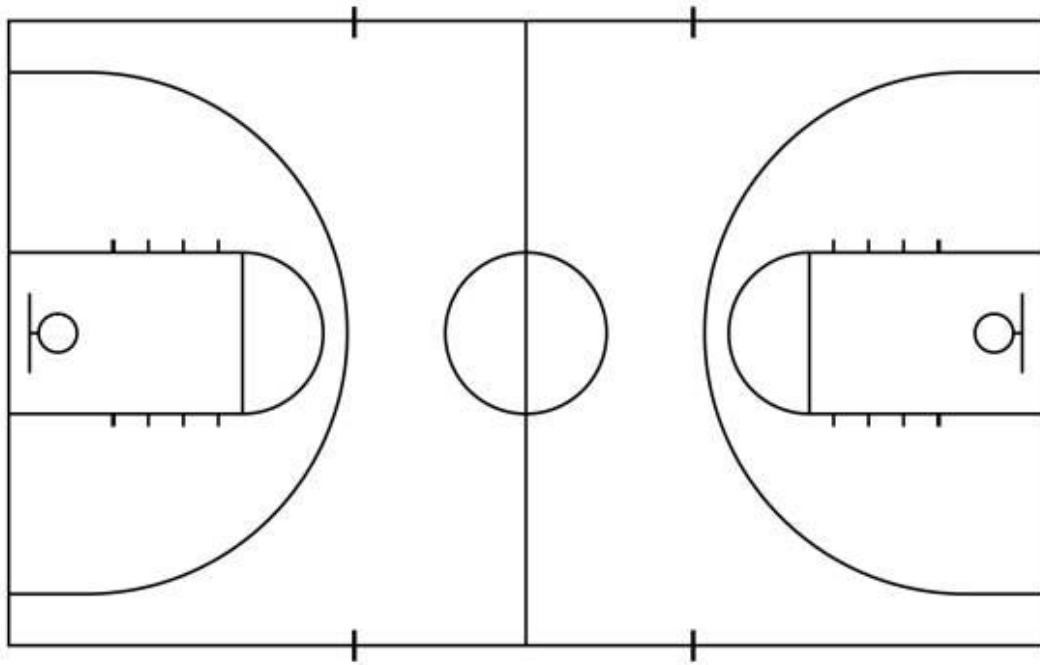Name: Key   Class: _____

Module 1.1: BASKETBALL MEASUREMENTS

Label the following diagram with the actual lengths of your basketball court.

Example data based on NBA court sizes; actual measurements may vary.

Measurement	Actual	Scale Size
Endline to Endline	94 ft	10 inches
Half court line	50 ft	5.3 inches
Area of court E to E x Half Court line	4700 sq ft	
End line to backboard	63 in	0.6 inches
Backboard to foul line	13 feet 8 inches	1.5 inches
Three point to backboard	20 feet 9 inches	2.2 inches
Height of rim from court	9 ft 6 inches	1 inch

Do the sizes of the courts change proportionally?
No, the basketball courts do not get proportionally smaller.
- NBA Professional and College: 94 feet long and 50 feet wide
- High School: 84 feet long and 50 feet wide
- Junior High: 74 feet long and 42 feet wide

Module 2.1: SCIENCE OF BASKETBALL

Part 1: Example data below.

# of bounces	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Average
48 inches	8	8	11	7	10	8.8
24 inches	4	3	5	3	4	3.8

Part 2: Example data below.

# of bounces	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Average
48 inches dropped	12	9	10	11	8	10
48 inches Dribbled	11	12	10	8	11	10.4
24 inches Dropped	4	5	6	4	5	4.8
24 inches Dribbled	6	8	6	5	6	6.2

How does dropping the ball and dribbling the ball change how Newton's Third Law is demonstrated?
Answers will vary.
Example: By dribbling the ball, the player adds force with each bounce, plus gravity is acting on the ball. By dropping the ball, only gravity is acting on the ball -- less force on the dropped ball equals less reaction.

