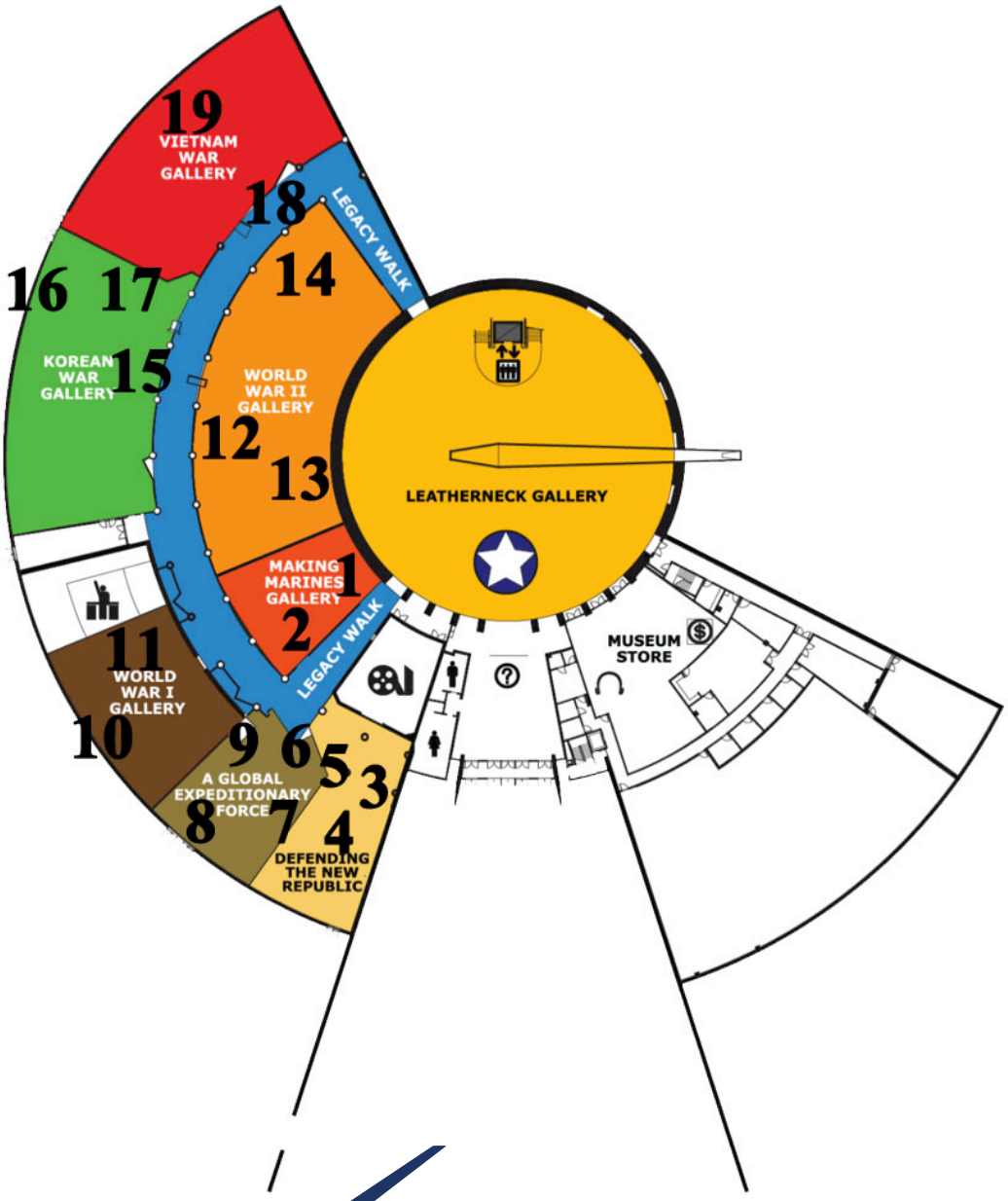
Science Technology Engineering Mathematics

Gallery Worksheet

The United States Marine Corps, since its formation in 1775, has used **STEM** (**Science**, **Technology**, **Engineering**, and **Math**) concepts to become a force in readiness. The activities in this worksheet illustrate how Marines have applied STEM to aid them in meeting the variables of the battlefield throughout their history.

