

The Science of Golf

Test Lab Toolkit **The Score: Handicap**

Grades 9-12



Science



Technology



Engineering



Mathematics



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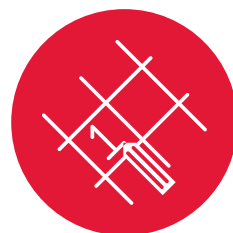
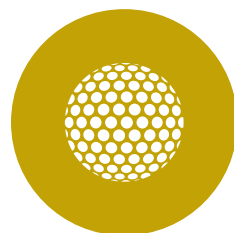
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Test Lab Toolkits bring math and science to life by showing how STEM studies play a big role in the game of golf. They are funded by the United States Golf Association (USGA).



Welcome to the Test Lab Toolkit!

Handicap



Sometimes the study of science and math can seem a little disconnected from the “real” world, a little irrelevant, a little boring. Yet a closer look reveals that science and math are everywhere in the world around you, in familiar and surprising ways.

Take something fun, like the game of golf. Sure, there's math, because you have to keep score. But there's also lots of science, technology, and engineering hidden in the game — from the physics of how you swing, to the mechanics of a golf club, to the remote sensors that tell you when to water the golf course.

At the United States Golf Association Test Center, scientists and engineers play around with golf balls, clubs, and other equipment every day so that they can

learn more about how they work. Since people keep thinking of new ways to improve the game, the USGA needs to constantly test new equipment to make sure it doesn't interfere with the game's best traditions or make game play unfair.

How does the USGA Test Center study this stuff? With golf ball cannons, robot clubs, and other cool experiments. And now you can do some of the very same experiments with the **TEST LAB TOOLKITS**, which let you set up your own test center in your club, class, or at home.

In this Toolkit, you'll explore the math behind the **HANDICAP** through activities that let you:

- 1 Experiment with the USGA Handicap System™ (and find out how it changes golf scores)
- 2 Design your own game (and figure out how to handicap it so that play is more equal)

3 Create a new handicap system for a sport that doesn't have one (and see how it changes the sport)

4 Calculate your own actual Handicap Index® (and discover your potential golf ability)

For every experiment you try, record your results with photos, diagrams, or any way you like, and then put it all together into your own Test Lab Log. The more Toolkits you do, the more of a golf (and science) expert you'll become!

Ready to explore the science and math behind the world's greatest game?

Investigate: Golf Scores

Handicap



Grades **9-12**



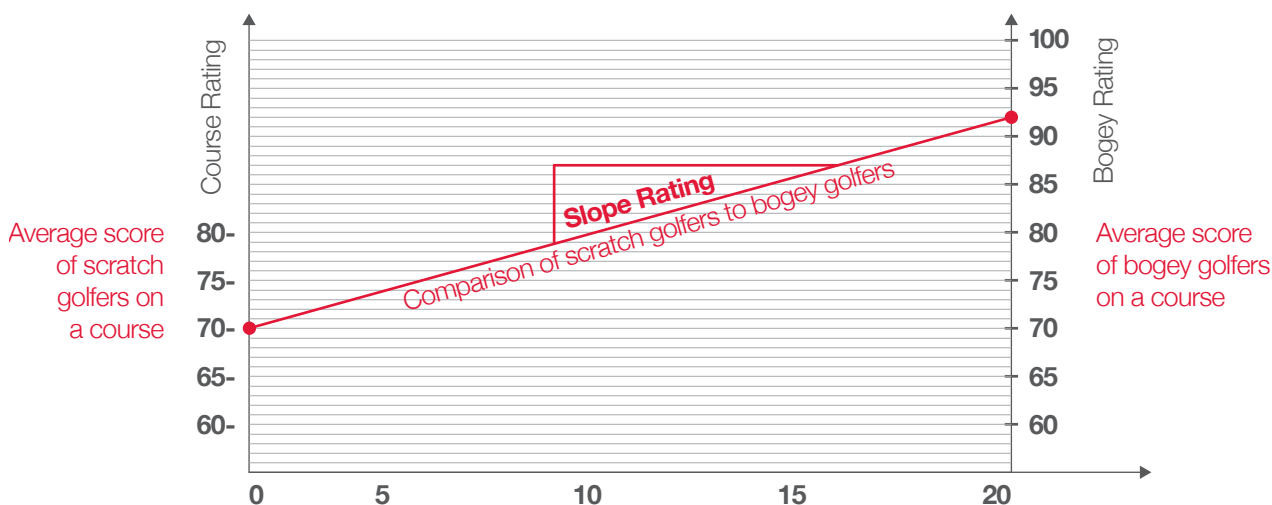
How do your scores change your Handicap Index®?

