Name: _____ Class: _____

Softballs vs. Baseballs

GRADES 6-8

Data Collection

	Softball		Baseball	
	Distance (meters)	Time (seconds)	Distance (meters)	Time (seconds)
Hit 1				
Hit 2				
Hit 3				

Calculations:

SOFTBALL

	Initial speed	Final Speed (distance divided by time)	Acceleration (initial-final divided by time)	Mass of ball	Force Acting on ball (Mass times Acceleration)
Tennis ball	0 m/s			.08 kg	
Golf ball	0 m/s			.05 kg	
Baseball	0 m/s			.14 kg	

BASEBALL

	Initial speed	Final Speed (distance divided by time)	Acceleration (initial-final divided by time)	Mass of ball	Force Acting on ball (Mass times Acceleration)
Tennis ball	0 m/s			.08 kg	
Golf ball	0 m/s			.05 kg	
Softball	0 m/s			.25 kg	

Name: _____ Class: _____

Softballs vs. Baseballs

GRADES 6-8

***Extend* only:**

Diagrams: Draw a diagram that shows the amount of force acting on each ball and how it affects the motion.

Underhand Throw/Pitch	Overhand Throw/Pitch

Module 2.0

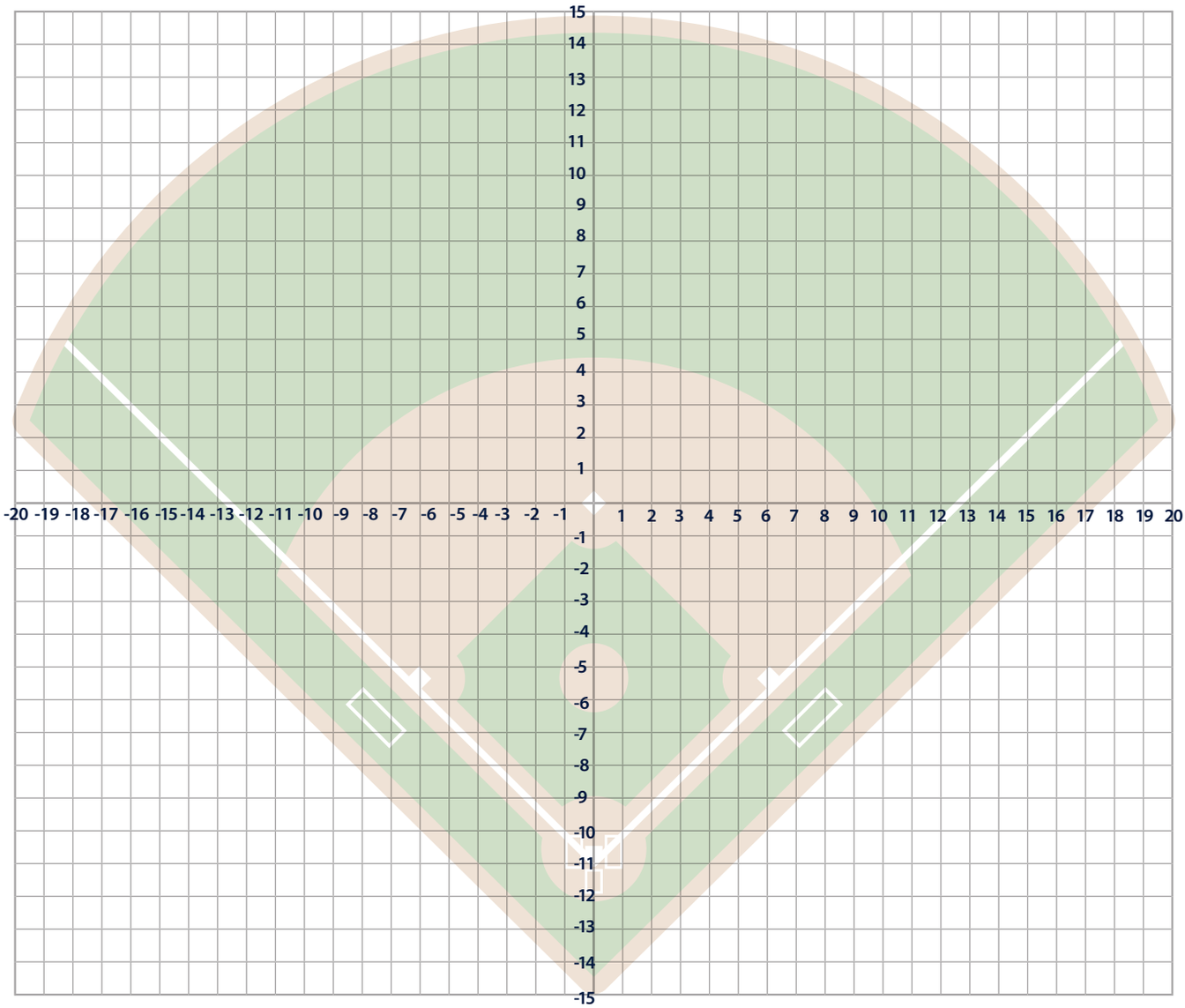
Name: _____ Class: _____

The Field of Play

GRADES 6-8

6th Grade Specific Standards

Plot each player on the coordinate plane. Label their x,y coordinates.



Center field: Pitcher: Shortstop:

Left Field: First Base: Third Base:

Right Field: Second Base: Catcher:

Name: _____ Class: _____

The Field of Play

GRADES 6-8

6th Grade Questions

Use the coordinate plane to determine the absolute value between players.

1. How far would the Second Base player need to throw to the Shortstop?

2. How far would the Third Base player need to throw to the First Base player?

3. How far would the Pitcher need to throw to the Catcher?

4. How far does the Center Fielder need to throw to the Pitcher?

5. If the First Baseman ran to (0, 6) to catch the ball and then needed to throw to Home to make the play, how far would he/she throw?

