1.0 The Stick & Puck

GRADES 6th-8th

1. What were some constraints of the first hockey stick and puck? Why do you think participants felt they needed to make a change?
The first pucks and sticks were not strong and stable. To enhance their ability and overall performance during play.

2. How has the structure of the hockey stick and puck changed over time? What drove this change?
The stick has become much stronger and lighter through advancements in materials used for durability and performance.
The puck has become more durable for play, as well as removing edges of what was initially a rubber ball to eliminate bounce to improve play.

3. How have the materials of the hockey stick and puck changed over time? How do you think the use of natural materials versus synthetic materials impacted play?
The stick materials have changed significantly from wood (natural) to synthetic (composite and carbon fiber) to generate maximum player performance by way of control, shot speed, and durability.
The puck's most significant advancement was from cow dung (natural) to rubber (synthetic).

4. What was the purpose of this article? Provide evidence from the text to support your claim.
To understand the game's evolution and the societal impact from advancements: materials/resources used, contributions to the game, and how the game changed to ensure safety over performance for the well-being and enjoyment of the sport.

5. Do you think there will be future changes to the game of hockey? If so, what changes do you foresee being made and why?
Possibly a few equipment changes to enhance performance yet ensure safety, as this should be the game's continued objective.

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

Examples below.

Criteria	Constraints
Examples: • Durable • Lightweight	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/puck was easiest to control and release with the hockey stick and explain why.

Ball/Puck Type	Rate: 1 - 5	Reason for rating
Golf Ball	3	A good weight to control with the stick, yet very small.
Ping Pong ball	5	Too small and light to effectively control with the hockey stick.
Tennis Ball	2	A good weight and size to control, yet too much bounce affects stick-handling.
Hockey Puck	1	The perfect weight and material for handling the puck consistently..

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

Bat/Stick Type	Rate: 1 - 5	Reason for rating
Baseball/Softball Bat	4	Difficult to control the puck without the blade.
Golf Club	2	The club's blade helped control the puck.
Tennis Racket	3	The racket was too short and not ideal for controlling and striking the puck.
Hockey Stick	1	Excellent for controlling and striking the puck with force consistently.

Based on evidence from the article, video, and your experiment, write a claim and support it with evidence and reasoning: Explain how and why the hockey stick controls and releases each ball type differently and why the hockey puck behaves differently when using a baseball/softball bat, golf club, tennis racket, and hockey stick

Claim: How did the evolution of the hockey stick and hockey puck become a design that handles and controls its intended sport effectively?
The evolution of the hockey puck and stick allows players to effectively play – control and durability – while increasing their overall performance.

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

Aluminum sticks with wood blades: consistent weight and flex; 2-piece composite stick: ultra lightweight shaft for maximum shot speed; 1-piece composite stick: maximum control and shot speed; Carbon Fiber and high strength composite: maximum control, shot speed, and durability.

Reasoning: Justify your response.

The hockey stick and puck has advanced for all types of specific positions and players, allowing flexibility for versatility during game play.

2.0 The Net

GRADES 6th-8th

Elaborate

Using the scale 1 inch = 1 foot (12 inches) calculate the dimensions of the scale model.

Width

$$\text{Model: } \frac{1\text{ in}}{12\text{ in}} = \frac{w}{72\text{ in}} \qquad 12w = 72 \qquad \text{cross multiply}$$
$$\text{Actual} \qquad w = 6\text{ in} \qquad \text{divide by 12}$$

Height

$$\text{Model: } \frac{1\text{ in}}{12\text{ in}} = \frac{h}{48\text{ in}} \qquad 12h = 48 \qquad \text{cross multiply}$$
$$\text{Actual} \qquad h = 4\text{ in} \qquad \text{divide by 12}$$