Make a hypothesis on how bouncing the ball on a harder surface would change the forces acting on the ball.
Answers will vary.

Name: Key   Class: _____

Module 3.1: UNDERSTANDING BASKETBALL

Part 1: Example data below.

Bounce Height	Trial 1	Trial 2	Trial 3
Indoor basketball: Cool Environment	4 feet	3 feet 6 inches	4 feet 2 inches
Indoor basketball: Warm Environment	5 feet 3 inches	4 feet 11 inches	6 feet
Outdoor basketball: Cool Environment	4 feet 10 inch	3 feet 9 inches	3 feet 1 inch
Outdoor basketball: Warm Environment	5 feet 3 inches	3 feet 11 inches	3 feet 4 inches

1. How does temperature affect the bounce height? Write a claim that supports why it may happen?
   Answers will vary based on data.
   Example: As the temperature increases so does the bounce height.

2. Did you notice a larger or smaller difference in bounce height based on the ball type? Why would the ball type influence bounce height?
   Answers will vary.
   Example: The outdoor basketball had less of a range in bounce height because the ball is designed to function at many different outdoor temperatures.

Part 2: Record detailed observations about the ball materials. Include both qualitative and quantitative observations. Answers will vary: *Look for both measurements and descriptions.*
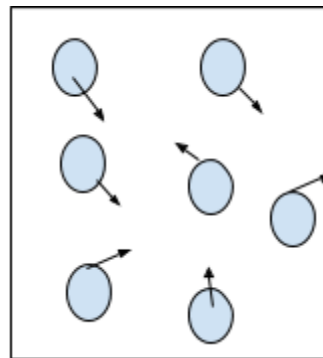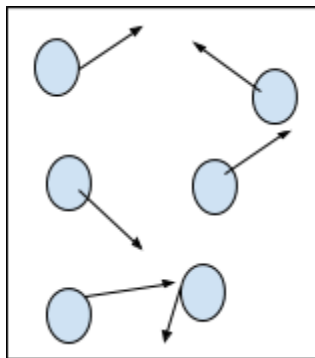
Ball type	Observations (cut sample)	Observations after heating (cut sample)	Observations after heating (basketball)
Indoor			
Outdoor			

	Observations (cut sample)	Observations after cooling (cut sample)	Observations after cooling (basketball)
Indoor			
Outdoor			

3. Draw a diagram at a molecular level of what would happen to the ball if they played on a winter day outside. Drawings will vary.
   Look for atoms/molecules closer together, out and slower moving.

4. Based on your data from part one and your observations from part two: Predict which ball (indoor v. outdoor) will have the greatest change in behavior based on the difference in material. Support your answer with evidence.
   Answers will vary based on data and content knowledge.
   Example: The indoor basketball will have the greatest change in behavior due to the thickness and material make up. The indoor basketball is half the thickness of the outdoor basketball, so differences in air pressure due to temperature in the indoor basketball will have a greater impact.

Name: Key   Class: _____

Module 4.1: VELOCITY AND ACCELERATION

Force Diagram Drawings will vary.

Chest Pass	Bounce Pass	Overhead Pass

Data Collection Example data below.

	Distance (meters)	Time (seconds)
Chest pass	5 meters	3 s
Bounce Pass	9 meters	5 s
Overhead Pass	11 meters	4.5 s

Calculations Example data below.

	Initial Speed	Final Speed (distance divided by time)	Acceleration (initial- final divided by time)	Mass of ball	Force Acting on ball (N) (Mass times Acceleration)
Chest pass	0 m/s	1.6 m/s	0.5 m/s^2	0.625 kg	0.3 N
Bounce Pass	0 m/s	1.8 m/s	0.36 m/s^2	0.625 kg	0.2 N
Overhead Pass	0 m/s	2.4 m/s	0.53 m/s^2	0.625 kg	0.3 N

Calculate the force acting on the ball when the NBA's Steph Curry shoots a free throw at the acceleration of 8.3 m/s2 (mass of the ball: 0.625 kg).
5.2 N

Module 5.1: ENGINEERING DESIGN CHALLENGE

Test your initial design: Answers will vary.