Following the numbers on the floorplan below, find these STEM activities in the galleries of the **National Museum of the Marine Corps**!



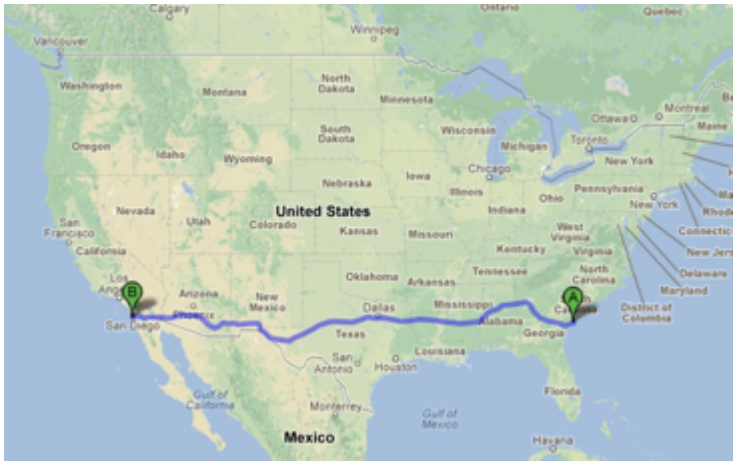
NATIONAL MUSEUM OF THE MARINE CORPS™

www.usmcmuseum.org

Making Marines

1. A Few Good Recruits

- The U.S. Marine Corps has two different Recruit Training Depots, where recruits go to become Marines: **Parris Island, South Carolina,** and **San Diego, California**.



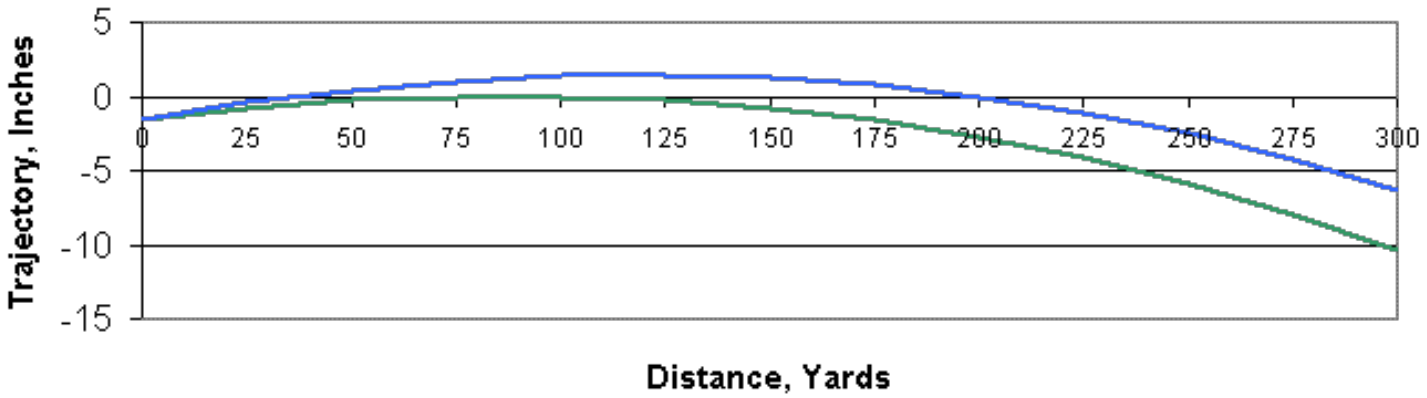
If you are driving the 2,426 miles between Parris Island, SC, (**A**), and San Diego, CA, (**B**) at a speed of 60 miles per hour, how many hours would it take you to reach your destination?

