1.0 The Lacrosse Stick

GRADES 6th-8th

1. What were some constraints of the first lacrosse stick? Why do you think participants felt they needed to make a change?

The first lacrosse stick was not durable, flimsy, unstable, and difficult to maneuver during play.

Thoughts will vary.

2. How has the structure of the lacrosse shaft and head changed over time? What drove this change?

The first head was wooden and looked like a large fishing net , the shaft was a long piece of wood. Sticks today are a two-part lacrosse stick with separation and/or interconnection of the shaft and head. The head is made of plastic, with a smaller net design easier to maneuver.

It was important for these changes to occur to produce equipment that is durable and long-lasting, that supports players and their ability to improve.

3. How have the materials of the lacrosse shaft and head changed over time? How do you think the use of natural materials versus synthetic materials impacted play?

The original materials were natural resources were used such as wood from trees, and animal byproducts such as leather and fur.Today's stick is made from synthetic materials such as metal for the shaft, and plastic for the head.

The natural materials resulted in a stick that was not durable, flimsy, unstable, and difficult to maneuver during play. Whereas the synthetic materials resulted in a lightweight, functioning stick, that allows skilled players to easily maneuver and function at a high level.

4. What was the purpose of this article? Provide evidence from the text to support your claim.

Technological advancements have enhanced and expanded the game.

Evidence will vary.

5. Do you think there will be future changes to the game of lacrosse? If so, what changes do you foresee being made and why?

Answers will vary.

Using the article and classroom discussion, complete the following criteria and constraint table.

Criteria	Constraints
Answers will vary. **Examples:** **Durable** **Lightweight**	**Answers will vary.** **Examples:** **Can't be too heavy** **Still needs to be durable**

Using the rating system of 1 - 5 (1 = Best; 5 = Worst), have students rate which ball was easiest to release, catch, and control with the lacrosse stick and explain why.

Ball Type	Rate: 1 - 5	Reason for rating
Golf Ball	**Answers will vary.**	**Answers will vary.**
Ping Pong ball	**Answers will vary.**	**Answers will vary.**
Tennis Ball	**Answers will vary.**	**Answers will vary.**
Lacrosse Ball	**Answers will vary.**	**Answers will vary.**

Based on evidence from the article and your experiment, write a claim and support it with evidence and reasoning, explaining how and why the lacrosse stick controls, releases, and catches each ball type differently.

Claim: How did the evolution of the lacrosse stick - shaft and head - become a design that handles and controls each ball type effectively?

Answers will vary.

The evolved lacrosse shaft that is made of metal and the head design that is pinched, allows each type of ball to be caught and released effectively.

Evidence: Record and reference in words any data that supports your claim.

Answers will vary.

“The two-part lacrosse stick….was momentous for the prototyping and creating of lax sticks for specific positions/players”

Reasoning: Explain why your claim is supported by evidence and scientific ideas. Use the ideas in your experiment and understanding of engineering an object for a specific function.

Answers will vary.

The lacrosse stick was designed to work for all types of specific positions and players, this flexibility allows the lacrosse stick to be versatile in the way it catches and releases all types of balls.

2.0 Intricacies of a Lacrosse Field

GRADES 6th-8th

Calculate the following to determine the width of a scaled down lacrosse field.

$$\frac{1.25 \text{ inch } (\frac{1}{4})}{5 \text{ yards}} = \frac{x \text{ inches}}{60 \text{ yards}}$$

$$1.25 \bullet 60 = 5x$$
$$75 = 5x$$
$$15 \text{ inches} = x$$

$$\frac{.5 \text{ inches } (\frac{1}{2})}{5 \text{ yards}} = \frac{x \text{ inches}}{60 \text{ yards}}$$

$$0.5 \bullet 60 = 5x$$
$$30 = 5x$$
$$6 \text{ inches} = x$$

$$\frac{.125 \text{ inches } (\frac{1}{8})}{5 \text{ yards}} = \frac{x \text{ inches}}{60 \text{ yards}}$$

$$0.125 \bullet 60 = 5x$$
$$7.5 = 5x$$
$$1.5 \text{ inches} = x$$

Which of the three scales would have a reasonable end width? Why?
Answers will vary.

The first scale, it creates the largest scale drawing.