Depth

$$\text{Model: } \frac{1\text{ in}}{12\text{ in}} = \frac{d}{40\text{ in}} \qquad 12d = 40 \qquad \text{cross multiply}$$
$$\text{Actual} \qquad d = \sim 3.3\text{ in} \qquad \text{divide by 12}$$

Support Post

$$\text{Model: } \frac{1\text{ in}}{12\text{ in}} = \frac{x}{66\text{ in}} \qquad 12x = 66 \qquad \text{cross multiply}$$
$$\text{Actual} \qquad x = 5.5\text{ in} \qquad \text{divide by 12}$$

Evaluate

Before you cut your craft sticks, make a plan for how many of each dimension (width, height, depth, support post) you will need in your scale model.

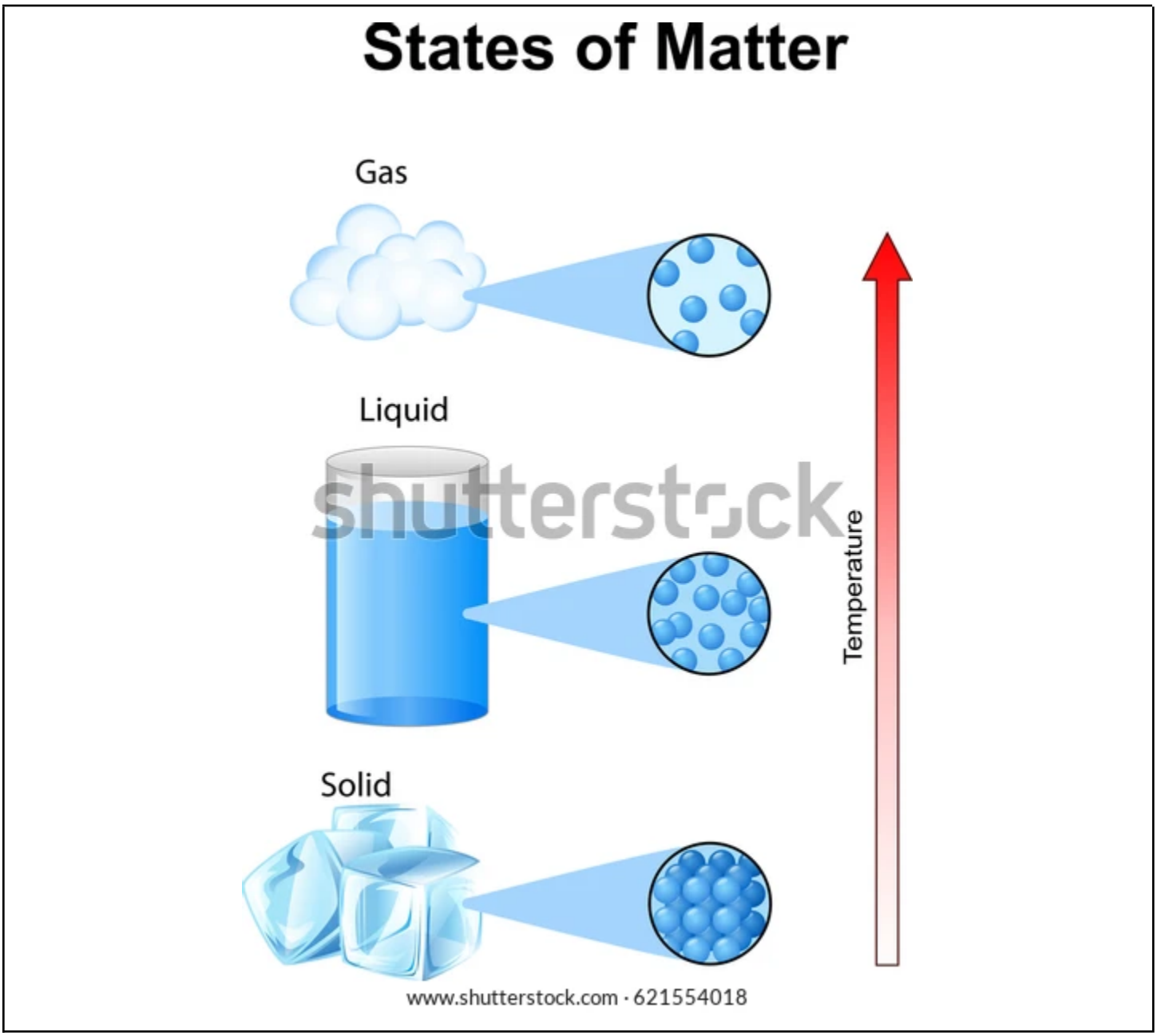
Width	Height	Depth	Support Post
1 bottom	**1 left**	**1 left**	**1 left**
1 top	**1 right**	**1 right**	**1 right**