6. If the Catcher (-11) was trying to throw out a runner stealing Third, how far would he/she throw?

Module 2.0

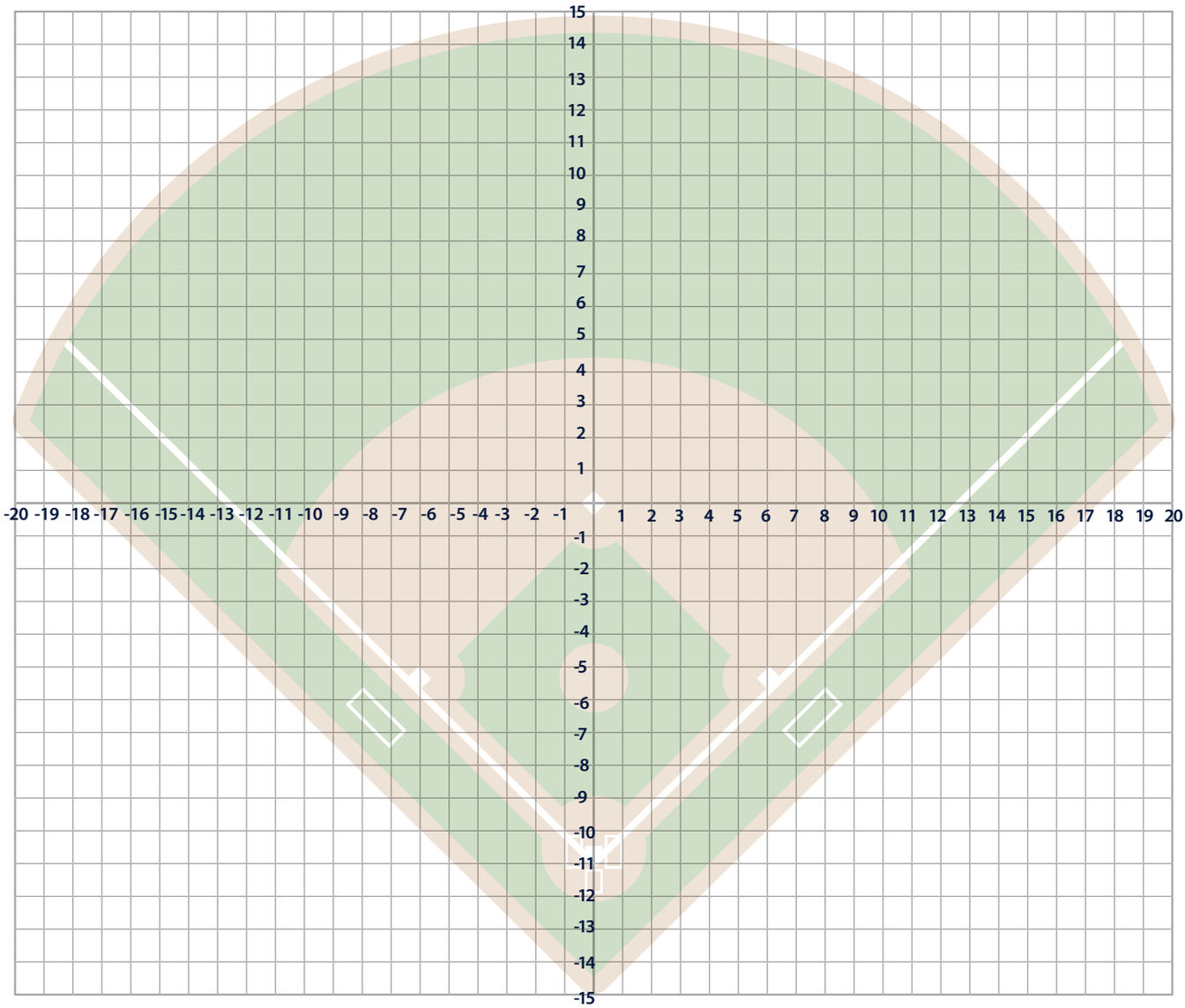
Name: _____ Class: _____

The Field of Play

GRADES 6-8

8th Grade Specific Standards

Plot each player on the coordinate plane. Label their x,y coordinates.



Center Field: Pitcher: Shortstop:

Left Field: First Base: Third Base:

Right Field: Second Base: Catcher:

STEM sports

Module 2.0

Name: _____ Class: _____

The Field of Play

GRADES 6-8

8th Grade Questions

1. Use the distance between the Pitcher and First Base (A), and the Pitcher and Catcher (B). Use the Pythagorean Theorem to calculate the distance between First Base and Catcher. $A^2 + B^2 = C^2$

2. Use the distance between the Pitcher and Third Base (A), and the Pitcher and Catcher (B). Use the Pythagorean Theorem to calculate the distance between Third Base and Catcher. $A^2 + B^2 = C^2$

3. Use the distance between the Pitcher and Center Field (A), and the Pitcher and Third Base (B). Use the Pythagorean Theorem to calculate the distance between Third Base and Center Field. $A^2 + B^2 = C^2$

4. Use the distance between the Pitcher and Center Field (A), and the Pitcher and First Base (B). Use the Pythagorean Theorem to calculate the distance between First Base and Center Field. $A^2 + B^2 = C^2$

5. The Catcher moves to (6, -11). Use the distance between First Base and Catcher (A) and First Base and Pitcher (B). Use the Pythagorean Theorem to calculate the distance between the Pitcher and Catcher. $A^2 + B^2 = C^2$

6. The Right Fielder moves to (4, 7) in line with the Second Base player. Use the distance between the Second Base player and the Right Fielder (A) and the Second Base player and Shortstop (B). Use the Pythagorean Theorem to calculate the distance between Right Field and Shortstop. $A^2 + B^2 = C^2$