The second scale, it is the best fit width on a standard piece of paper.

Calculate the following to determine the length of a scaled down lacrosse field.

$$\frac{.25 \text{ inch } (\frac{1}{4})}{5 \text{ yards}} = \frac{x \text{ inches}}{110 \text{ yards}}$$

$$0.25 \bullet 110 = 5x$$
$$27.5 = 5x$$
$$5.5 \text{ inches} = x$$

$$\frac{.5 \text{ inches } (\frac{1}{2})}{5 \text{ yards}} = \frac{x \text{ inches}}{110 \text{ yards}}$$

$$0.5 \bullet 110 = 5x$$
$$55 = 5x$$
$$11 \text{ inches} = x$$

$$\frac{.125 \text{ inches } (\frac{1}{8})}{5 \text{ yards}} = \frac{x \text{ inches}}{110 \text{ yards}}$$

$$0.125 \bullet 110 = 5x$$
$$13.75 = 5x$$
$$2.75 \text{ inches} = x$$

Which of the three scales would have a reasonable end length? Why?
Answers will vary.

The second scale, it is the best fit length on a standard piece of paper.

Coaches have clipboards that are 8.5 x 11 inches. What scale would you use to ensure the field fits on a single sheet of paper?

The 0.5 inches for both the width and length, it would be a consistent scale that fits perfectly on a standard piece of paper.

3.0 Kinetic Energy in Lacrosse

GRADES 6th-8th

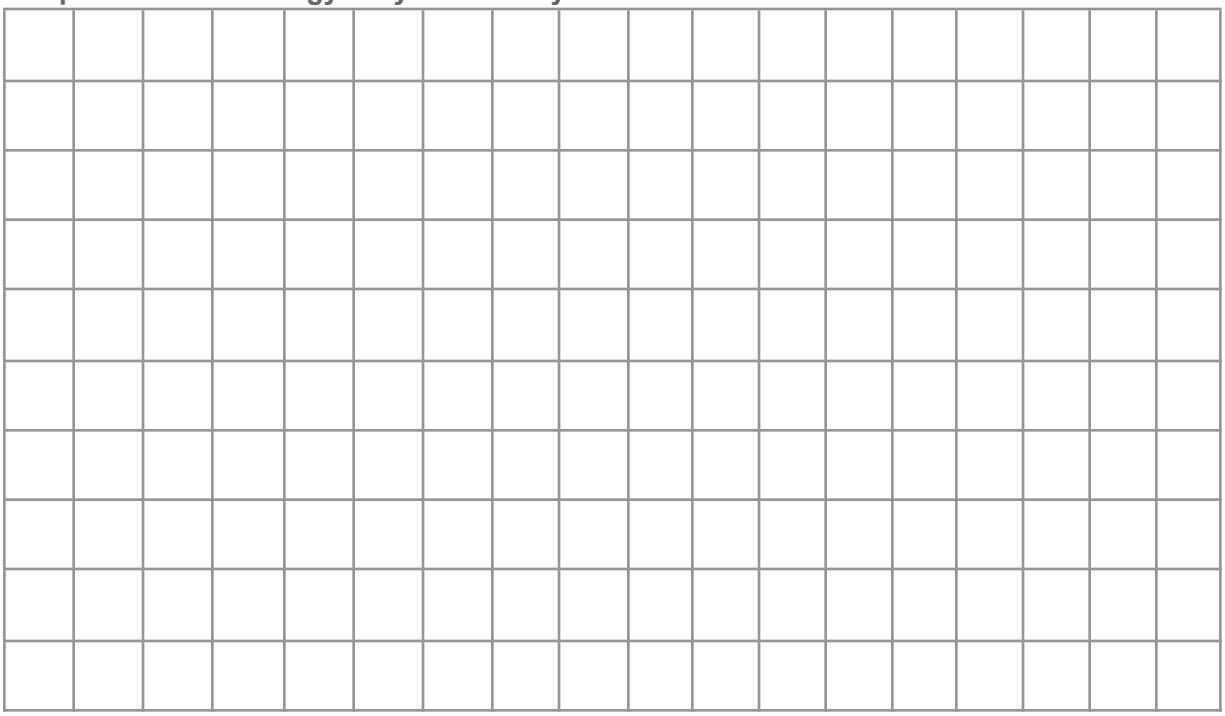
	Pass 1 = 10 meters			Pass 2 = 10 meters		
Mass of ball: 0.15 kg	Time (s)	Velocity (m/s)	Kinetic Energy (Joules)	Time (s)	Velocity (m/s)	Kinetic Energy (Joules)
Student 1	1.4	10/1.4=7.14	$0.15*7.14^2$ /2 = 3.82	1.5	10/1.5=6.67	$0.15*6.67^2$ /2 = 3.34
Student 2	2.3	10/2.3=4.35	$0.15*4.35^2$ /2 = 1.42	2.2	10/2.2=4.55	$0.15*4.55^2$ /2 = 1.55
Student 3	1.7	10/1.7=5.88	$0.15*5.88^2$ /2 = 2.59	2.1	10/2.1=4.76	$0.15*4.76^2$ /2 = 1.70
Student 4	2.5	10/2.5=4.00	$0.15*4.0^2$ /2 = 1.2	2.4	10/2.4=4.17	$0.15.4.17^2$ /2 = 1.30