_____ =

2. Marksmanship

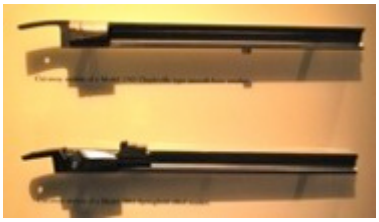
- The ability to hit a target with a rifle at ranges up to 500 yards is essential to being a Marine.
- When shooting at a target, Marines must consider possible variables that could affect their shot. The two biggest variables that affect a projectile's flight are **wind** and **gravity**. Marines need to consider how much gravity will pull the bullet down after it is released. To read the wind's direction and strength, Marines can use indicators like smoke or blowing leaves to help them.

If the blue projectile hit a target 200 yards away, why did the green projectile not hit the same target?



American Revolution (Defending the New Republic): 1775-1865

3. Smooth-Bore and Rifled Musket



- Learn about Colonial gun technology. Touch the gun barrels and watch the videos.

  What new technologies were used to make guns more accurate?

4. Pacific Expeditions

- Between the Revolutionary War and the Civil War, Marines sailed all over the world with the U.S. Navy on distant expeditions. One of the ships that sailed in the famous Wilkes Expedition was the USS *Vincennes*. This ship was a "sloop-of-war," or warship, and was powered by wind.
- The force of **wind** on the sails of a ship can change both its direction and speed. Wind comes from the uneven heating of the earth's surface. Hotter air rises, and then colder air sinks down and replaces it. This movement is what makes the wind blow.

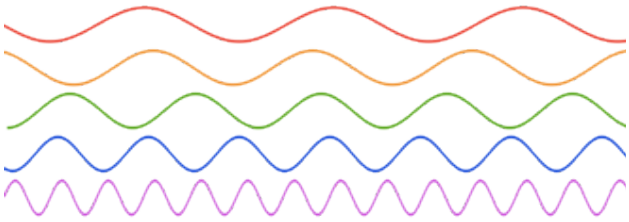
  Why do you think there are both cold winds and warm winds?

  To learn more about winds and weather, visit: http://www.noaa.gov/

Civil War (Defending the New Republic): 1775-1865

5. Command and Communications

- Instruments were used during the Civil War for communicating combat actions.
- Field drums were used to signal field maneuvers in battle and control daily routine activities in camp. The sound of a drum can be heard because of the **sound waves** it sends out.
- In this image, the different lines show different sound waves, or sinusoidal waves, at various frequencies and wavelengths. **Frequency** is defined as the number of reoccurrences of a repeating events over a certain amount of time.



Wavelength is the spatial distance of one complete wave.

Which sound wave has the greatest frequency?
Which has the largest wavelength?
Greatest frequency:
Largest wavelength:

Global Expeditionary Force: 1866-1916

6. Technology

- During the Industrial Revolution, steam-powered ships were one of the inventions that drastically changed how far and how quickly Marines could travel. U.S. Marines were aboard President Roosevelt's "Great White Fleet," which was a group of **steam-powered ships** sent around the world to display America's power.
- These ships had boilers that made steam by boiling water. **Energy** was used to turn the water into steam. The steam then gave off energy before turning back to a liquid. This energy is considered the "usable" energy of steam, which powered steam ships. The process of powering steam ships is a repeating circular system.

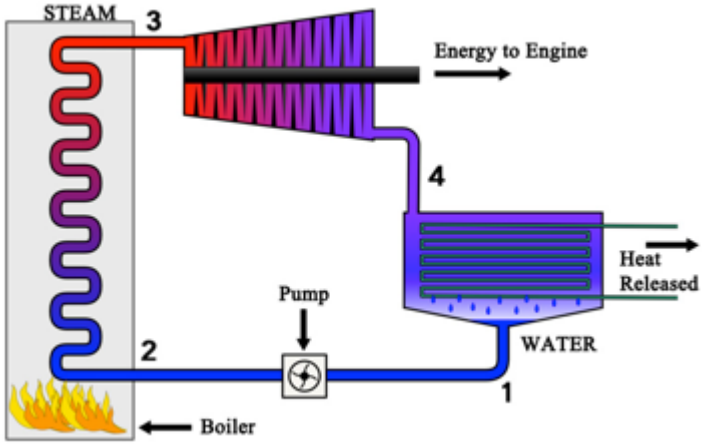
In this diagram, describe what is going on at each of the numbered steps.