	Test 1	Test 2	Test 3	Average
Distance				
Time				
Acceleration				
Force (N) (Mass of a marshmallow is 0.007g)				

Brainstorm ways to increase the force in the design: Answers will vary.

Select a single design (draw in detail, label materials and provide measurements): Designs will vary among students.

Name: Key   Class: _____

Retest the new design: Answers will vary based on design.

	Test 1	Test 2	Test 3	Average
Distance				
Time				
Acceleration				
Force (N) (Mass of a marshmallow is 0.007g)				

Communicate (Did it work? What evidence supports that you improved the design? Would you make any changes?) Answers will vary based on design and data.

Module 6.1: CALCULATING CALORIES

Kids burn an average of 200 calories per hour of play. How many 8 oz Coconut Waters would you need to drink to replace the calories you burned? *Please note: Label is 8 fl oz*
(8 oz = 50 cals) 4
32 oz = 200 calories or **4 containers of coconut water**

Nutrition Facts

Real Coconut Water - From Taste Nirvana

| 8 | fl oz (224.8g) |

Servings Per Container 3

Amount Per Serving

Calories 50	Calories from Fat 0

	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 50mg	2%
Total Carbohydrates 13g	4%
Dietary Fiber 0g	0%
Sugars 10g	
Protein 0g	

Vitamin C	6%
Calcium	4%
Iron	2%

* Percent Daily Values are based on a 2000 calorie diet.
Your Daily Values may be higher or lower depending on your calorie needs.

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 7.0.
- Step 3: Multiply the product by the time you performed the activity in hours to get the number of calories you burned.
- Equation: (Weight/2) x 7 x number of hours.

Example: Lebron James: 250 ÷ 2 x 7 x .5 hours = 437.5 Calories Burned

1. How many calories did you burn for 15 minutes (¼ or 0.25)?
   Apply the above formula to ensure accuracy.
   Based on a student who weighs 80 pounds.
   80 ÷ 2 x 7 x 0.25 = 70 calories

Name: Key   Class: _____

1. Using the equation, how many calories will you burn if you play for 30 minutes? 1 hour?
   Answers may vary based on the student's weight.
   Based on a student who weighs 80 pounds.
   30 minutes: 80 ÷ *2 x 7 x 0.5 = 140 calories*
   1 hour: 80 ÷ *2 x 7 x 1 = 280 calories*

2. Bonus: How long would it take you to burn 450 calories?
   Answers may vary based on the student's weight.
   Based on a student who weighs 80 pounds.
   80 ÷ *2 x 7 x ? = 450 calories (or guess and check* 1.6 hours)

Module 7.2: SHOT TRACKING WITH TECHNOLOGY

Probabilities of Success Example data below.

	Self	Partner 1	Partner 2	Partner 3
FT	0.7	0.6	0.85	0.4
2PT	0.65	0.7	0.7	0.4
3PT	0.1	0.3	0.25	0.1

Calculate your frequency of success for the following:

If you attempted **27** - 3PT shots: 2.7 shots

If you attempted **93** - 2PT shots: 60.5 shots

If you attempted **21** - FT shots: 14.7 shots

Based on the graph you constructed with your class data and your frequency and probability above, make a claim that expresses who would be the highest paid player on your class' team. Support your claim with evidence and reasoning.

Answers will vary based on student data.

Example is based on data table only: Partner 1 would likely be the highest paid player. They have the highest probability of shot success for both 2PT and 3PT shots, which are the most common points earned throughout a game. Although, she has a slightly lower probability for free throw shots. These points would be made by her increased success rate in 3-pointers.