	Pass 3 = 10 meters			Pass 4 = 10 meters		
Mass of ball: 0.15 kg	Time (s)	Velocity (m/s)	Kinetic Energy (Joules)	Time (s)	Velocity (m/s)	Kinetic Energy (Joules)
Student 1	See table	above for	examples	and calcu	lation	
Student 2						
Student 3						
Student 4						

1. What percent of the Kyle Hartzell shot (111 MPH) was your fastest pass/shot? Example: If you threw at 14 M/S / 50 M/S = .28 or 28%. Your fastest pass was only 28% as fast as Kyle Hartzell's shot.

Student 1 Pass 1 = 7.14 meters per second
7.14/50 = 0.1428 or 14.28% as fast as Kyle Hartzell's shot.

Graph the kinetic energy vs. your velocity for each throw from slowest to fastest.



Students should label:
X Axis/X Coordinate - Velocity (meters/second)
Y Axis/Y Coordinate - Kinetic Energy (Joules)
Title : Kinetic Energy vs. Velocity

Teachers and students should discuss the scale the x and y value should go by to maximize the amount of the graph used for best results.

Example of graphing:

Mass of ball: 0.15 kg	Time (s)	Velocity (m/s)	Kinetic Energy (Joules)	Time (s)	Velocity (m/s)	Kinetic Energy (Joules)
Student 1	1.4	10/1.4=7.14	$0.15*7.14^2$ /2 = 3.82	1.5	10/1.5=6.67	$0.15*6.67^2$ /2 = 3.34

The coordinates graphed would be close to (7, 3) and (6,3), explain to students that we can't plot the point (7.14, 3.82) exactly, so we approximate as best as we can.

2. Based on your data/graph, explain the relationship between velocity and kinetic energy by making a claim about the relationship. Support your claim with evidence and reasoning.

Claim: What is the relationship between velocity and kinetic energy?
Exponential relationship, as the velocity increases the kinetic energy increases exponentially.

Evidence: Record and reference in words any data that supports your claim.
The data should resemble the kinetic energy graph found on page 49 of your curriculum manual.

Reasoning: Explain why your claim is supported by evidence and scientific ideas. Use the kinetic energy formula to support you.
The variable v (velocity) in the formula is squared, this means for every increase in 1 m/s, the kinetic energy gets 4 times bigger.