1.

2.

3.

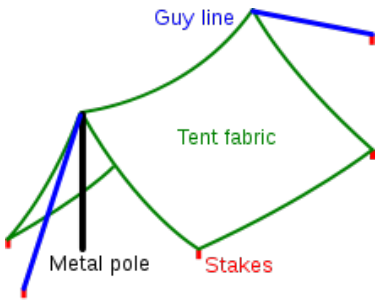
4.



7. Marine Life: Philippines, 1901

- A dry **tent** was one of the small pleasures in which Marines in the Philippines could take comfort. To keep the Marines sheltered, the tents had to be constructed properly.

Step inside this tent and describe the steps needed to construct a tent like this so that it would provide the best shelter possible.



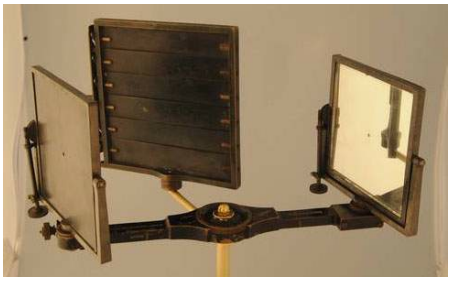
1.

2.

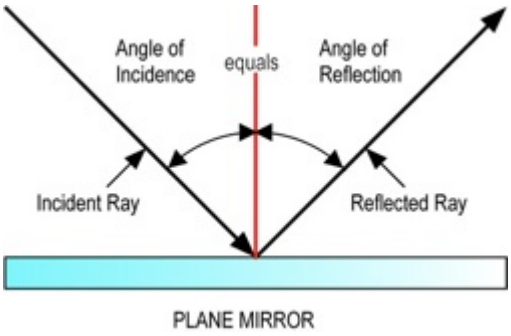
3.

4.

8. Field Heliograph



- The field heliograph reflected the sun's rays with a **mirror**, and a spring-activated shutter could be opened and closed to transmit Morse code messages to a receiving station located 30 or more miles away.
- Mirrors reflect light at an **angle** equal to that in which the light comes in.



If a Marine field heliograph operator sent a message to a receiving station with an Angle of Incidence of 45º, what would be the Angle of Reflection?

9. King Armored Car

- The King armored car was the first American **armored vehicle** and was acquired by the U.S. Marine Corps in 1916. The King armored car was built on top of a King luxury sedan chassis car. This armored car was covered with quarter-inch-thick armor that was placed in sections over the car.
- If you look closely at the armor on the left side of this car, you can see a small **dent** the about the size of a bullet. This mark is from the testing of the car's armor to see if it could be penetrated.

Why do you think that is it important that engineers test their products before they are used?

World War I: 1917-1918

10. Chemical Warfare

- Chemicals and gases were commonly used weapons during World War I. Mustard gas was especially dangerous. It acquired the name "mustard gas" because when the gas was used in an impure form, which was more common, the gas had a yellow-brown color and had an odor that resembled the smell of mustard or garlic.
- The molecular formula of mustard gas, also called sulfur mustard, is $C_4H_8Cl_2S$.

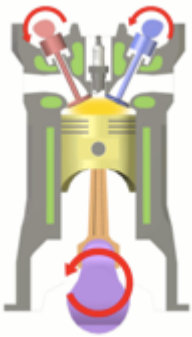
Using the atomic masses below, find the formula mass of sulfur mustard.
C (Carbon) = 12.01, H (Hydrogen) = 1.008, Cl (Chlorine) = 35.45, S (Sulfur) = 32.07

11. Liberty L-12 Aircraft Engine

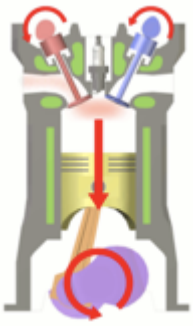
- This engine was designed during the heat of war and was perhaps America's greatest material contribution to the Allied victory in World War I. The Liberty L-12 engine powered thousands of British, French, and Italian aircraft. This engine had an internal combustion engine.