3.0 Playing on Ice

GRADES 6th-8th

Elaborate

Create and label an outline that demonstrates the transformation from a gas to a liquid to a solid. Use lines, arrows, boxes and/or circles to concisely describe each composition's transformation from a few molecules to a defined structure.



Evaluate

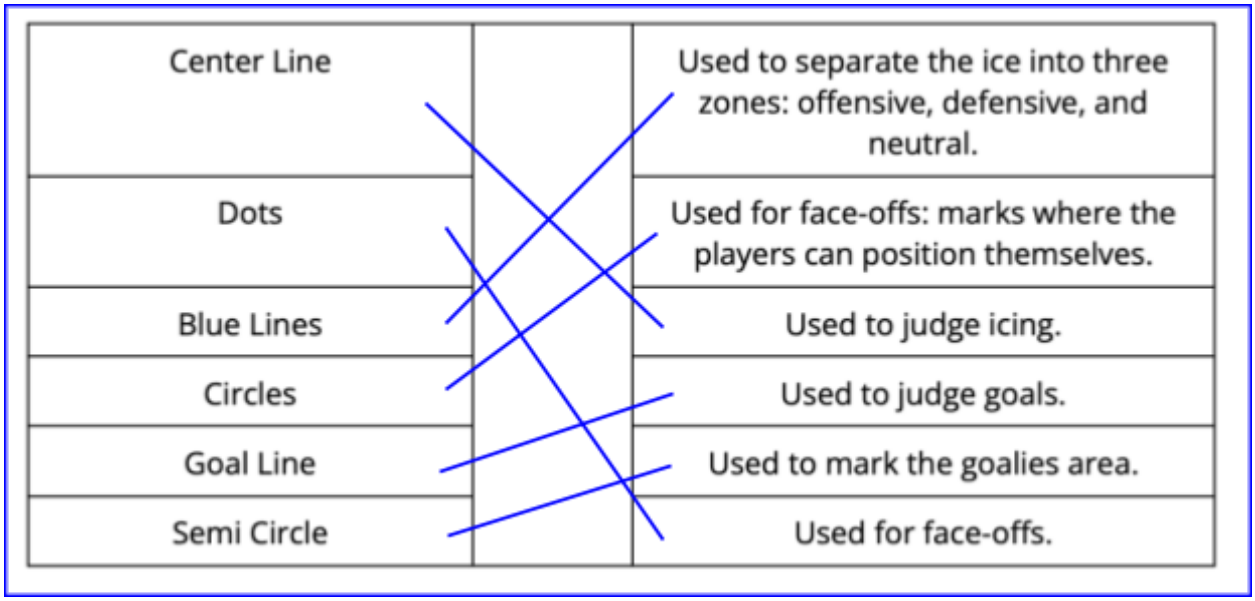
Draw a scale model of a hockey rink. Depict how the playing surface/ice is created and sustainable using information and data throughout the lesson, including molecular composition and transformation by way of heat/energy before, during, and after a hockey game.

4.0 Ice Time

GRADES 6th-8th

Explore

Draw a line connecting the ice marking to the corresponding rule.