$KE = 0.5mv^2$
$KE = 0.5(0.15)(1)^2$
$KE = 0.075$ Joules

$KE = 0.5mv^2$
$KE = 0.5(0.15)(2)^2$
$KE = 0.3$ Joules

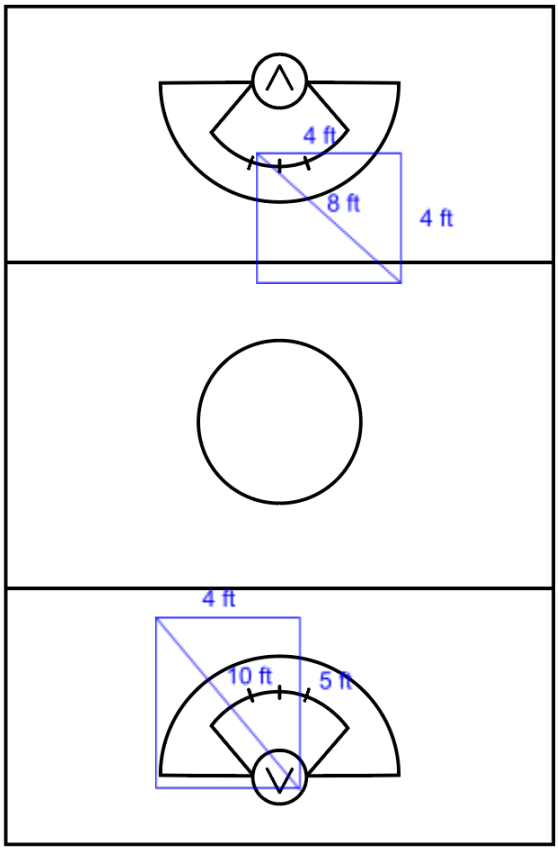
$KE = 0.5mv^2$
$KE = 0.5(0.15)(3)^2$
$KE = 0.675$ Joules

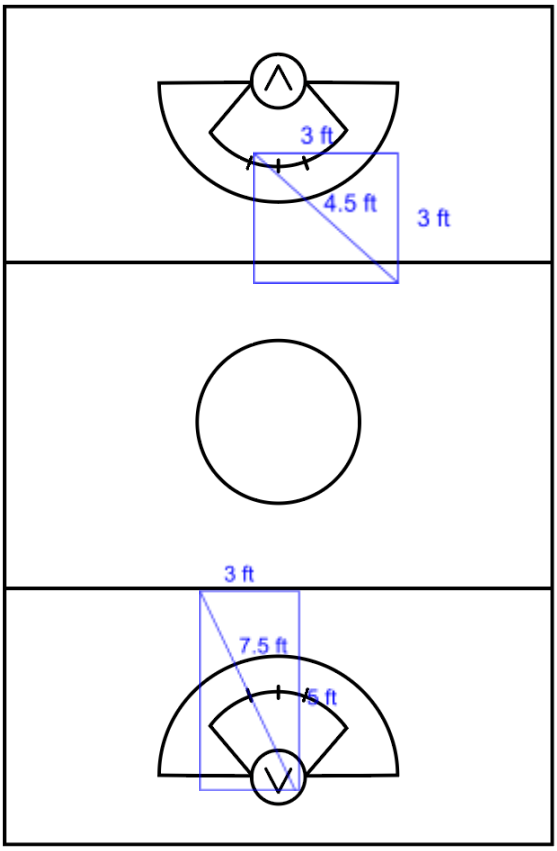
4.0 Area of Shooting Spaces

GRADES 6th-8th

Shooting Triangle	Person 1	Person 2	Person 3	Person 4
Height	4 feet	3 feet	5 feet	3 feet
Base	4 feet	3 feet	4 feet	5 feet
Area (calculated)	4x4 / 2 = 8 feet	3x3 / 2 =4.5 feet	5x4 /2 = 10 feet	3x5 /2 =7.5 feet
Number of goals made (out of 10)	6 goals	3 goals	8 goals	5 goals

Sketch each group member's shooting triangle. Label each side with the correct measurement and include the area in the center.





Claim: What is the relationship between the shooting triangle area and number of goals made?

Answers will vary.

The larger the shooting triangle, the higher number of goals made.

Evidence: Using your data, explain why your claim is supported.

Answers will vary. Students should reference the table.

The person with the largest shooting triangle, had the highest number of goals made.
The person with the smallest shooting triangle, had the least number of goals made.

Reasoning: Justify your response.

Answers will vary.

5.0 Predicting Potential Energy

GRADES 6th-8th

Point by point Diagram 1

Answers will vary.