The USGA Handicap System™ enables golfers of all skill levels to compete on a more even basis. Each golfer can calculate a personal Handicap Index®, which can be used to determine the number of strokes that can be subtracted from the golfer's score on a particular course (**course handicap**). It's based on how well you play — a good **scratch golfer** may have a course handicap of 0, while a **bogey golfer** may have a course handicap of 20. In this activity, you'll investigate how golf scores work by playing a made-up game for a real course.

What Do You Need?

Paper

Pencil



Course and Slope Ratings for a Golf Course

This activity is adapted from NBC Learn: Science of Golf, "Calculating a Golf Handicap Index" (www.nbclearn.com/science-of-golf)

The Science of Golf





What Do You Do?

- 1 Decide whether you will be a scratch golfer or a bogey golfer. Also decide whether you will “play” from the forward (easiest), middle, or back (hardest) tee position.
- 2 On the blank score card, make up golf scores for yourself for a full round (18 holes) for 10 days. Imagine you have both good and bad days, so that your scores vary.
- 3 Add up the total score for each day in the **gross score** column.
- 4 Find the five lowest total scores and calculate the **handicap differential** for each one. Use the course and slope rating numbers from the same tee position for all of them.
- 5 After calculating the differentials, find the average of them. Use that average to calculate the **Handicap Index®**.
- 6 Once you know the Handicap Index®, subtract that number from each gross score, and put the new scores in the **net score** column.
- 7 Then figure out how your Handicap Index® would change if you used the same scores, but the course and slope ratings from a different tee position.

		Course Rating	Slope Rating		Yardage
		Based on scores of scratch golfers	Ratio of scores of scratch and bogey golfers		
Tee Position					
Where you tee off					
Par					
Expected number of strokes					
Score					
Actual number of strokes					

Score Card

Formulas

To find the handicap differential, use the formula:

$$[(\text{gross score} - \text{course rating}) \times 113] / \text{slope rating} = \text{handicap differential}$$

- Take your gross score and subtract the course rating.
- Multiply the result by the standard slope rating of 113.
- Divide by the slope rating for the specific course you played.
- Round to the nearest tenth.

To find the Handicap Index®, continue with the formula:

$$\text{handicap differential} \times 0.96 = \text{Handicap Index®}$$



What Happens?

Use the score card to record your results, and make more as needed.

What Does it Mean?

- What did you learn about the USGA Handicap System™?
- What effect does it have on the game of golf?

Challenge!

Find out the course rating, slope rating, and par for a second golf course, and “play” that course with a new set of scores. First use the same Handicap Index® you calculated from the first course. Then calculate a new Handicap Index® for the second course. Use each Handicap Index® to figure out your course handicap and net score. How do they compare?

Find Out More

- Read *Key Concepts* at the back of this toolkit.
- Read *Handicap: Background Information*.
- Watch the NBC Learn video “Calculating a Golf Handicap Index” at www.nbclearn.com/science-of-golf.

Back	350	536	219	600	418	420	362	359	183	303	367	380	115	418	411	430	245	463	6579	
Middle	336	526	170	561	405	412	352	349	165	293	350	352	115	390	360	408	208	407	6159	
Forward	318	513	154	541	390	394	328	332	151	270	330	320	114	370	334	356	197	395	5807	
Holes	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	GROSS SCORE	NET SCORE (gross – handicap)
PAR	4	5	3	5	4	4	4	4	3	4	4	4	3	4	4	4	3	4	70	
Day 1	5	5	4	6	4	5	6	4	3	5	4	5	4	4	5	6	5	4	84	
Day 2																				
Day 3																				
Day 4																				
Day 5																				
Day 6																				
Day 7																				
Day 8																				
Day 9																				
Day 10																				

This chart is adapted from Merion Golf Club, East Course, Haverford, PA

 Add this chart to your Test Lab Log!