Center Line	Used to separate the ice into three zones: offensive, defensive, and neutral.
Dots	Used for face-offs: marks where the players can position themselves.
Blue Lines	Used to judge icing.
Circles	Used to judge goals.
Goal Line	Used to mark the goalies area.
Semi Circle	Used for face-offs.

Elaborate

1. What ice marking can be found at (10, 1)?

   Face off circle

2. What ice marking can be found at (0, -5)?

   Center line

3. What two ice markings can be found at the origin (0, 0)?

   Center line and face off dot

Evaluate

Use the coordinate plane to find the distance between the ice markings by finding the absolute value.

1. Find the distance between the blue lines at (-5, 2) and (5, 2).

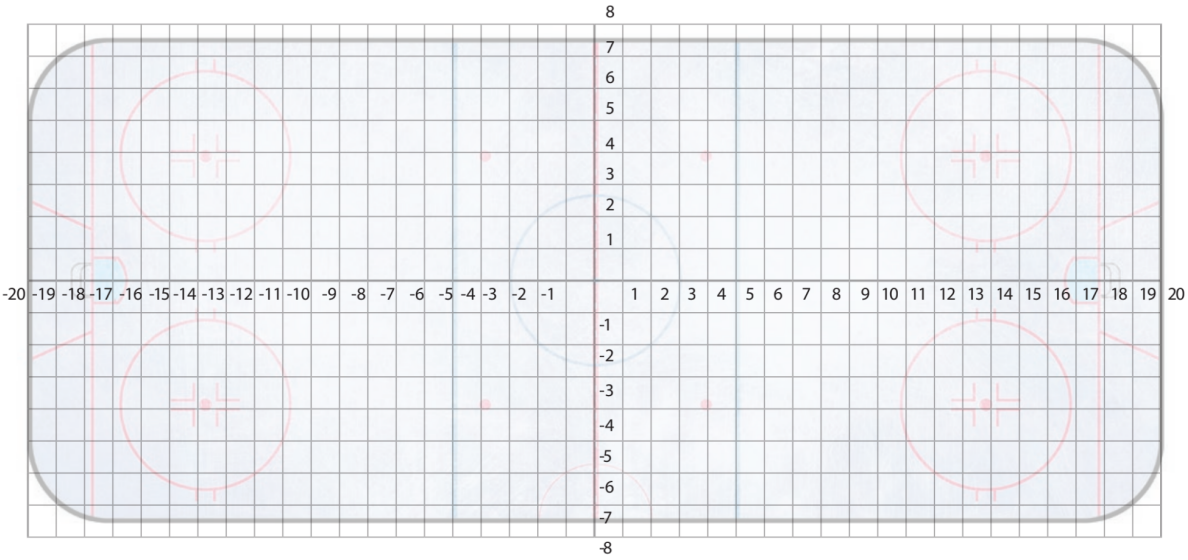
   10 units

2. Find the distance of the goal line using (-18, 7) and (-18, -7).

   14 units

3. Find the distance a player would have to skate to go from one goal line (-18, 4) to the other (18, 4).

   36 units



Use the coordinate plane to find the distance between the ice markings by using the Pythagorean Theorem.

1. Find the distance between the face-off dots at (-14, -4) and (14, -4).

   28 units

2. Find the distance a player would have to skate from the goal line at (-18, -3) to the center line at (0, 5) to avoid an icing penalty.

   $a^2 + b^2 = c^2$ or (change in x)^2 + (change in y)^2 = (distance between)^2

   $(-18 - 0)^2 + (-3 - 5)^2 = c^2$

   $(-18)^2 + (-8)^2 = c^2$

   $324 + 64 = c^2$

   $388 = c^2$

   $\sqrt{388} = \sqrt{c^2}$

   $19.70 = c$

3. Find the distance a player would have to shoot the puck for it to go from the face-off dot at (14, 4) and the goal at (18, 0).