Module 3.0

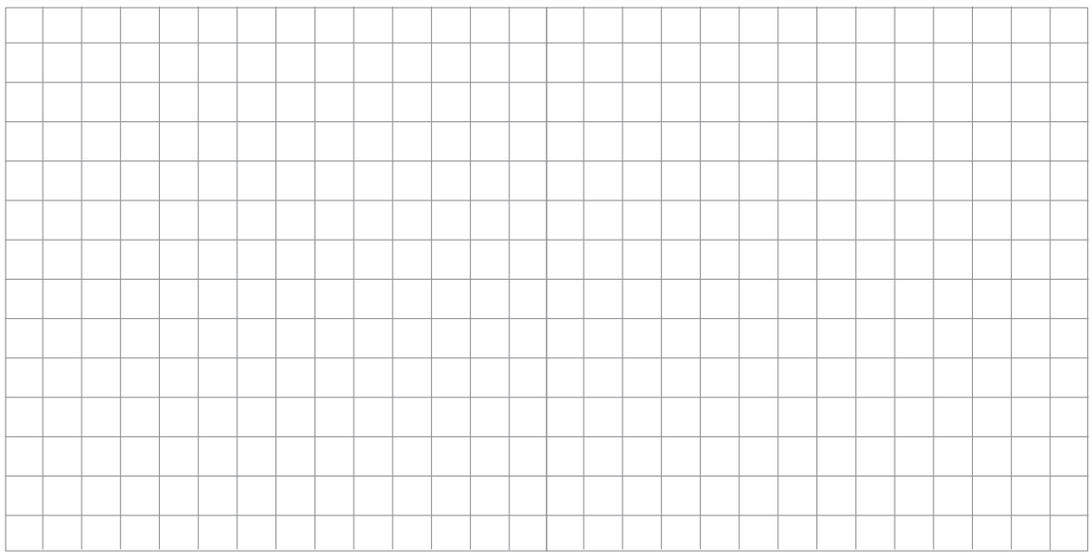
Name: _____ Class: _____

Is it Fast or Slow?

GRADES 6-8

Pitches	Pitch 1	Pitch 2	Pitch 3	Average Velocity	Mass (.25 kg)	Kinetic Energy (Calculated) $KE = \frac{1}{2}mv^2$
Fastball						
Curveball						
Change-up						

Graph the kinetic energy of each pitch:



Why do some pitches have more kinetic energy than others? Support your claim with evidence and reasoning.

Module 4.0

Name: _____ Class: _____

Advancements in Baseball

GRADES 6-8

After review of GamePlan:

Pitching

Rate your pitches: best to worst. Explain your reasoning.

Swinging

Rate your swings/hits: best to worst. Explain your reasoning.

Problem: In Baseball, comprehensive skills (swinging and pitching) happen more quickly than we can see and analyze. How can coaches and players better analyze their skills?

Brainstorm a list of criteria and constraints with students and display below:

Criteria	Constraints

Name: _____ Class: _____

Advancements in Baseball

GRADES 6-8

After review of Performance Technology:

Pitching

Rate your pitches: best to worst. Explain your reasoning. What evidence did you collect from the technology?

Swinging

Rate your swings/hits: best to worst. Explain your reasoning. What evidence did you collect from the technology?

Which is the best solution to the problem that coaches and players need a better way to analyze their skills: GamePlan Technology, Performance Technology or a redesign? These questions will help support your writing: Which technology – GamePlan or Performance Technology – better supports a player improving their skills? What are the similarities and differences from each technology? How do both technologies meet or not meet the criteria/constraints brainstormed in the *Explain* section? What improvements would you make to both technologies?

Module 5.0

Name: _____ Class: _____

What is a Golf Ball?