The Steps of an Internal Combustion Engine

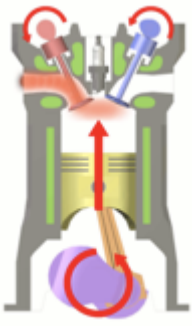
At which two steps does an internal combustion engine generate its power?



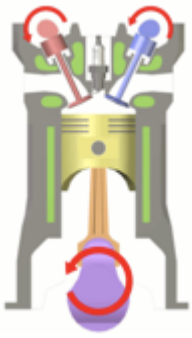
Starting position



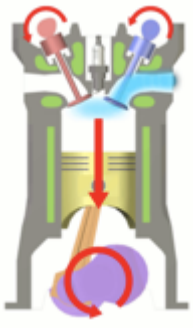
Intake stroke



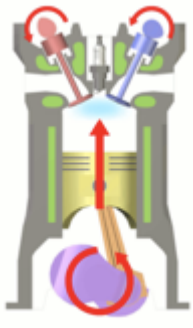
Compression stroke



Ignition of fuel



Power stroke

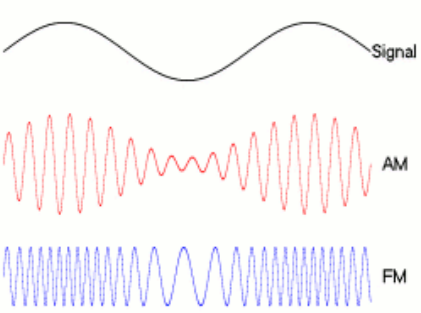


Exhaust stroke

World War II (Uncommon Valor): 1940-1945

12. Pearl Harbor

- When Japanese forces attacked U.S. forces at Pearl Harbor, Hawaii, in 1941, many people across the U.S. found out the news by listening to their **radios**. Radio newscasts were one of the important ways people learned about what was going on in the world during that time.



- The first radio stations were **AM** stations. **FM** radio was invented in the 1940s but didn't become commonly used until the 1970s. AM stands for "amplitude modulation," and FM stands for "frequency modulation." AM radio works by changing the **amplitude** (strength) of the broadcasted signal. FM works by changing the **frequency** (repetition) of the signal instead of the strength.

AM radio stations have more interference in their signals than FM stations. What kind of sources do you think would create the interference that sounds like static on the radio?

13. Ford GPW Jeep

- In 1941, the word "Jeep" became a part of the American lexicon. Jeeps like this one were used by the Marine Corps throughout World War II.
- The table below gives different measurements of this Ford Jeep.

COMBAT WEIGHT	LENGTH	HEIGHT	WIDTH	MAX SPEED	CAPACITY
2,800 pounds	11 ft	6.3 ft	5 ft	65 mph	17 gal
1,272.7 kg	3.35 m	1.92 m	1.52 m	68.9 kph	64.43 L

- While the **Standard system** (inch, gallon, ounce, etc.) is used in the United States, in other parts of the world, like the United Kingdom, the **Metric system** (centimeter, liter, gram, etc.) is used.

Use the following conversions to convert the measurements in the first row of this table into metric measurements. Place your answers in the blank spaces in the second row of the table.