   $a^2 + b^2 = c^2$ or (change in x)^2 + (change in y)^2 = (distance between)^2

   $(14 - 18)^2 + (4 - 0)^2 = c^2$

   $(-4)^2 + (4)^2 = c^2$

   $16 + 16 = c^2$

   $32 = c^2$

   $\sqrt{32} = \sqrt{c^2}$

   $5.66 = c$

5.0 Puck Precision

GRADES 6th-8th

Elaborate

Take five forehand shots from each of the 3 shooting spots, record your makes and misses below.

Distance of Shot = 10 ft	Shot 1	Shot 2	Shot 3	Shot 4	Shot 5
Left Side	Make	Miss	Make	Make	Miss
Center	Miss	Make	Make	Make	Make
Right Side	Miss	Make	Miss	Miss	Make

Calculate your shooting percentage for each shooting spot.

1. Left Side (Total Made/Total Shots Taken) x 100

   (3/5) x 100 = 60%

2. Center

   (4/5) x 100 = 80%

3. Right Side

   (2/5) x 100 = 40%

Evaluate

Take five forehand shots from each of the 3 shooting spots, record your makes and misses below.

Distance of Shot = 15 ft	Shot 1	Shot 2	Shot 3	Shot 4	Shot 5
Left Side	Miss	Miss	Make	Miss	Miss
Center	Make	Make	Make	Make	Make
Right Side	Miss	Miss	Miss	Miss	Miss

Calculate your shooting percentage for each shooting spot.

1. Left Side (Total Made/Total Shots Taken) x 100

   (1/5) x 100 = 20%

2. Center

   (5/5) x 100 = 100%

3. Right Side

   (0/5) x 100 = 0%

4. How do your shooting percentages compare from 10 feet away to 15 feet away?

   Left Side - Shooting percentage decreased from 10 feet to 15 feet. 60% > 20%

   Center - Shooting percentage increased from 10 feet to 15 feet. 80% < 100%

   Right Side - Shooting percentage decreased from 10 feet to 15 feet. 40% > 0%

Extend

Take five slap shots from each of the 3 shooting spots, record your makes and misses below.

Distance of Shot = 10 ft	Shot 1	Shot 2	Shot 3	Shot 4	Shot 5
Left Side	Miss	Miss	Make	Make	Make
Center	Make	Make	Make	Make	Make
Right Side	Make	Make	Miss	Miss	Make

Calculate your shooting percentage for each shooting spot.

1. Left Side (Total Made/Total Shots Taken) x 100

   (3/5) x 100 = 60%

2. Center

   (5/5) x 100 = 100%

3. Right Side

   (3/5) x 100 = 60%

Take five slap shots from each of the 3 shooting spots, record your makes and misses below.

Distance of Shot = 15 ft	Shot 1	Shot 2	Shot 3	Shot 4	Shot 5
Left Side	Miss	Make	Make	Make	Make
Center	Miss	Make	Make	Make	Make
Right Side	Miss	Make	Make	Miss	Make

Calculate your shooting percentage for each shooting spot.

1. Left Side (Total Made/Total Shots Taken) x 100

   (4/5) x 100 = 80%

2. Center

   (4/5) x 100 = 80%

3. Right Side

   (3/5) x 100 = 60%

4. How do your shooting percentages compare from forehand shot to slap shot?

   Students can compare at each spot, at each distance, and/or overall percentages.

   Each Spot Left Side Forehand : 4/10 Left Side Slap Shot : 7/10

   Center Forehand : 9/10 Center Slap Shot :9/10

   Right Side Forehand : 2/10 Right Side Slap Shot : 6/10

   Distance 10 feet Forehand: 9/15 10 feet Slap Shot: 11/15

   15 feet Forehand: 6/15 15 feet Slap Shot: 11/15

   Overall Forehand 15/30 Slap Shot 22/30

6.0 Shooting Forces in Hockey

GRADES 6th-8th

Elaborate

What variables do you need to control?

