Grade 6 Science

Week of January 4 – January 8

<u>Forces 1</u>

Force and Motion

When you push someone on a swing, why do they swing forward? Why is it so easy to throw a tennis ball, but so difficult to throw a bowling ball? When you drop your pencil, why does it fall to the ground? Why do rockets fly upwards when they shoot gasses downwards?

Did you know that our world and our universe are governed by laws, laws that can answer the questions above? Physicists study these laws, which are called **The Laws of Nature**. Force and motion are both part of these laws

What is force you ask? Well, A force is **the push, or pull of an object**.

- *Pushing* an object will move it **away from** the force. **Example**: When you jump in the air, you *push* yourself down, off the ground, <u>causing your body to go up</u>.
- *Pulling* an object will move it **towards** the force. **Example:** Gravity is a force that *pulls* everything towards the earth. So when you jump, <u>gravity is what pulls you back down.</u>

We cannot *see* a force, but we can see the *effects* of a force

Forces can help an object speed up, slow down, stay in place, or even change shapes; forces cause motion or a lack of motion. To change an object's motion, a force needs to be applied. So if a rock was in place, still, not moving, chilling, and living its life, a force would have to come along in order for it to move (because a rock can't move on its own!). Make sense?

Think about when you ride your bike. It doesn't move on its own! The force of your feet *pushing* against the pedals causes your wheels to turn and your bicycle to move **forward**. When you want to stop, you *pull* the brakes, thus applying a *force* that is strong enough to **stop your motion**.

All forces are measured in something called **Newtons** - Named after Isaac Newton who discovered much of what we know now about force and motion. But don't think too much about him just yet, we'll learn more in the coming chapters.

Watch these short videos to further understand force and motion. Make sure you follow along in your learning guide!

chttps://youtu.be/fnCDk-SnNGQ

Friction

You might have noticed during the bobsled simulator that it went farther depending on what surface it was sliding on. Ice was a better surface than asphalt because of an invisible force called **Friction**.

Think about this: If you were to slide two hockey pucks, using the same force, but one puck was on ice and one puck was sandpaper, which would go farther? The puck on the ice would! But why? It's because ice has less friction than sandpaper; it's smoother, so it causes less friction and in turn, will allow the hockey puck to slide farther.

Friction always acts in the opposite direction of the object in motion. Now, that's certainly a bit tricky to wrap your brain around, especially since friction is an invisible force! But take a look at the image of the soccer ball below. When you kick the ball, you're applying a force from your foot to the ball pushing it forward, while the grass is applying friction in the opposite direction, ultimately slowing the ball down.

Friction: https://youtu.be/_LSevw1sfpk

The smoother the surface and the object are, the less friction there will be.

So, are there ways we can *intentionally* **reduce friction**? Yes! Think about sliding down a waterslide vs. sliding down a regular slide. Which slide will make you go faster? The waterslide will, and that's because the addition of water **reduces the amount of friction** between your body and the slide.

Have you ever used a slip and slide during the summer? Water definitely helps reduce the friction between your body and the plastic of the slip and slide, but have you ever tried adding soap? Soap **lubricates** the surface of the slip and slides reducing friction even further, making you go even faster!

Other ways we try and reduce friction are the use of things such as wax or oil. If you ski or snowboard, you'll know that each year it's a good idea to get your skis or snowboard waxed, so that you can glide down the hill smoother and faster! Really, it's all about **lubrication**. Soap, water, wax, and oil are all **lubricants** that can help reduce friction.

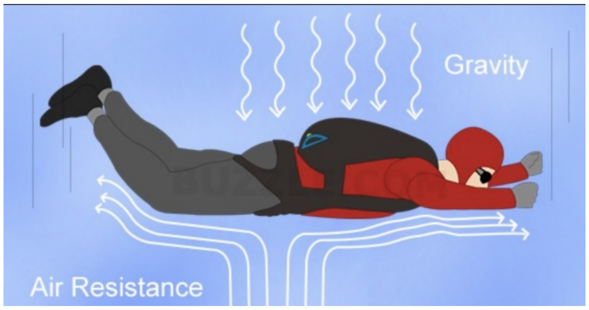
Air Resistance

However, something that causes friction can't always be seen. For example, air resistance is a type of friction that is caused by, yes you guessed it, air! **Particles of air hinder the motion of an object** (slow it down). So for instance, when someone skydives and parachutes out of a plane, **gravity** is *pulling* them down to earth, but **air resistance** (a type of friction) is also working in the opposite direction to slow them down.

Air resistance is also known as **drag** in physics.

