THE BALANCE OF BOXING OUT

What role does balance play in putting up a good defense near the rim?

Rebounding is an incredibly important part of basketball. If your team collects more rebounds, they will have more chances to score points. Boxing out allows your team to get more rebounds. Boxing out, or separating your legs far apart and stretching out your arms to keep the opponent away from the basketball, is an awesome skill used by basketball players from grade school to the NBA. Boxing out can even help a small player prevent a bigger player from getting the ball. Boxing out requires balance!

HERE'S WHAT YOU'LL NEED:

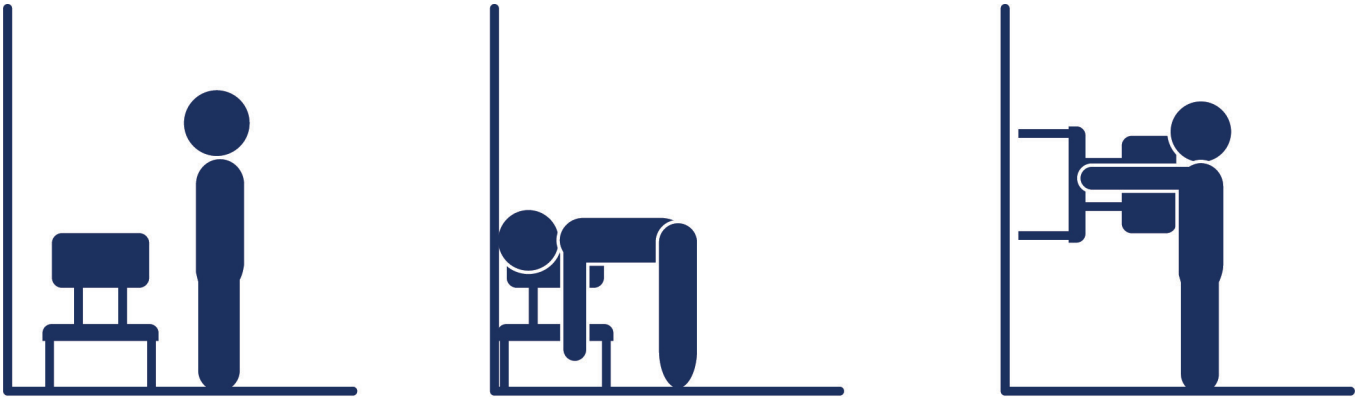
- **Chair**
- **Tape measure**
- **Small electric fan**
- **Similar supplies and material for each group such as index cards or similarly sized cardstock, dry spaghetti or straws, cotton balls, and tape**
- **Book or board**
- **Ruler**
- **Stopwatch**
- **Pencil**
- **Journal**

WARMUPS

Work with a partner or in small groups. This activity works best if boys and girls are in the same group. Stand, facing the wall and have a classmate place a chair sideways, between you and the wall. Make sure your feet are not under the chair. Bend over the chair until your head touches the wall and your upper body is parallel to the floor. Keep your legs straight, lift the chair to your chest and then try to stand up.

Take turns until everyone who is going to participate has done so.

The rest of the group should make observations of the person doing the lifting, and be ready to help if anyone loses their balance.



Pro Tip: If time is limited or the class notices only subtle variances, the demonstration can be done using two or more adults as long as both men and women are represented.

Was the task easier for some classmates than it was for others?

Did any patterns emerge?

What do you think caused these results?

What change do you think could be made to improve the results?

How do you think this activity may relate to the role basketball players play when trying to secure a rebound close to the goal? Imagine the chair is the basketball, an elbow, or an arm of an opposing player. What did this activity with the chair demonstrate about our ability to balance when our distribution of weight (mass) changes? Record your ideas in your journal.

GAME TIME

Now that you have witnessed how the position and weight location can change balance, see if you can use your observations to participate in a challenge. You can work in your small groups to perform this challenge.

Each group will need four cotton balls, four dried spaghetti noodles or straws, two index cards (or similarly shaped cardstock), and 15 centimeters (cm) of tape.

Set the small electric fan at a low speed at the same height as the tabletop. Use a tape measure and a piece of tape to mark a line 60 cm in front of the fan.

When boxing out, an athlete wants to take up as much space as possible, preventing players from the other team from being able to get around them. This helps ensure that their team will get the ball. In addition to taking up a lot of space, the athlete needs to be able to hold the space without being moved around or even knocked over.

For this challenge, each group is limited to using only these supplies provided. The challenge is for each group to **prototype** and test a model that not only takes up a lot of space but can also withstand the force of moving air from the fan.

Pro tip: This challenge can be completed within 20 minutes, giving each group time to discuss ideas and settle upon a final model based on the prototypes.