Investigate: USGA Handicap System™

Handicap



Grades **9-12**



How does the USGA Handicap System™ equalize players?

The USGA Handicap System™ takes into account not only the **skills of a particular golfer**, but also how he **compares to better and worse golfers** on a particular golf course. So your Handicap Index® can change as your skill increases. In this activity, you'll investigate how and why the USGA Handicap System™ depends on these comparisons by creating your own game and a handicap system for it.

What Do You Need?

Several containers, such as large cans or buckets

Several small objects, such as pennies or golf balls

Paper

Pencil

Tape measure

Player A		Player B	
Gross Score	79	Gross Score	87
	-		-
Course Handicap	6	Course Handicap	15
Net Score	73	Net Score	WIN! 72
After subtracting course handicaps, Player B wins			

This activity is adapted from NBC Learn: Science of Golf, "Calculating a Golf Handicap Index" (www.nbclearn.com/science-of-golf)

The Science of Golf



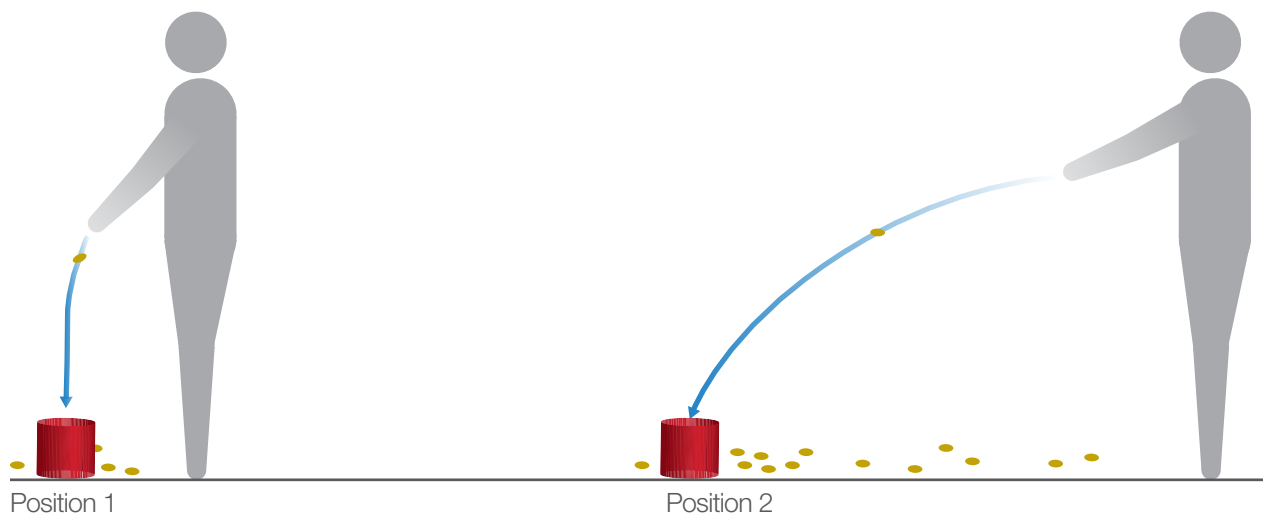


What Do You Do?

- 1 Experiment with tossing small objects into a container from different distances. Figure out which distances are easy or challenging.
- 2 Create a tossing game: Set up several containers. Decide where the player needs to stand for each one, and how many objects they need to toss inside. Name your game. Write up the rules.
- 3 Play a full game to set up the **handicap system**. For each container, use the score card to record how many tosses each person takes to get the right number of objects inside.
- 4 Total all the scores. Add up the better (lower) half of the scores and calculate the “**better half**”

average. Subtract this number from each person’s total score to get their **handicap**. For example, if the “better half” average for the game was 36, but John scored 45, his handicap would be $45 - 36 = 9$.