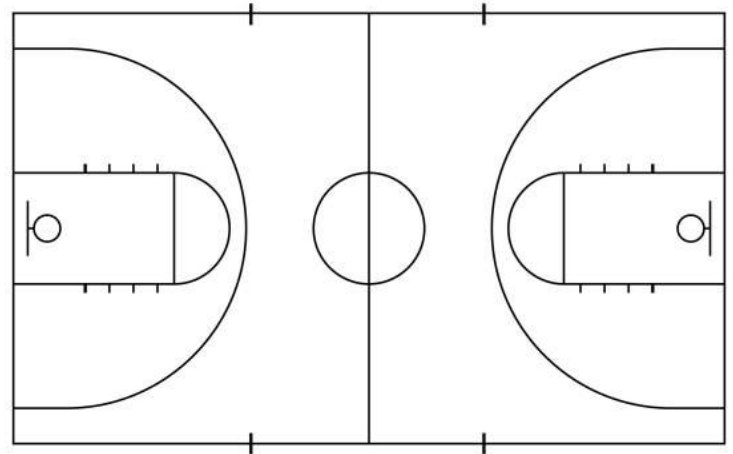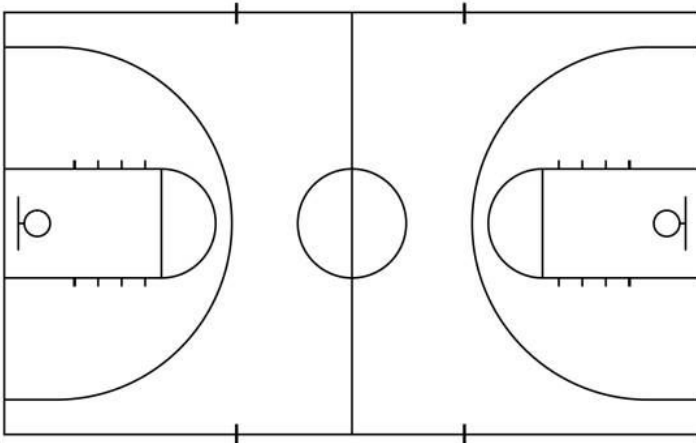## Module 7.2: SHOT TRACKING (*Non-technology Option*)

O - Shot Made   X- Shot missed

Answers will vary based on location and success.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	TOTAL Made
Free Throws		x	x		x	x	x	x	x	x	x			x		0.66
Lay-Ups	x	x	x	x				x			x	x		x		0.53

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

Answers will vary based on data.

Example: Lay up < free throw

Because I only made 8/15 lay-up shots or 53% and for free throws I made 10/15 or 66%.

Name: **Key**   Class: _____

Module 8.1: ADVANCEMENTS IN SHOE TECHNOLOGY

Observations will vary: Example observations below.

Shoe	Observations: Quantitative	Observations: Qualitative	Inference about why there was a design change
	1 material	Thin sole Flat Made of leather	
	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

1. What would you consider the single greatest advancement in basketball shoe technology in the last 100 years? Why? Explain.

Answers will vary.
Example: Synthetic material technology: When basketball shoes were first created they used natural fibers and materials like cotton and leather. Now they are made of synthetic materials that are light and provide support.

2. Hypothesize why basketball shoes have changed more in the last 40 years (1972 – present) than they did the previous 60+ years (1910 to 1972)?
    Answers will vary.
    Example: In the past 40 years, basketball became part of the mainstream culture, brands started to advertise and compete for the market, driving product development.

3. Do you think high-top shoes reduce ankle injuries compared to low-top shoes? Why? Explain.
    Answers will vary.
    Example: The high top shoe provides support around the ankle to keep it stable/keep a player from rolling or twisting his/her ankle when the body moves quickly.

4. Converse Chuck Taylor sneakers lasted many athletes an entire season, if not more. Now most players change their shoes every week, if not every day. Explain.
    Answers will vary.
    Example: The synthetic material can compact due to use and then lose some of its cushioning or traction effect. In addition, shoes are made differently now then in the past.

Brainstorm three designs that improve shoe technology to increase performance and decrease injury: Answers will vary.

Select your best design: Use your observations and inferences from the shoe advancement data table to justify why your design will increase performance and decrease injury.

Answers will vary.