GRADES 6-8

The Golf Ball Evolved

Like many sports, the landscape of the game of golf has changed significantly over the years. Yet golf has evolved more than most sports because of its long history. What are some of the most significant changes? Moreover, have these changes improved or hurt the game?

During the games four-hundred-year history (1618), the process of developing the golf ball has changed considerably, such as:

The first balls used during competition were constructed from pieces of horse or cowhide, filled with goose feathers, and stitched.

In turn, water was used to harden the leather-like exterior to create a harder and heavier ball to hit the ball further and straighter.

The first balls used during competition were constructed from pieces of horse or cowhide, filled with goose feathers, and stitched.

However, this was a time-consuming process, in addition to creating challenges to create a durable club that did not damage the ball over several rounds; this entailed both irons and woods (now composed of metal and graphite) made of wood. Furthermore, this process of creating golf balls was costly.

The most significant update to the ball did not take place for another two hundred years (1848). This process involved use of "rubbery sap" from tropical trees; heat was applied to generate a very solid, round product that could be struck hard by the club; society referred to this ball as "guttie" (from the term gutta percha). Fortunately, unlike the original designed ball made of leather and feathers, it was less expensive to produce. In addition, to yield a better flight model, the ball was outlined with a design to track flight characteristics. By the late 1800s, rubber-based company Dunlap got involved and began mass production. During this time, production included adding round bumps to the ball, forming a more durable ball.

By the late 1800's to early 1900's, Coburn Haskell introduced a ball composed of a solid rubber core – encompassed by a rubber wrap – inside the gutta percha (rubbery substance made from the sap of tropical trees). This was essentially the greatest step in golf innovation, as it added an average of 20 yards for players from the tee box. This excitement generated the need for mass production through the invention of a thread-winding machine of the "Haskell ball," named for the creator of this newly developed ball with a rubber core and dimple outline — ascertaining a ball that enhanced trajectory and length. These golf balls were used during play for the first time in 1905.

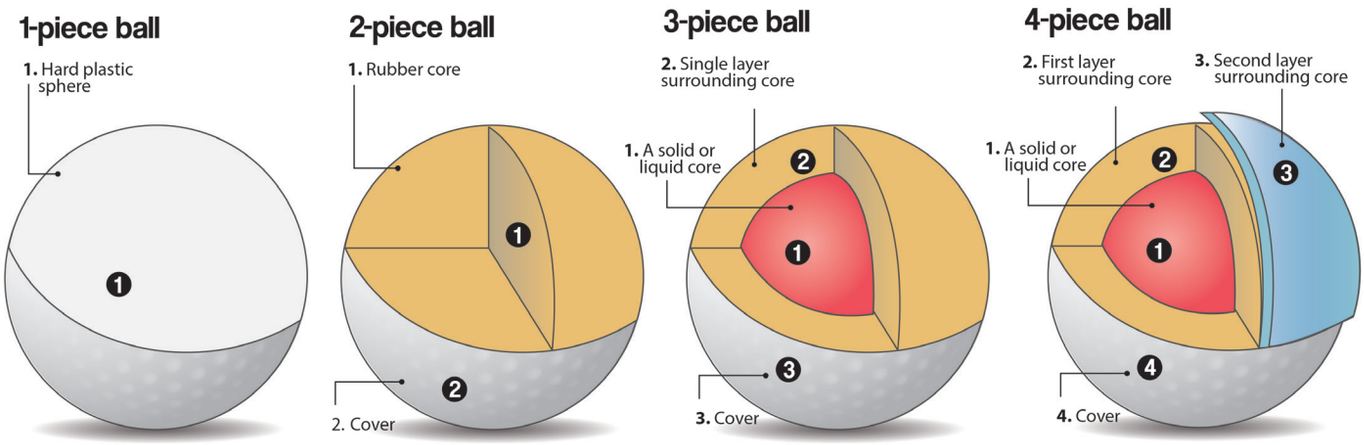
While players supported this change, it

Name: _____ Class: _____

What is a Golf Ball?