Potential or Kinetic

_____ _____ _____ _____ _____ _____

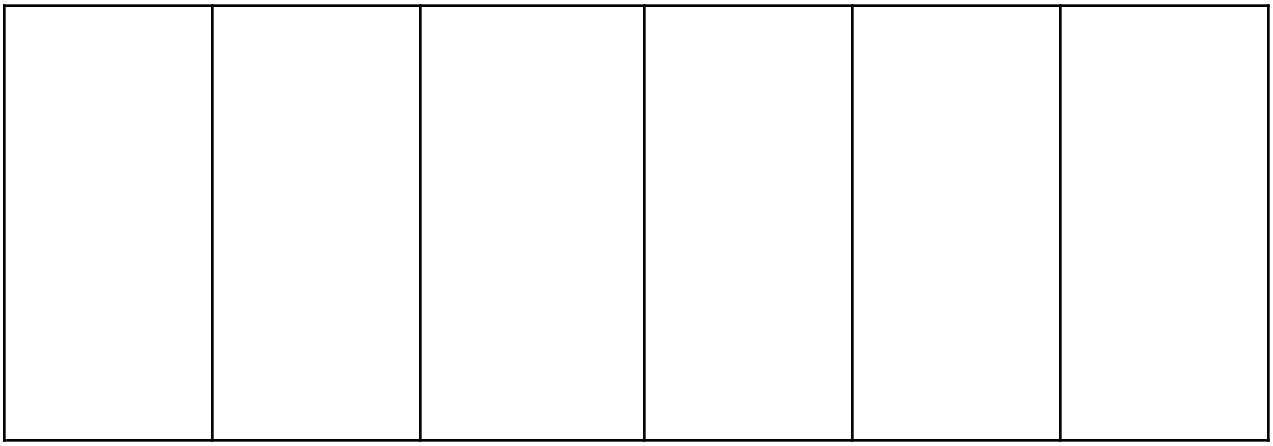
Height of the ball (potential areas only)

_____ _____ _____ _____ _____ _____

Velocity of the ball (kinetic areas only)

_____ _____ _____ _____ _____ _____

Point by point Diagram 2



Potential or Kinetic

_____ _____ _____ _____ _____ _____

Height of the ball (potential areas only)

_____ _____ _____ _____ _____ _____

Velocity of the ball (kinetic areas only)

_____ _____ _____ _____ _____ _____

6.0 Passing with Accuracy

GRADES 6th-8th

Record the number of successful passes below from a distance of 5 meters.
O = Completed Pass X = Incomplete Pass

	1	2	3	4	5	6	7	8	9	10	Probability
Trial 1	O	O	O	X	O	X	X	O	O	X	6/10
Trial 2	X	O	O	O	O	X	O	O	O	X	7/10
Trial 3	X	X	X	O	X	O	O	X	O	O	5/10

Testable Question:
Answers will vary.

How many times can I complete a pass at 20 feet?

Statistical Question:
Answers will vary.

How does my pass success rate change as the distance changes?

Variables and results may vary.