How much space can your model cover without being moved or knocked over? How tall can you make it? How wide can you make it? How much fan-facing surface area can your index cards create before the model gets moved or knocked over by the fan?

Pro tip: No cheating! Teams cannot tape their model to the tabletop.

Use your journal to sketch out some designs before getting started. Discuss with your group concepts that will allow your model to stay.

At the end of the allotted time, each group should have settled upon a design and completed the models. Each group should test their model against the fan, placing it on the line 60 cm away from the fan. Can each model stand up to the fan for 5 seconds, maybe even 10 seconds? Take turns making notes as each team's model tries to stay in place against the fan. Note if the model moves and if it gets knocked over by the fan how many seconds it stood.

After every model has been tested, create a graph to compare the following things about each model:

1. Total time standing
2. Did it stay put, move, or fall over
3. Maximum height
4. Maximum width
5. Total surface area covered by index card

Model	Time Standing	Did it Fall Over?	Height	Width	Surface Area
Group Name					
Group Name					
Group Name					

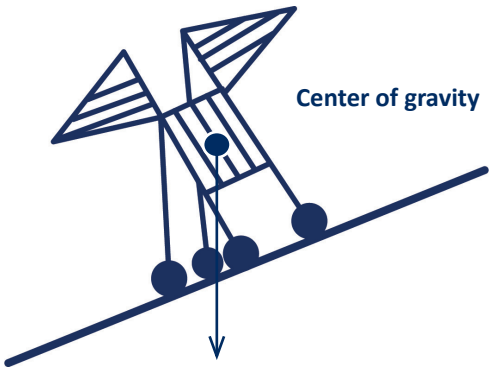
Remember: To figure surface area, multiply length and width. If you used all of both index cards, just multiply the length and width of the card and multiply by two. If you did not use all of the card material, you may need to figure the surface area of the remaining card material and subtract that from the total surface area of both index cards. You may need to estimate, but try to be as accurate as you can be.

ANALYZE THE REPLAY
What happened?

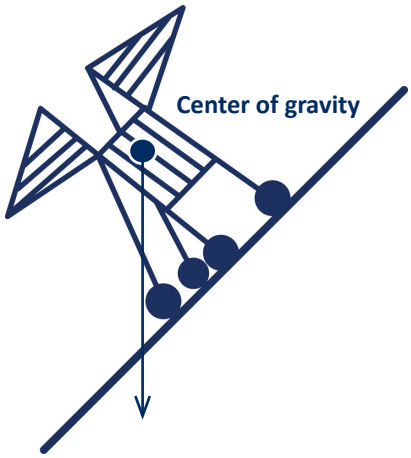
Reflecting on the models made by each of the teams, what characteristics did the most successful models share? Based on your observations of these models, how could a player use these models to better understand the mechanics of boxing out? If you could add one item not included in your supplies to improve the model that your team created, what would it be? Are there any other adjustments that you would make to your model to help it occupy more space and not be knocked over?

