



# Newton's Second

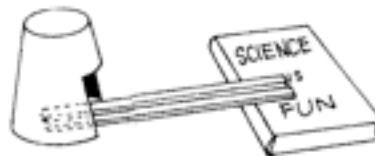
Newton's second law is commonly known as  $F=ma$  where  $F$  is the force in Newtons, " $m$ " is the mass in kilograms and " $a$ " is acceleration. So, the Force need to move an object can be calculated by multiplying the Mass times the Acceleration you want the object to have.

An easy way to think about this is if you wanted to kick a goal with a soccer ball or with a bowling ball. To make the bowling ball move fast you would have to kick it much harder than the soccer ball.

**Materials:** book, ruler with a groove down the middle, Styrofoam cup with part cut out, glass marble, plastic marble, wooden marble, meter stick, balance

## What To Do:

1. Place one book on the table.
2. Place the ruler on the book and then place the cup at the end of the ruler.  
(See picture)



3. Measure the mass of each of the marbles.
4. Roll the plastic marble down the ruler and measure how far the cup goes across the table. Repeat 2 more times.
4. Repeat with glass marble and wooden marble.
5. Fill in the data table and find the average number of centimeters traveled by the cup.



Object	Mass	Trial 1	Trial 2	Trial 3	Total	Average
Plastic						
Wooden						
Glass						

## Questions:

1. Which marble had the most mass?

2. Which marble pushed the cup the farthest?

3. How did the mass of the marble affect the acceleration of the marble?

4. How did the acceleration of the marble affect the distance the cup traveled?

In this activity we did not measure the acceleration but we did observe that more mass the marble had the more acceleration the marble had. With more acceleration we have more force with which to push the cup and it went farther.

Watch the video  $F=ma$  from [www.missdoctorbailer.com](http://www.missdoctorbailer.com)

Name three things that were accelerating in the video

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_



We can use the formula  $F = ma$  to calculate the forces on an object. Remember the unit for force is the Newton.

1. A train's mass is 50kg and its acceleration is 5 m/s.

What is the net force on the train? \_\_\_\_\_

2. A car's mass is 500 kg and its acceleration is 20 m/s.

What is the net force on the object? \_\_\_\_\_

3. A boy's mass is 14kg and his acceleration on the basketball court is 2 m/s. What is the net force on the other boy he hits as he goes for a layup? \_\_\_\_\_

What if we wanted to know the acceleration? We can rearrange the formula like you do in math.

$F = ma$  can change to  $\frac{F}{m} = a$

4. A bowling ball has a mass of 40kg and is kicked with a force of 10 N. What is its acceleration? \_\_\_\_\_

5. A soccer ball has a mass of 10 kg and is kicked with a force of 10 N. What is its acceleration? \_\_\_\_\_

6. A rocket with a mass of 5000kg is blasted off with a force of 1500 N. What is its acceleration? \_\_\_\_\_



What if we wanted to know the mass? We can rearrange the formula like you do in math.

$F = ma$  can change to  $\frac{F}{a} = m$

7. A soccer ball is kicked with a force of 20N and accelerates at  $2\text{m/s}^2$ . What is its mass? \_\_\_\_\_

8. A bowling ball is kicked with a force of 50N and accelerates at  $1\text{m/s}^2$ . What is its mass? \_\_\_\_\_

9. A basketball is thrown with a force of 30 N and accelerates at  $3\text{m/s}^2$ . What is its mass? \_\_\_\_\_

10. Make up your own problem and share it with a classmate to solve.



Name \_\_\_\_\_ period \_\_\_\_\_

## EXIT TICKET

Newton's Second

1. What is the abbreviation for Newton's Second Law of Motion?

- A.  $A = Fm$
- B.  $F = ma$
- C.  $M = FA$

2. If a bowling ball has a mass of 10 kg and an acceleration of  $2 \text{ m/s}^2$ , what is the force of the bowling ball?

- A. 2 N
- B. 20 N
- C. 200 N

3. How does increasing the mass of an object affect the force of that object?

- A. Increasing mass means decreasing force.
- B. Increasing mass mean decreasing acceleration.
- C. Increasing mass means increasing force

4. If a rocket has an acceleration of  $10 \text{ m/s}^2$  and a force of 5 N what is its mass?

- A.  $1/2 \text{ kg}$
- B. 2 kg
- C. 20 kg



Name \_\_\_\_\_ period \_\_\_\_\_

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- A.  $1/2 \text{ kg}$
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2. If a bowling ball has a mass of 10 kg and an acceleration of  $2 \text{ m/s}^2$ , what is the force of the bowling ball?

- A. 2 N
- B. 20 N
- C. 200 N