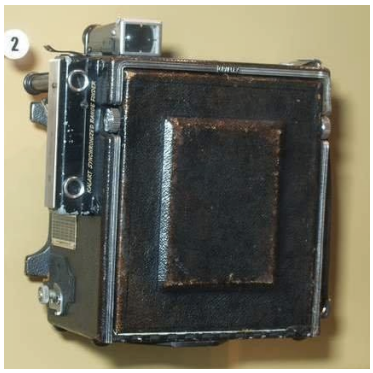
1 kilogram = 2.2 pounds

1.06 kilometers per hour = 1 mile per hour

1 meter = 3. 28 feet

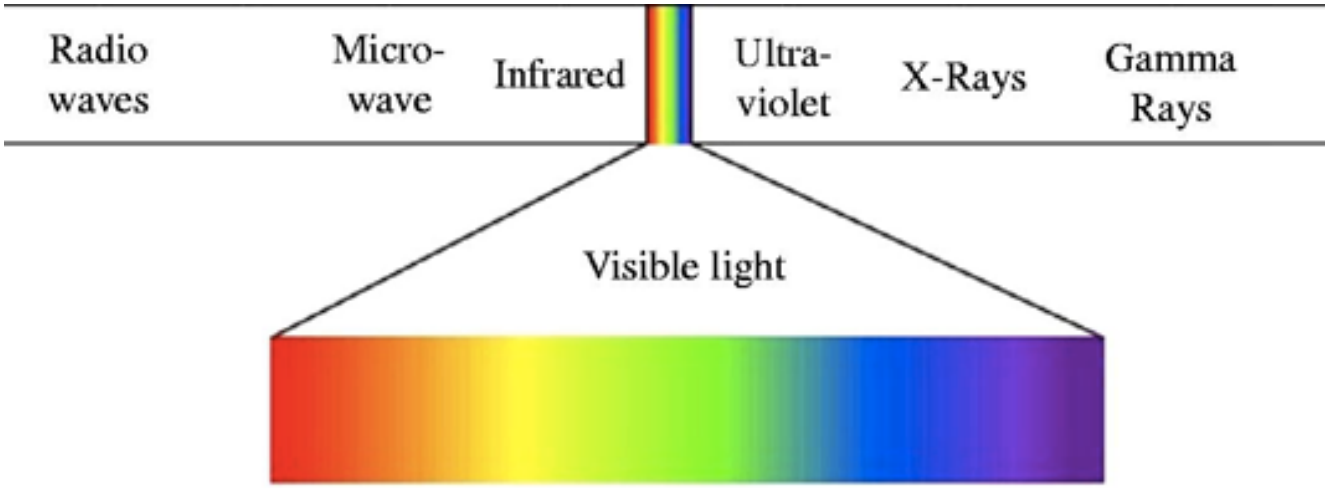
3.79 liters = 1 gallon

15. Speed Graphic Camera



- In the Battle of Iwo Jima during World War II, photographer Joe Rosenthal used the Anniversary Speed Graphic camera to photograph the second flag-raising over Mt. Suribachi. The camera worked by recording the visible light that is reflected from objects in a single moment in time.
- Humans are only able to see a small part (the **visible** light) of the **electromagnetic spectrum** that comes from the sun. A camera works similar to the way the human eye does by detecting the **visible** light.

The Electromagnetic Spectrum



Although the human eye cannot see the invisible portions of the electromagnetic spectrum, can you name some of the devices we have invented to detect those measures?

Korean War (Send in the Marines): 1946-1953

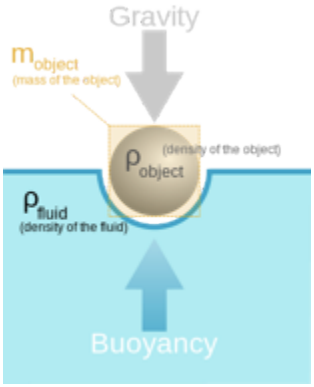
16. 3.5-inch Rocket Launcher "Super Bazooka"

- This rocket launcher could launch a rocket 900 yards, and the rocket could penetrate 11 inches of armor.
- Newton's Second Law of Motion: Force equals mass times acceleration (**F = MA**).
- The connection between the rocket launcher and Newton's Second Law: The **force** (F) of a launched rocket is the product of that rocket's **mass** (M) and **acceleration** (A) multiplied together. (F = MA)

If the acceleration of a launched rocket from a 3.5-inch rocket launcher is 20.6 meters/second squared (m/s^2) and the mass is 4 kilograms, what is the force of the rocket?

17. LVT3

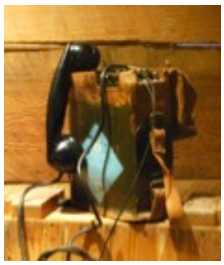
- This vehicle is an **amphibious tractor** that has the ability to travel over the water and then come up on land and carry its cargo over beaches. These large and heavy vehicles are able to stay afloat in water because of a force called buoyancy.