However, skydivers need the help of a **parachute to increase the air resistance**, since gravity is a stronger force naturally. Without a parachute...splat! Yikes

Watch this quick experiment that demonstrates air resistance using 2 sheets of paper. Make sure to follow along in your Learning Guide!



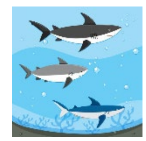
Demo of Air Resistance: https://youtu.be/O-KYLXp2MG4

Types of Friction

There are 3 main types of friction:

Sliding Friction: The friction that occurs when an object slides, for example when you slide down a slide.

Rolling Friction: The friction that occurs when an object rolls, for example, skateboard wheels rolling on the sidewalk.



Fluid Friction: The friction that occurs between an object and a fluid or a gas, for example, a shark swimming through the ocean water.

Watch the video to help you further understand these types of friction. Make sure you follow along in your learning guide! https://youtu.be/H877C_5BMkI

Different Kinds of Forces

Non-Contact Force vs. Contact Force

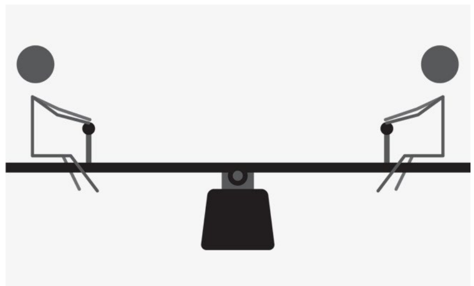
A Non-Contact Force is a force that affects an object **without coming physically in contact with it**. Forces like gravity pulling you down to earth or a magnet pulling a paper clip towards it, are both non-contact forces. They aren't **physically** touching an object in order to apply their force to it.

A Contact Force is a force that affects an object by **physically applying a force to it**.

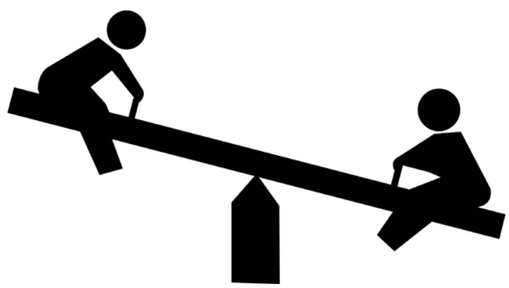
- When you push your friend on a swing you are physically applying a push force to them that is sending them forward.
- When you pull the rope during tug-o-war you are physically applying a pull force that is making the rope come towards you.
- When you kick a soccer ball and there is friction between it and the grass, that friction is also a contact force that is affecting the speed of the soccer ball, slowing it down.

Balanced Force vs. Unbalanced Force

Balanced Force: Forces that are **equal in size**, but **opposite in direction**. **Balanced forces cause no movement because they balance each other out!**

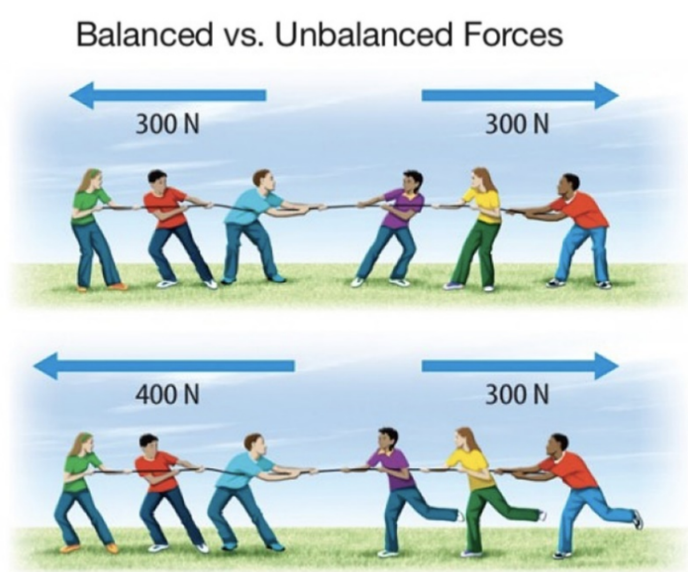


Unbalanced Force: Forces that are **unequal in size**, will cause **movement in the direction of the stronger force.**



Remember how we learned earlier that forces are measured in Newtons? So, if you and your friends were playing a game of tug-o-war, and each team was **pulling with the force of 300 Newtons**, **the force would be balanced**, and neither side would be moving.

But, if one team was pulling with the force of **400 Newtons** and the other team was only pulling with **300 Newtons**, **the force would be unbalanced**, and the team pulling with the most force would be winning, and pulling the other team closer towards them. Take a look at the graphic below to better understand!