GRADES 6-8

Anatomy of Golf Balls



was important the USGA (United States Golf Association) and other international governing bodies establish protocol for the weight and size of the golf ball in the 1920s. However, specifications (size and weight) of the golf balls between the U.S. and other countries differed until 1990. In turn, recognition of the game's global presence led to amendments, so specifications were equal globally.

Today, there are a litany of golf balls and brands in the market. Why? Because no one player performs the same. Some players hit the ball extremely far yet with less control. While others hit the ball less far yet with more accuracy and precision. The below breakdown and model provide a good example of how engineering and technology has played a role in the game:

- Two-piece ball: a larger and more forgiving ball to improve distance; less spin to effectively hit the ball straighter.
- Three and four-piece ball: players that control the ball well and with a high swing speed; these balls have a thinner layer covering the ball.
- Five-piece ball: players that control the ball with a high rate of club head speed, looking for greater distance based on a soft inner core and outer layer. A high-performance ball, popular amongst professional golfers.

The above diagram demonstrates how comprehensive the game has become to suit both the amateur and professional golfer. It also exhibits immense transformation of the game. Based on technological advancements to-date, what will the next four hundred years look like? What effect will designers and engineers have on the game?

Information based on *The Evolution of Golf Balls* by Brian Hill for *Golfweek*

Module 5.0

Name: _____ Class: _____

What is a Golf Ball?

GRADES 6-8

What were some of the constraints for the first golf ball? Why did golfers feel the need to make changes?

_____

_____

_____

How has the anatomy of golf balls changed over time? What drove this change?

_____

_____

_____

What criteria and constraints did golf industry engineers need to consider in the early 1900's?

_____

_____

_____

Why are there multiple golf balls in today's golf game?

_____

_____

_____

Why do you think it was necessary for the international golf governing bodies to regulate the mass and size of the golf ball? Support your claim with evidence and reasoning.

_____

_____

_____

Name: _____ Class: _____

What is a Golf Ball?

GRADES 6-8

What is the author's purpose of this article? Provide text evidence to support your claim.

_____

_____

_____

_____

Using the article and classroom discussion, fill in the following criteria and constraints table.

Criteria	Constraints

	Qualitative Observations	Quantitative Observations
Callaway Golf® Supersoft Golf Ball (2-piece ball)		
Callaway Golf® ERC Soft Golf Ball (3-piece ball)		
Callaway Golf® Chrome Soft Golf Ball (4-piece ball)		

Module 5.0

Name: _____ Class: _____

What is a Golf Ball?

GRADES 6-8

Trial #____

	Distance of Putt 1	Distance of Putt 2	Distance of Putt 3	Distance of Putt 4	Distance of Putt 5	Number of putts to hit the target
Tennis Ball						
Ping Pong Ball						
Callaway Golf® Supersoft Golf Ball (2-piece ball)						
Callaway Golf® ERC Soft Golf Ball (3-piece ball)						
Callaway Golf® Chrome Soft Golf Ball (4-piece ball)						

Name: _____ Class: _____

What is a Golf Ball?

GRADES 6-8

Complete the following statement and support your claim with evidence from the article and experiment, and support it with reasoning regarding the criteria and constraints.

"Ball number ___ is the best technologically engineered ball for the game of golf."

Module 6.0

Name: _____ Class: _____

Scoring in Golf

GRADES 6-8

HOLE	1	2	3	4	5	6	7	8	9	TOTAL	10	11	12	13	14	15	16	17	18	TOTAL	18-Hole TOTAL	SCORE
PAR	5	4	3	4	4	5	3	4	4	36	4	4	3	4	5	3	4	5	4	36	72	
Bradley																						
Snell																						
Smith																						
Bradshaw																						
Gibson																						
Palmer																						
Raymo																						
Davis																						
Marone																						
Stein																						

Write a mathematical expression for how you could calculate your score for each hole.