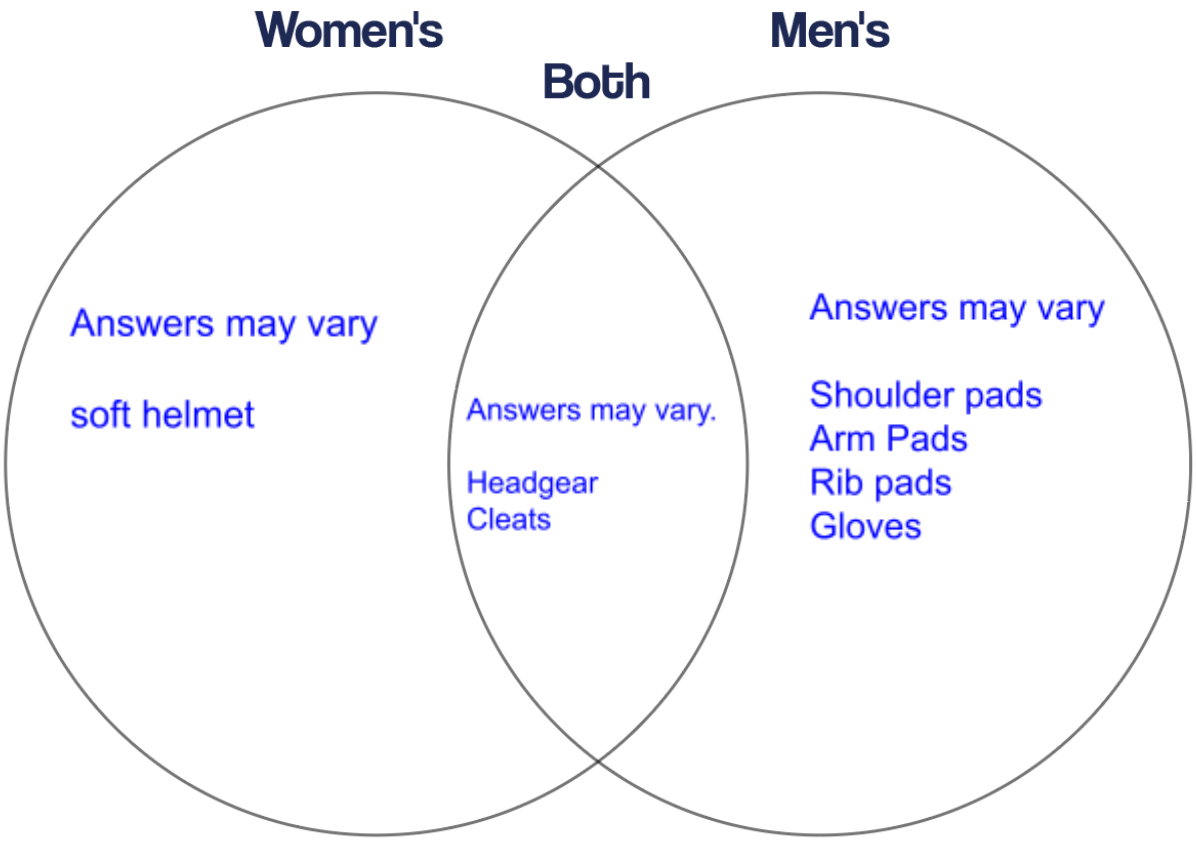
	Variable 1	Probability	Variable 2	Probability
Trial 1	Pass at 3 meters	9/10	Pass at 12 meters	4/10
Trial 2	Pass at 6 meters	7/10	Pass at 15 meters	2/10
Trial 3	Pass at 9 meters	6/10	Pass at 18 meters	1/10

7.0 Headgear

GRADES 6th-8th

I noticed...	I wonder...	I think...
Answers will vary. Women only wear goggles and a mouthpiece. Men wear a helmet and 3 types of pads.	Answers will vary. Why do men need more protective gear? Why don't girls wear gloves?	Answers will vary. Men's lacrosse must have more physical rules than women's.

Men's required helmet	Women's required 'Head' protection	Women's optional 'soft sided' Helmet
		