Gravity

Gravity is an invisible, non-contact force that draws things towards the center of an object, such as a planet or a star.

- **Gravity is a force of attraction between two objects**
- **Gravity always pulls, it never pushes.**

Earth has gravity, and gravity is the reason why we aren't floating around everywhere. **Gravity** is what **pulls us down towards the earth**. It kind of straps us on, so that we don't fly off the planet!

Did you know? The **farther** we move from the Earth, the **less** gravity there is! There can be very little gravity in space if we're away from planets because planets provide gravitational pull!

Since the moon is much smaller than Earth, the gravity is much smaller.

 https://youtu.be/icSMMLqBTFw

Anything that has mass, has a gravitational pull. So a car, an apple, your shoe, a tree, and even you.. all have a gravitational pull. It's just A LOT less of a pull compared to the gravitational pull of the earth.

More mass = More gravity

Above, you'll see a picture that looks similar to my Great Dane, who's name is Maggie. Did you know that Maggie, who weighs 100lbs here on Earth, would only weigh 38lbs on Mars, and only 13lbs on the moon?

That's right! But why, you might ask? Well, because there's **less gravity on Mars and on the moon than there is on Earth**! Know how high you can jump here on earth? Well, if you were on Mars you'd be able to jump almost **3 times higher on Mars**!

But why is there less gravity on Mars than there is here on Earth? Well, **force depends on the sizes of the masses involved**. So, since Earth is **bigger** (has more mass) than Mars and the moon, it has **more gravitational force**.

The bigger the mass, the bigger the attraction.

Did you know that if we didn't have gravity on earth, all of the water from our lakes, rivers, and oceans would float away? There would be nothing holding the water down! Check out Canadian Astronaut Chris Hadfield's videos to see what daily life is like in outer space.

https://youtu.be/JUUvlnnVMSQ https://youtu.be/xICkLB3vAeU

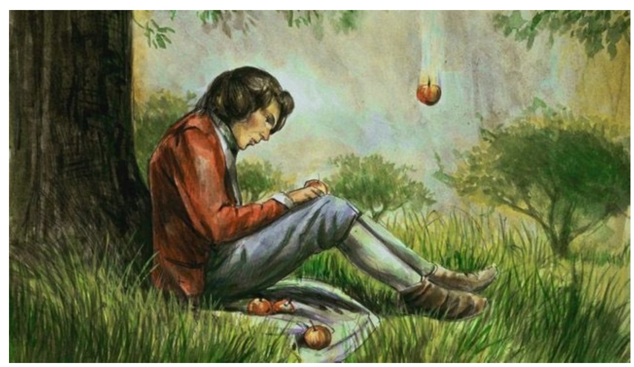
Gravity on the Moon

A trip to the moon would be fun!

https://youtu.be/05EXSF5rVSE

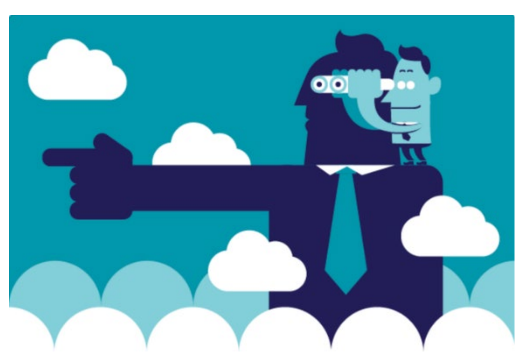
Sir Isaac Newton

So, if gravity is an invisible force, how do we know about it?



Well, believe it or not, we didn't always know that gravity existed! The story goes that Isaac Newton was sitting under an apple tree when he saw one fall and wondered why it fell down towards the ground. He realized that if it was being pulled towards the earth, some invisible force *must* be pulling it. This was the start of Newton's exploration into the laws of motion.

In 1687, Sir Isaac Newton published his book ***Philosophiæ Naturalis Principia Mathematica*** which is still seen as one of the most important books in the history of math and science. Can you imagine discovering something that still influences the world hundreds of years later? Amazing!



One of the admirable qualities of Newton was that he was a humble man. He realized that had it not been for contributions of those before him, such as Aristotle, he would not have been able to make his discoveries and create his widely celebrated theories. He once said, **"If I have seen further it is only by standing on the shoulders of Giants"**.

Watch these quick videos on Sir Isaac Newton and the 3 Laws of Motion:

https://youtu.be/m2JhWkQzw9A

The next video will introduce you to Newton's 3 Laws of Motion. Don't worry too much about understanding them yet, the next few books will teach you more about these 3 laws. https://youtu.be/MDoO19J6Jic

Physics

Learning Guide

Name: ______________________

Instructions:

Using a pencil, complete the following notes as you work through the related lessons. Show **all** of your work. This learning guide needs to be completed before you write your unit test. Do your best and ask questions if you don't understand anything!