Pass and Shot Type	Speed (measured by radar) m/s	Time of travel (From video) s	Acceleration (Calculated (SI-SF)/time) m/s^2	Mass kg	Force F=MA N (newtons)
Forehand Pass	**45 mph**	**1.6 s**	**28.13 m/s2**	**.65**	**18.3 N**
Forehand Shot	**53 mph**	**1.4 s**	**37.86 m/s2**	**.65**	**24.6 N**
Slap Shot/ One-timer	**68 mph**	**1.1 s**	**61.82 m/s2**	**.65**	**40.2 N**
Slap Shot/ One-timer	**70 mph**	**1.0 s**	**70.0 m/s2**	**.65**	**46 N**

Evaluate

How does a change in force affect a change in motion? Support your answer with evidence from the experiment.

Example: Based on the above results, a change in force of the motions – forehand pass/shot and slap shot/one-timer -- demonstrated a difference in higher 'Newtons' in the forehand pass/shot motion versus the slap shot/one-timer motion, as the slap shot/one-timer motion requires more force.

7.0 Skating in the Zone

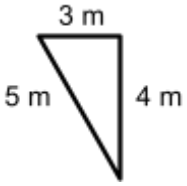
GRADES 6th-8th

Explain

Use the formula A = ½BH to calculate the area of the triangles below.

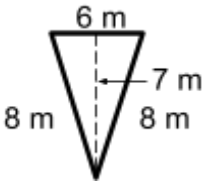
A = ½ (3)(4)

A = 6 m^2



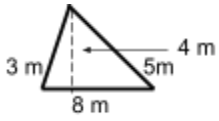
A = ½ (6)(7)

A = 21 m^2



A = ½ (8)(4)

A = 16 m^2



Elaborate

Outline the shooting triangle, and measure all three sides. Then use the table to record if each student made or missed their shot from this location.

Answers will vary based on students' shooting triangle.

Shot Location 1		Shot 1	Shot 2	Shot 3
Side Lengths of Triangle: 4 m, 8 m, 10 m	Person 1	make	make	make
Base = 4 m Height = 8 m	Person 2	miss	make	make
Area Calculation: ½ (4) (8) = 16 m^2	Person 3	miss	miss	make
	Person 4	miss	miss	miss