OVERTIME
Let's take it further

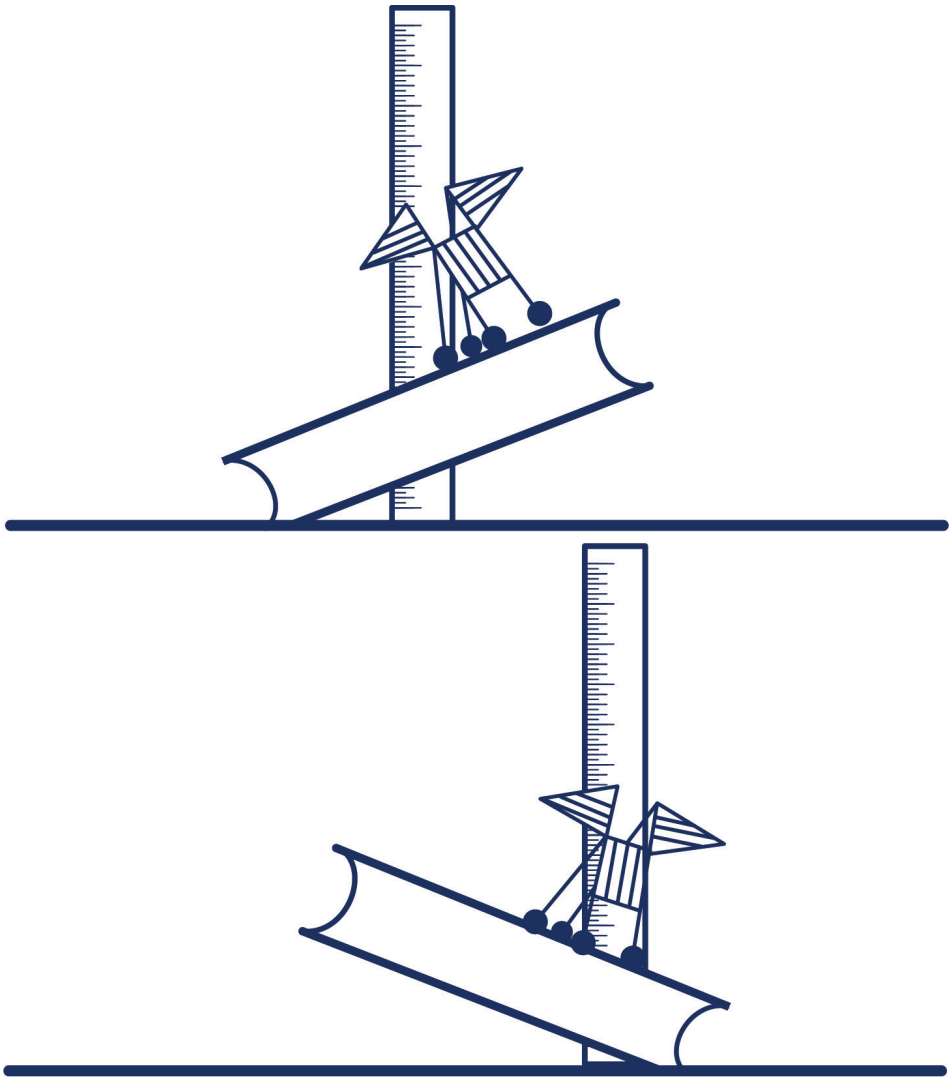
Let's take it a step further. Each of the models likely withstood the force of the fan with varying levels of success. This is partially due to the model's **center of gravity.** The center of gravity can be found by tipping your model until it falls over.



As long as the center of gravity is above the area of support or the feet of your model, it will not tip. But as soon as the center of gravity is moved outside of the space directly over the support it will tip over.



Balance your model on a book or flat board. Carefully and slowly tilt the book until you find the point where your model just begins to tip. At this point the center of gravity is directly above the outer edge, or foot, where your model touches the ground. Find this point by holding a ruler straight up and down to draw a vertical line on your model directly up from the edge where it touches the ground. Next tilt your model the other way until it begins to tip over in that direction. Move your ruler to the other side of the model and draw another line directly up from this edge where the model is tipping over. If your model has more feet you may have to tilt it backward and forward as well as left and right. All that tilting lets you find the center of gravity. It is the place where the lines all cross.



COACH'S CORNER
Additional information and explanations for parents and educators

Boxing out is a crucial part of basketball. When your team is able to position themselves between the ball and the other team, boxing out helps ensure that your team will get more possessions than the other team, increasing your team's chance of winning the game. To be effective though, players must be able to take up a lot of space, so the other team cannot get around. Players also have to be able to take up that space without being moved or knocked over. By being aware of their center of gravity, players are both hard to get around and hard to move. The Warmups activity showed that people of different body shapes have different centers of gravity. Being able to use their centers of gravity allows basketball players of smaller sizes to box out against slightly larger players.

Isaac Newton's Three Laws of Motion are very helpful in understanding the science within a game of basketball. Newton's First Law, or the **Law of Inertia,** helps us understand how physics is used to effectively box out by your team's basketball players. According to this law, an object at rest tends to stay at rest unless acted upon by an external force; similarly, an object in motion will stay in motion until acted upon by a net external force. The basketball player is the net external force that will stop the basketball, the object in motion. The basketball player using the technique of boxing out is also attempting to be the object at rest that cannot be moved, unless the opposing basketball player acts upon them with enough net force to knock them over or push them out of the way. Such applied force may draw the referee to blow the whistle and call a foul on the opposing player.

In order to remain in position, or at rest, without the opposing player being able to move them, the boxing out player must lower their center of gravity to become more difficult to move. This activity and the created model aimed to show how center of balance and Newton's First Law are invaluable to a basketball team needing to ensure they secure more rebounds and more shot opportunities than the other team.

DO YOU WANT TO LEARN MORE?

Research: Applied Force, Center of Balance, Gravity, Inertia, Newton's Laws

OKLAHOMA ACADEMIC STANDARDS: MATHEMATICS

STANDARD	5th Grade	6th Grade
Science		
MS-PS2-5: Motion & Stability: Forces & Interactions		●
MS-PS3-2: Energy		●
Math		
N.1.4: Numbers & Operations	●	
A.1.1: Algebraic Reasoning & Algebra	●	
GM.2.2: Geometry & Measurement	●	
N.4.4: Numbers & Operations		●
A.1.2: Algebraic Reasoning & Algebra		●
GM1.3: Geometry & Measurement		●