3.1 Forces

1. Our world and our universe are governed by laws that are called:

a) The Laws of the Universe
b) The Laws of Life
c) The Laws of the World
d) The Laws of Nature

2. What is a Force?

____

3. Give 1 example (that has not already been given in this chapter) of a pushing force.

____

____

4. Give 1 example (that has not already been given in this chapter) of a pulling force.

____

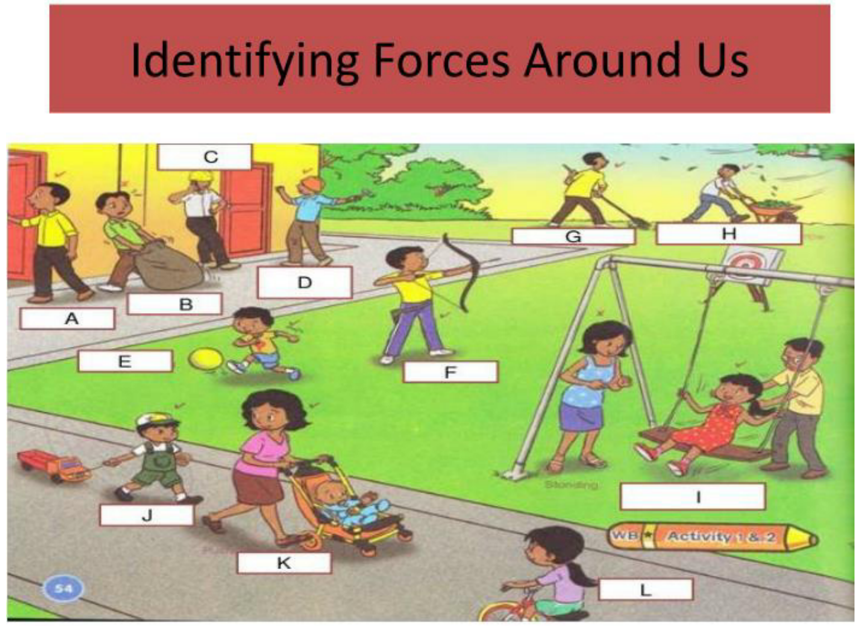
____

5. Kicking a soccer ball is an example of a:

1. Push Force
2. Pull Force
3. Gravitational Force

6. Look at the image on the right. **Circle** if the force shown is a **push or pull.**

A: Push or Pull?
E: Push or Pull?
F: Push or Pull?
H: Push or Pull?
J: Push or Pull?
K: Push or Pull?



7. **Fill in the blanks:** We cannot__________ a force, but we can see the _______________ of a force.

8. Forces can help objects:

a) Speed up
b) Slow down
c) Stay in place
d) Change shape
e) All of the above

9. **Fill in the blank:** All forces are measured in something called ____________________________.

10. Watch the 3 videos in this chapter to answer the following questions.

Video 1: Force and Motion

1. **True or False:** If Mia's kick on the ball was the only force acting upon it, it would keep moving, it would never stop.
   1. True
   2. False

2. **True or false:** It's harder to move things with a lot of mass, and also harder to stop them.
   1. True
   2. False

3. What friction stopped the ball from rolling?
    1. Friction caused by air resistance
    2. Friction caused by the grass
    3. Gravity

4. **Fill in the blank:** The more friction there is, the more ________________________ you need to apply.

Video 2: Swings, Slides and Science

1. **True or False:** Something that's sitting still will stay still, unless a force makes it move
    a. True
    b. False

2. **True or False**: Something that's moving will keep moving, unless a force makes it stop.
    a. True
    b. False

3. When you are swinging on a swing set, and you want to stop, what are the forces of friction at play, making you stop?
    a. Air resistance
    b. Friction from where the swings chains meet the top of the swing set
    c. Your feet dragging on the ground
    d. All of the above

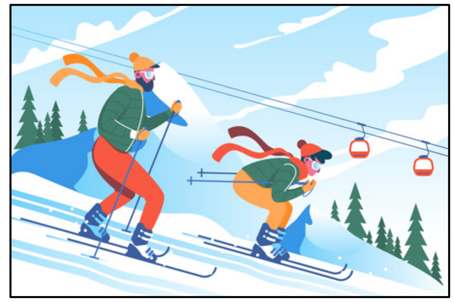
Video 3: Gravity, Force and Work

1. **Fill in the blank:** The _________________kept the rock from falling to the ground from the force of gravity