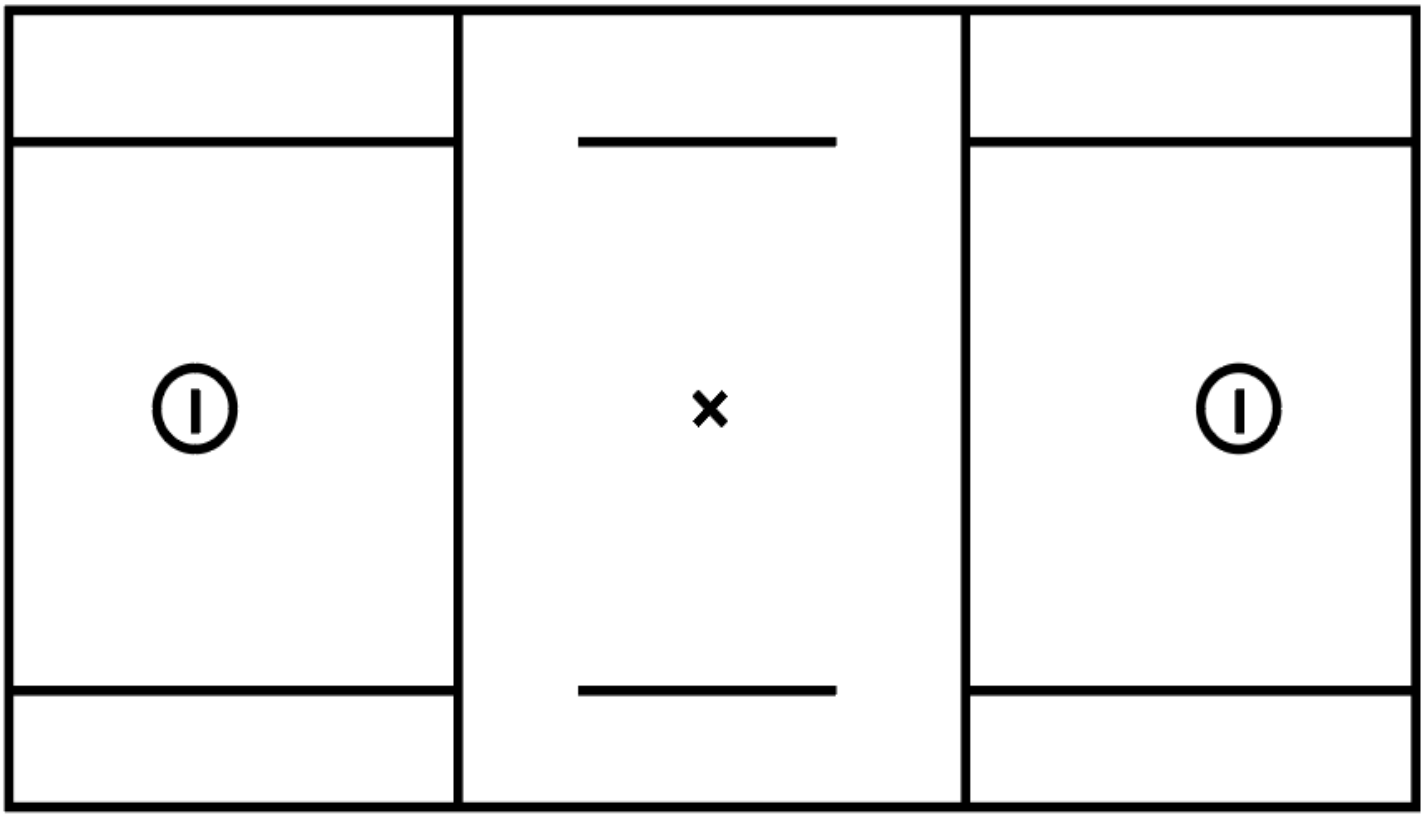
8.0 Wearable Technology

GRADES 6th-8th

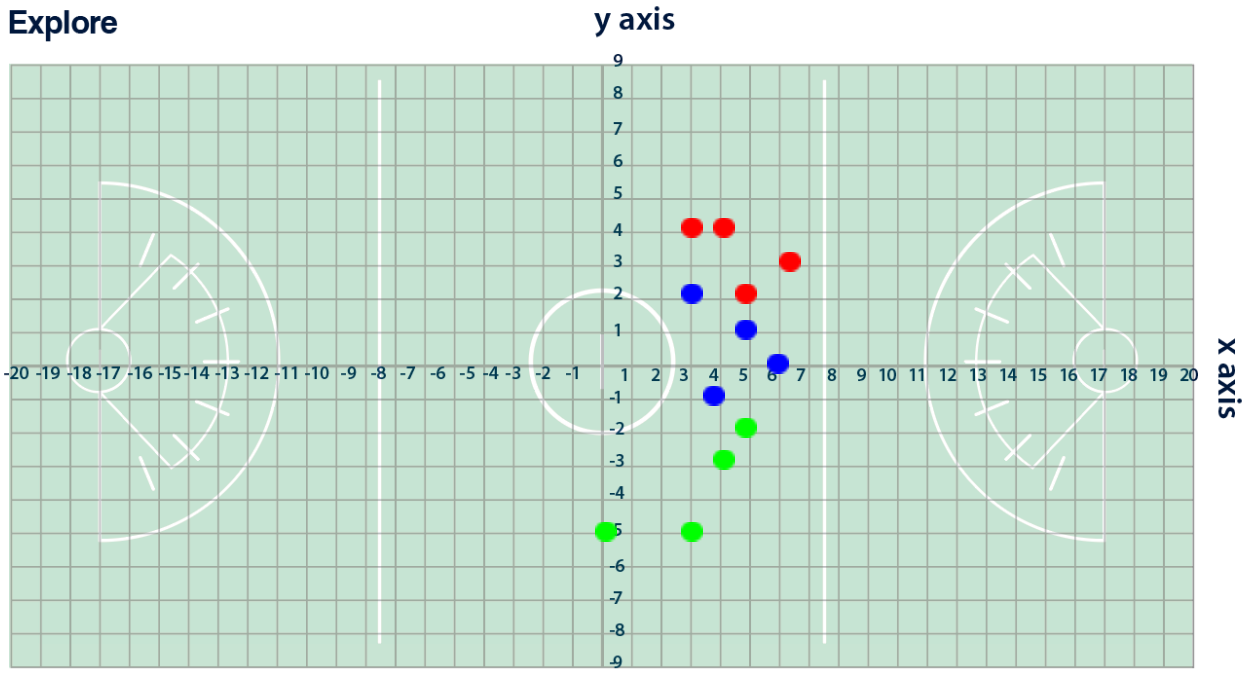
Engage

Shade the field based on your area of play.

Dark Gray: Area where you spent the most time.
Light Gray: Area where you spent the least amount of time.
White: Area where you spent no time.
Results will vary.



Explore



PLAYER 1

X	Y
3	2
4	-1
5	1 (pass to player 2)
6	0

PLAYER 2

X	Y
3	4
4	4
5	2
6.5	3 (shoots)