- 5 Now play a tournament game. Record everyone’s **gross score** (the actual number of tosses). Then subtract their handicap to get their **net score**.
- 6 After the game, calculate the **mean** (average), **median** (middle number), **mode** (most common number), and **range** (top and bottom values) for the group’s handicaps, gross scores, and net scores. What do they tell you about the group’s overall ability?



What Happens?

Use the score card to record your results, and make more as needed.

What Does it Mean?

- What did you learn about creating a handicap system?
- How does having a handicap system affect the fairness (and the fun) of the game?

Challenge!

Rearrange the containers, as if it were a different course. Play again. Does the same handicap seem to work well? Or do you need to calculate a new one, just as you would for a different golf course?

Find Out More

- Read *Key Concepts* at the back of this toolkit.
- Read *Handicap: Background Information*.
- Watch the NBC Learn video “Calculating a Golf Handicap Index” at www.nbclearn.com/science-of-golf.



Name of the Game:

Container	1	2	3	4	5	6	7	8	9	10	Gross Score	Handicap	Net Score (gross-handicap)
Number of Objects to Get Inside	3	3	3	3	3	3	3	3	3	3			
Player 1 # Tosses	3	4	3	5	4	6	3	3	4	5	35		
Player 2													
Player 3													
Player 4													
Player 5													
Player 6													
Player 7													
Player 8													
Player 9													
Player 10													



Add this chart to your Test Lab Log!

Create: Beyond Golf

Handicap



Grades **9-12**



How would a handicap system work for other sports?

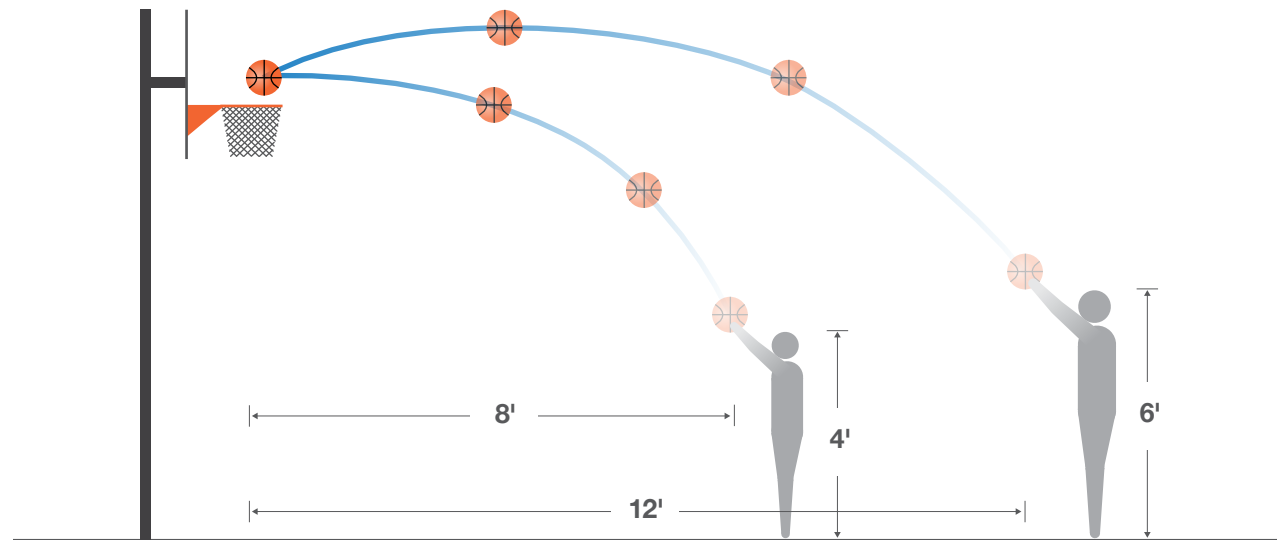
If you played golf with a professional golfer like Phil Mickelson, the USGA Handicap System™ would help **equalize your scores** and give you a chance to compete against each other more fairly, though Phil would probably still beat you. There's no system to equalize most other sports, but what if there were? What if you could **create a system** that would let you play a relatively fair game of basketball with LeBron James, or tennis with Maria Sharapova? In this activity, you'll create that handicap system yourself!