2. **True or False**: Anytime anything at all that isn't moving, starts moving, it's because some force acts on it.
    a. True
    b. False

12. **True or False:** Friction is an invisible force.
    1. True
    2. False

13. **True or False:** Friction acts in the same direction of the object in motion.
    1. True
    2. False



14. Fill in the blanks: The____________________ the surface and the object are, the_____________ friction there will be.

15. Fill in the blanks: Soap, water, wax and oil are all _____________________that can help ________________ friction.

16. Air resistance is when:

____

____

17. Air resistance is also known as: ______________________

18. After watching the video demonstration of air resistance, circle which paper will fall to the ground faster:

b) 

a) 

19. How is it possible that one paper falls to the ground faster than the other, when they both weigh the same amount? Explain.

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____

20. Types of Friction: Write the definition beside each type of friction.

Sliding Friction:

____

Rolling Friction:

____

Fluid Friction:

____

21. Indicated which type of friction is ***most likely*** occurring in the examples below.

1. You and your friend sled down a snowy hill: _____________________________
2. You kick a soccer ball during your soccer game: ___________________________
3. You pull your little cousin in a wagon on the pavement: ____________________
4. Your dad snowboards down a black diamond run: _________________________
5. A pod of dolphins swimming in the bay: _________________________________
6. You rollerblade to the park with your family: _____________________________
7. Your Grandma kayaks over to your lake house: ___________________________

22. Watch the following video to answer the following questions.

Video: Types of Friction

1. **True or False:** There is Friction between your jacket and your t-shirt.
   a. True
   b. False

2. **True or False:** Air resistance is a type of fluid friction.
   a. True
   b. False
3. **True or False:** If friction **wasn't** present when you were swimming, you would be able to glide all the way across a pool with one stroke.
   a. True
   b. False

23. Provide the definition of and an example for the following terms:

A Non-Contact Force:

____

Ex: ____

A Contact Force:

____

Ex: ____

Balanced Force:

____

Ex: ____

Unbalanced Force:

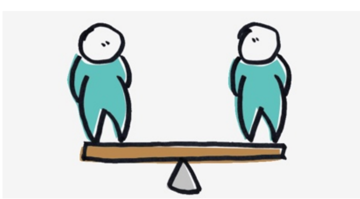
____

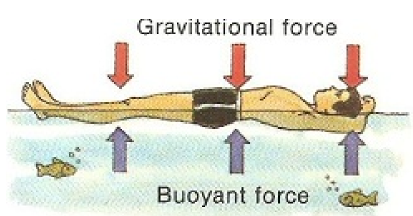
Ex: ____

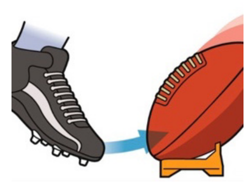
24. Fill in the blanks:

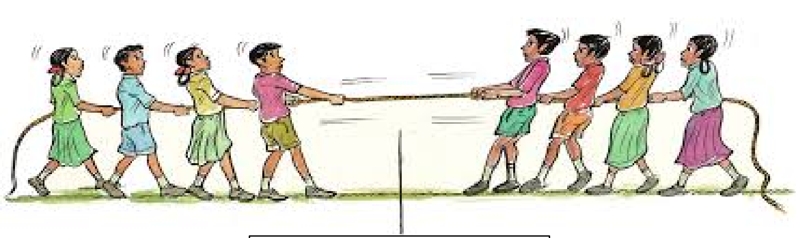
1. Pushing a car is a ______________________(contact or non-contact) force.
2. Pulling a wagon is a ______________________ (contact or non-contact) force.
3. Friction is always a ______________________ (contact or non-contact) force.
4. Gravity is always a ______________________ (contact or non-contact) force.

25. In the following pictures, indicate whether you are being shown **a balanced** or **an unbalanced** force.









26. Gravity is:

____

27. True or False: There is **no gravity** on the moon or in space.

1. True
2. False

28. Fill in the blank: More _________________ = More __________________

Why is there less gravity on Mars than there is on Earth?

____

____

Who discovered gravity and how did he discover it?

____

____

____

____

29. Watch the following video to answer the following questions.

Video: Who was Isaac Newton?

1. **Fill in the blank:** Isaac Newton was a _____________________________.
2. **Who said that Isaac Newton was the smartest person who ever lived?**

   ____
3. **True or False:** Isaac Newton **invented** gravity
   a. True
   b. False
4. Newton invented a new kind of math called:
   a. Geometry
   b. Calculus
   c. Algebra