PLAYER 3 (Starts with Ball)

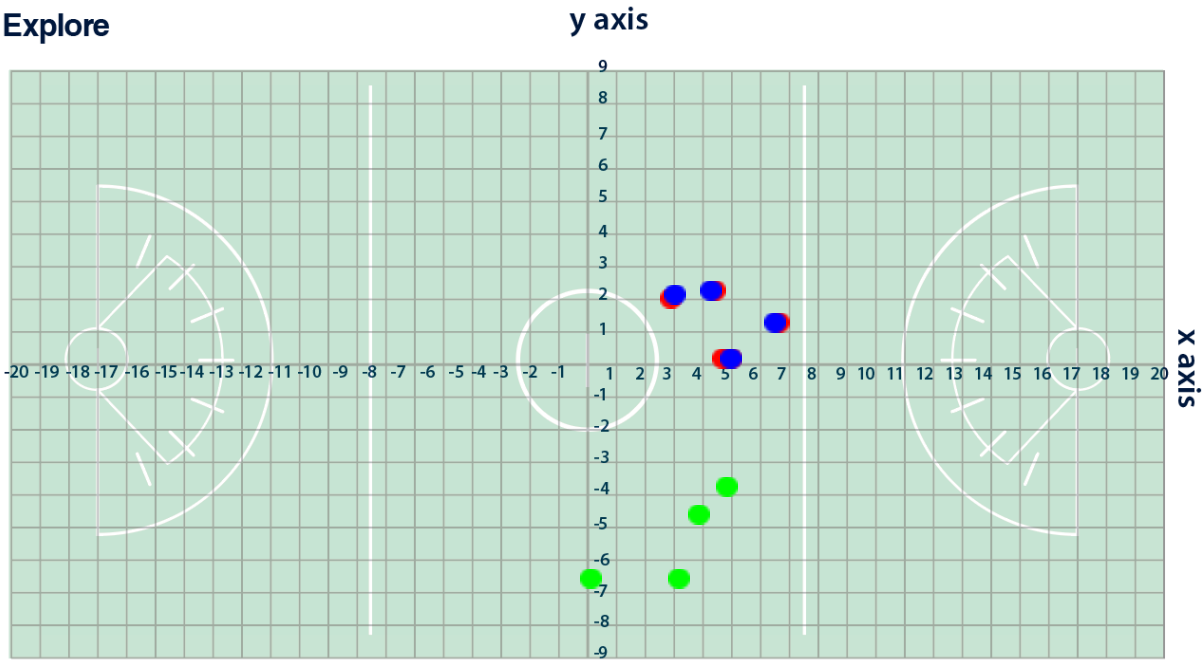
X	Y
0	-5
3	-5 (pass to player 1)
4	-3
5	-2

Player 1 - Red

Player 2 - Blue

Player 3 - Green

Explore



PLAYER 1 (Starts with Ball)

X	Y
0	-5
3	-5 (pass to player 2)
4	-3
5	-2

PLAYER 2

X	Y
3	4
4	4
5	2
6.5	3 (pass to player 3)

PLAYER 3

X	Y
3	4
4	4
5	2
6.5	3 (shoots)

Player 1 - Green **Player 2 - Blue** **Player 3 - Red**

Prediction:

Answers will vary.