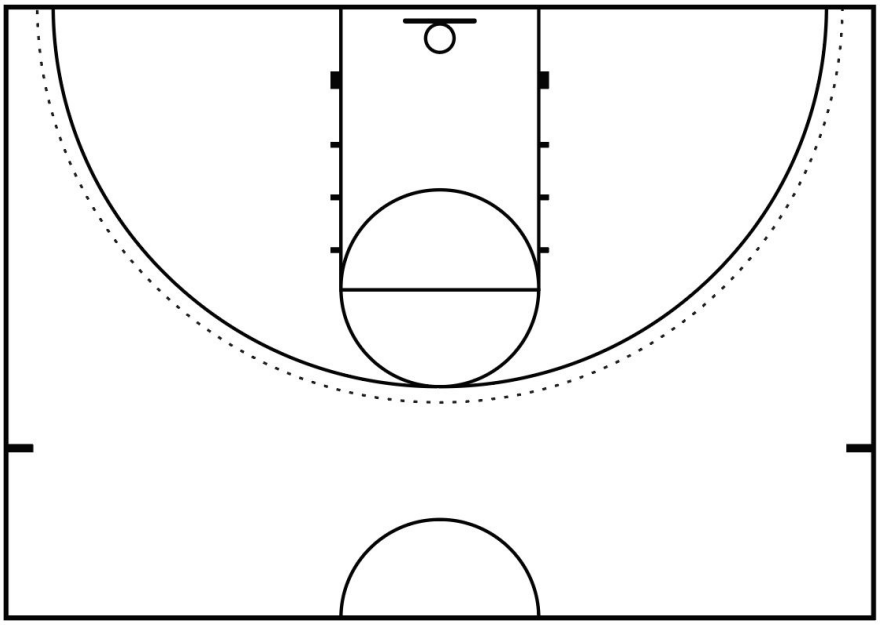
8.2 Shot Tracking

GRADES 3-5

O - Shots Made



X - Shots Missed



Name: KEY

8.2 Shot Tracking

GRADES 3-5

Example data below.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	TOTAL Made
Free Throws	O	O	X	X	X	X	O	X	O	O	O	X	X	O	O	7
Lay-Ups	X	X	X	X	X	X	O	X	X	X	X	O	O	X	X	12

Write a mathematical expression that states if your free throw accuracy is greater than or less than your layup accuracy. Justify it with evidence.

-> Free Throws: 7 / 15

-> Lay-Ups: 12 / 15

Free Throws < Lay-ups: The free-throw fraction 7/15 compared to 12/15 lay-ups made and is “less than” your free-throw accuracy.