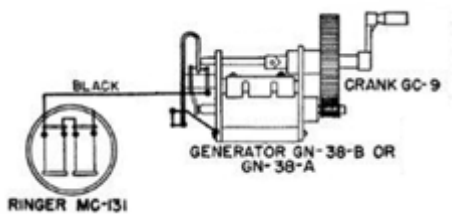
- **Buoyancy** is an upward force that pushes against the weight of an object that is immersed in a fluid. Archimedes' principle states: Any object, wholly or partially immersed in a fluid, is buoyed up by a force equal to the weight of the fluid displaced by the object.

How would this LVT, which has a combat weight of 14.8 tons, float?

18. Main Line of Resistance (MLR) Field Telephone



- The fortified trench lines of the Korean War, in its final years, allowed the US Marines to stay inside shelters for long periods of time. **Field telephones**, like the one inside this bunker, were used to communicate with others without having to leave the shelter.



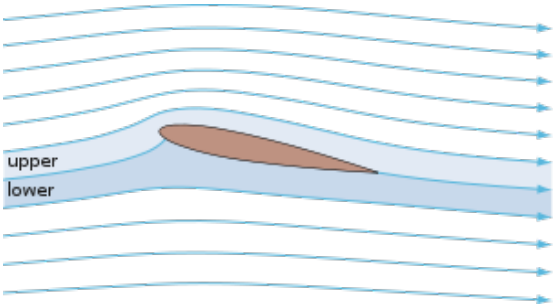
- The field telephone was a way of signaling the operator, or another party, that you wanted to make a call, or talk to them. The field telephone operator would use a **hand crank** to generate **electricity**, which would then **ring** the bell on the field phone the user was trying to contact.

Why does a hand crank generate electricity?

Vietnam War (In the Air, on Land and Sea): 1954-1975

19. Bell UH-1E Iroquois (Huey)

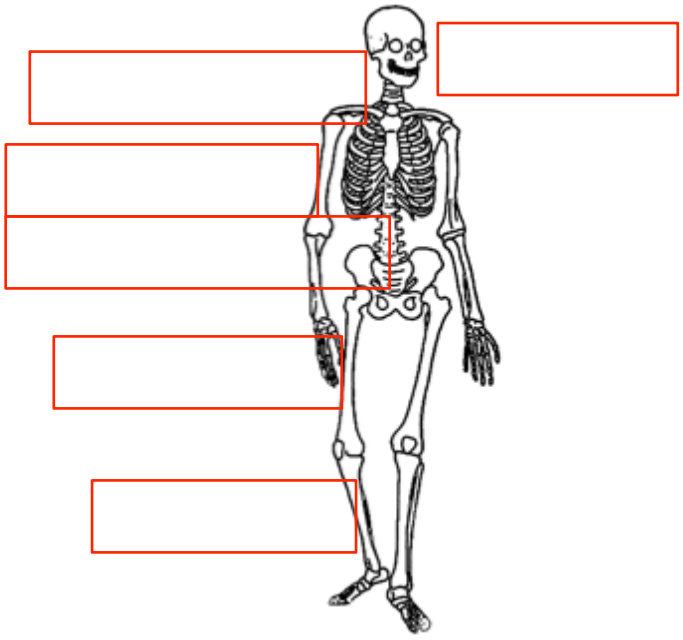
- Helicopters were used extensively during the Vietnam War. A U.S. Marine flew the Huey helicopter hanging above your head during the Vietnam War.
- The **propellers (rotor blades)** on a helicopter are **curved** so that they create **lift** when they spin. The rotor blades of a helicopter are like the wings of an airplane. Air moves faster at the top of the spinning curved blade so slower air underneath is at a higher pressure and pushes up on the blade, which causes the helicopter to rise.



Do scientists consider air a fluid? Explain why or why not.

20. Navy Medical Support

- **Navy Corpsmen** who tended wounded Marines belonged to the Navy Hospital Corps. Marines called them "Angels of Mercy."
- Navy Corpsmen were trained to be able to perform as **doctors** and treat those who are wounded in the field. Navy Corpsmen need to understand the human body and its **skeletal system**.

Place these names of the skeletal system next to their appropriate location on the skeleton.

- Collarbone
- Skull
- Femur
- Humerus
- Tibia
- Vertebrae