What Do You Need?

Paper

Pencil

Sports equipment



Basketball with a Distance Handicap

This activity is adapted from NBC Learn: Science of Golf, "Calculating a Golf Handicap Index" (www.nbclearn.com/science-of-golf)

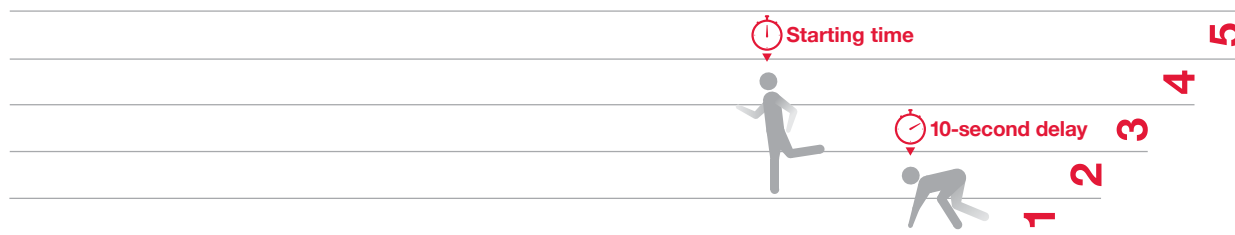
The Science of Golf





What Do You Do?

- 1 Pick a sport that doesn't have a **handicap system**. It should be something that you can play yourself, like basketball.
- 2 Think about the different levels of skill that players have in that sport. How could you create a handicap system that makes the game more equal for everyone? You could change the scoring or the actual game play. For example, in basketball, maybe shorter players get an extra point for each basket. In a running race, maybe faster runners have to start 10 seconds later than slower runners.
- 3 Write up rules for a handicap system for that sport.
- 4 Play a full game to see how well your handicap system works. Make adjustments.
- 5 Invite friends to play your new version of the sport!



Running Race with a Time Handicap

What Happens?

Write up the new handicap system for sport, and note how it changes the way you play (and win).

Add your results to your Test Lab Log.

What Does it Mean?

- What did you learn about creating a handicap system?
- Do you think different sports would be better with handicaps?

Find Out More

- Read *Key Concepts* at the back of this toolkit.
- Read *Handicap: Background Information*.
- Watch the NBC Learn video "Calculating a Golf Handicap Index" at www.nbclearn.com/science-of-golf.

Connect: Your Own Handicap Index®

Handicap



Grades **9-12**



How do you figure out your own Handicap Index®?

The USGA Handicap System™ gives each golfer a **Handicap Index®** based on ability, adjusting it up or down as the golfer's potential changes. It's calculated with only your best and most recent scores, so that it reflects not how you score once or on average, but your **potential for playing well**. In this activity, you'll use your best scores on an actual golf course to calculate your own Handicap Index®, and find out your own golf potential.

What Do You Need?

Golf clubs

Golf ball

Local golf course

	Course Rating Based on scores of scratch golfers		Slope Rating Ratio of scores of scratch and bogey golfers		Yardage
Tee Position Where you tee off	Back	73.5/149	350	536	219
Par Expected number of strokes	Middle	71.6/144	336	526	170
	Forward	69.9/140	318	513	154
Score Actual number of strokes	PAR		4	5	3
	HOLE		1	2	3
	Name of Player		4	6	4

Score Card

The Science of Golf





What Do You Do?