Write a mathematical expression for how you could calculate your score for the game.

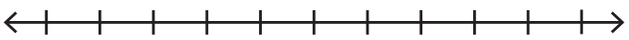
Module 6.0

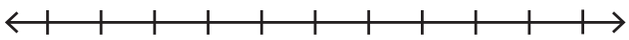
Name: _____ Class: _____

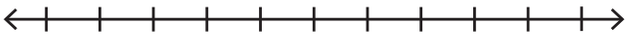
Scoring in Golf

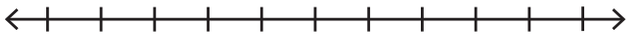
GRADES 6-8

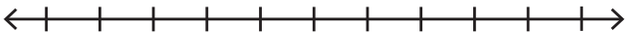
Use your expression and the number lines below to calculate your score. Start with the hits and then subtract par.

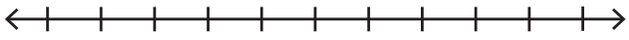


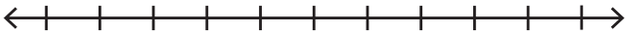


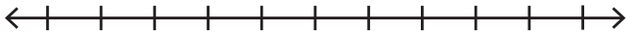


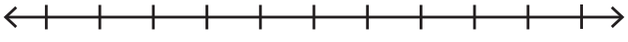












Module 7.0

Name: _____ Class: _____

Force of a Golf Swing

GRADES 6-8

How far can you hit a golf ball?

Estimate: _____ yards

	Trial 1	Trial 2	Trial 3	Average Drive
Drive				

Write a hypothesis on how you can increase your average drive distance.

_____

_____

Scaffold Experiment Guide:

Question: How can you increase the distance of a golf ball?

Hypothesis: If I _____, then the distance of the golf ball will increase because

_____

_____

_____

_____

Name: _____ Class: _____

Force of a Golf Swing

GRADES 6-8

Variables:

Independent (circle one):

Foot position **Follow-through** **Type of club** **Speed of the swing**

Angle of swing **Clubhead speed** **Height of the tee**

Dependent: Distance the ball travels.

Control: What other variables will you keep the same?

_____

Experiment Design: Briefly summarize how you will collect your data.

_____

_____

_____

_____

_____

_____

_____

Module 7.0

Name: _____ Class: _____

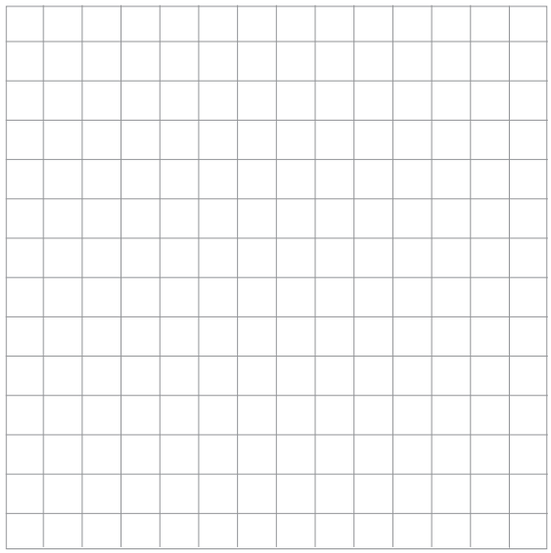
Force of a Golf Swing

GRADES 6-8

Data:
Record the distance in feet for 5 trials.

	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Average
Independent variable **Distance (feet)**						
Independent variable **Time (sec)**						
Control (same as *Explore*) **Time (sec)**						
Control (same as *Explore*) **Distance (feet)**						

Analyze: Find the average distance for both the controlled and changed swing and graph your average data comparing the two distances. If you are calculating the change in force using Newton's 2nd Law, calculate the average speed and then acceleration of the ball. Divide your speed by time. *Acceleration is initial speed subtracted from final speed divided by time. Since the initial speed is zero, just divide your speed by time.*



Name: _____ Class: _____

Force of a Golf Swing

GRADES 6-8

Report: Answer the following questions.
Did your data support your hypothesis?