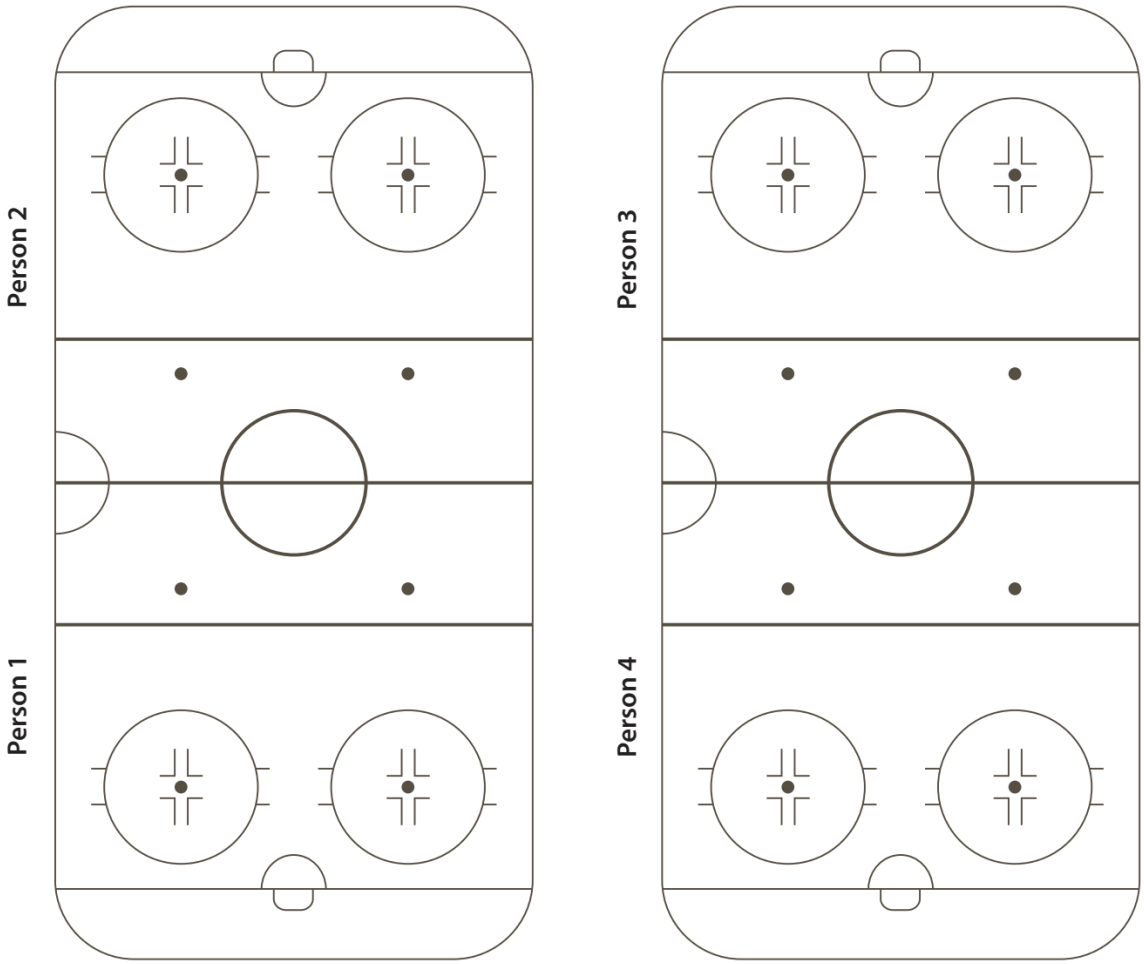
Shot Location 2		Shot 1	Shot 2	Shot 3
Side Lengths of Triangle: 8 m, 10 m, 10 m	Person 1	make	make	make
Base = 8 m Height = 9 m	Person 2	miss	make	make
Area Calculation: ½ (8) (9) = 36 m^2	Person 3	miss	miss	make
	Person 4	miss	miss	miss

Shot Location 3		Shot 1	Shot 2	Shot 3
Side Lengths of Triangle:	Person 1			
Base = Height =	Person 2			
Area Calculation:	Person 3			
	Person 4			

Shot Location 4		Shot 1	Shot 2	Shot 3
Side Lengths of Triangle:	Person 1			
Base = Height =	Person 2			
Area Calculation:	Person 3			
	Person 4			

Evaluate

Sketch the shooting triangle for each of the four shot locations. Label each side with correct measurements and include the area in the center.



Extend

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

Student answers will vary.

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

Student answers will vary.

Reasoning: Justify your response.

Student answers will vary.

8.0 Advancements in Hockey

GRADES 6th-8th

Circle your stance regarding instant replay: For or Against

Brainstorm: What problems do increased use of instant replay in hockey solve?

OR

What problems do increased use of instant replay in hockey cause?

Criteria for Improvements/Changes of Instant Replay	Constraints for Improvements/Changes of Instant Replay
Examples: • **Ensure play does not slow down.** • **Designate officials to view and operate instant replay.**	**Examples:** • **Play is slowed down even more.** • **Technological support is the same or ineffective as before.**

Letter to the NHL (National Hockey League) Commissioner:

Does science and technology (instant replay) make hockey more fair? Would an increased use of instant replay enhance or detract from the game? How can instant replay be improved to meet the needs of all stakeholders: referees, game officials, players, coaches, and fans)?

Stances and responses will vary among students.