- 1 Play at least 1 round of golf at a local course
- 2 Add up the total number of strokes you take. This is the **gross score**.
- 3 Calculate the **handicap differential**, using the course and slope ratings for the course you played.
- 4 Use the differential to calculate your **Handicap Index®**.
- 5 Once you know your Handicap Index®, subtract that number from your gross score to find your **net score**.
- 6 If possible, play more rounds on the same course. Use your Handicap Index® to figure out your net score each time.
- 7 The more rounds you play, the more accurate your Handicap Index® will be. Find your five lowest gross scores and calculate the handicap differential for each one. Use that differential to recalculate your Handicap Index®.
- 8 Compare the Handicap Index® you calculate yourself with the Handicap Index® that the golf course's computer calculates (or use the online USGA Course Calculator at www.usga.org/playing/handicaps/calculator/course_handicap_calculator.asp). How do they compare?



Formulas

To find the handicap differential, use the formula:

$$[(\text{gross score} - \text{course rating}) \times 113] / \text{slope rating} = \text{handicap differential}$$

- Take your gross score and subtract the course rating.
- Multiply the result by the standard slope rating of 113.
- Divide by the slope rating for the specific course you played.
- Round to the nearest tenth.

To find the Handicap Index®, continue with the formula:

$$\text{handicap differential} \times 0.96 = \text{Handicap Index®}$$

◀ Atlanta Athletic Club

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What Happens?

Use the score card to record your results, and make more as needed.

What Does it Mean?

- How do your scores change your Handicap Index® and why?
- What did you learn about your potential?

Find Out More

- Read *Key Concepts* at the back of this toolkit.
- Read *Handicap: Background Information*.
- Watch the NBC Learn video “Calculating a Golf Handicap Index” at www.nbclearn.com/science-of-golf.



Golf Course Name:																				
Course Rating:																				
Slope Rating:																				
Holes	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	GROSS SCORE	NET SCORE (gross – handicap)
PAR	4	5	3	5	4	4	4	4	3	4	4	4	3	4	4	4	3	4		
Day 1	5	5	4	6	4	5	6	4	3	5	4	5	4	4	5	6	5	4	84	
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Day 7																				
Day 8																				
Day 9																				
Day 10																				



Add this chart to your Test Lab Log!

Key Concepts

Handicap



Better Half Average

The average of the better half of a golfer's scores. The USGA Handicap System™ looks at only the better half of scores, because it's based on each golfer's potential to play well.

Bogey

A score for a hole that is one stroke more than par.

Bogey Golfer

A golfer who generally plays holes at one above par and has a course handicap around 20.

Bogey Rating

A rating of the playing difficulty of a golf course for a bogey golfer under normal course and weather conditions.

Bonus for Excellence

The mathematical constant 0.96, part of the Handicap Index® formula, which is used as an incentive for golfers to improve their skill.

Course Handicap

A specific number of strokes that a golfer can subtract from a specific set of tees at the course being played, to adjust the player's scoring ability to the level of a scratch golfer.

Course Rating

A rating of the playing difficulty of a golf course for a scratch golfer under normal course and weather conditions.

Gross Score

The actual number of strokes a golfer makes on a hole or round, plus any penalty strokes taken by the golfer.

Handicap Differential

A number that represents how a golfer's scores compare to a golf course's course and slope ratings. Used to calculate the golfer's Handicap Index®.

$$\text{Handicap differential} = \frac{[(\text{gross score} - \text{course rating}) \times 113]}{\text{slope rating}}$$

Handicap Index®

A number that represents a golfer's potential scoring ability. Used to calculate the golfer's course handicap for a specific golf course.

$$\text{Handicap Index}^{\circledR} = \text{handicap differential} \times 0.96$$



Net Score

A golfer's score after course handicap strokes have been subtracted from the golfer's gross score.

Par

The score that an expert player would be expected to make for a given hole.

Scratch Golfer

A very good golfer who generally plays holes at par and has a course handicap of 0.

Slope Rating

A rating that indicates the relative difficulty of a golf course for an average golfer. The higher the slope rating, the greater the gap in expected scores between scratch and bogey golfers.

**Slope rating = (bogey rating –
course rating) x (5.381 for men
or 4.24 for women)**

Stroke Play

When a golfer counts the total number of strokes per hole.