_____

_____

_____

How did your adjustment (independent variable) change the distance of the ball?

_____

_____

_____

How do you know your change (independent variable) influenced the distance the ball traveled?

_____

_____

_____

How did your adjustment (independent variable) increase the force on the ball?

_____

_____

_____

Module 8.0

Name: _____ Class: _____

Climate and Weather in Golf

GRADES 6-8

Weather Cards

Tropical Maritime

Warm

Humid

Example location: Southeast (Florida and Georgia)

Polar Maritime

Cool

Humid

Example location: Northeast and Northwest

Polar Continental

Cool

Dry

Example location: Central Canada

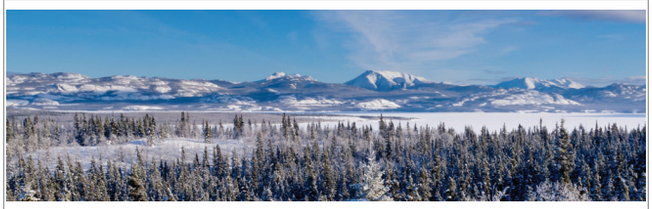
Tropical Continental

Warm

Dry

Example location: Southwest (Arizona and New Mexico)

Arctic Continental



Cool

Dry

Example location: Northern Canada

Module 8.0

Name: _____ Class: _____

Climate and Weather in Golf

GRADES 6-8

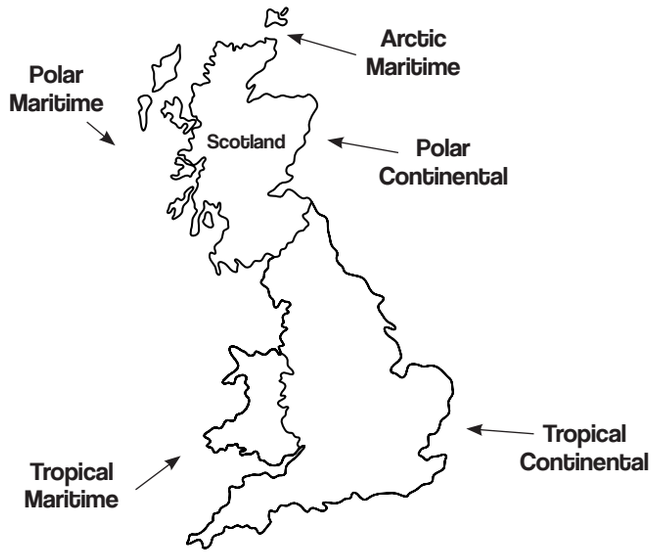
Scotland Annual Average Climate

Averages	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (mm)	93	67	67	53	54	58	71	80	82	96	93	95
Temp (°C)	3.4	3.5	4.8	6.8	9.5	12	13.9	13.7	11.6	8.7	5.7	3.6
Min Temp (°C)	0.9	0.8	1.9	3.3	5.7	8.4	10.4	10.2	8.3	5.8	3.1	1
Max Temp (°C)	6.1	6.3	8	10.4	13.4	15. 7	17.6	17.3	15	11.7	8.5	6.3

Los Angeles Annual Average Climate

Averages	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (mm)	82	87	61	26	6	2	1	7	12	32	62	66
Temp (°C)	14.1	14.7	15.6	16.8	18.2	20.2	22.6	23	22.3	20.1	17.2	14.6
Min Temp (°C)	9.1	9.8	10.6	11.9	13.6	15.4	17.3	17.7	17	14	11.8	9.5
Max Temp (°C)	19.1	19.6	20.4	21.7	22.7	25	27.9	28.4	27.7	25.3	22.7	19.7

United Kingdom



California