<u>Earth & Space Science Packet</u>

April 20th- May 1st, 2020

Griffin & King

This packet contains:

1. Worksheets for Ocean Floor, Ocean Water and Ocean Life, Earth's Atmosphere
2. All About Waves Article
3. Atmospheric Density Lab

What needs to be turned in for a GRADE?

- Worksheets with questions answered

(Ocean Floor and Ocean Water/Life is April 20-24; Atmosphere is April 27-May 1)

Optional/Enrichment included:

- Labs
- Science Articles

If these are completed, we would LOVE for you to share:
Send us pictures on remind/email, or tag @TheBurgScience and #Team DCS on Twitter

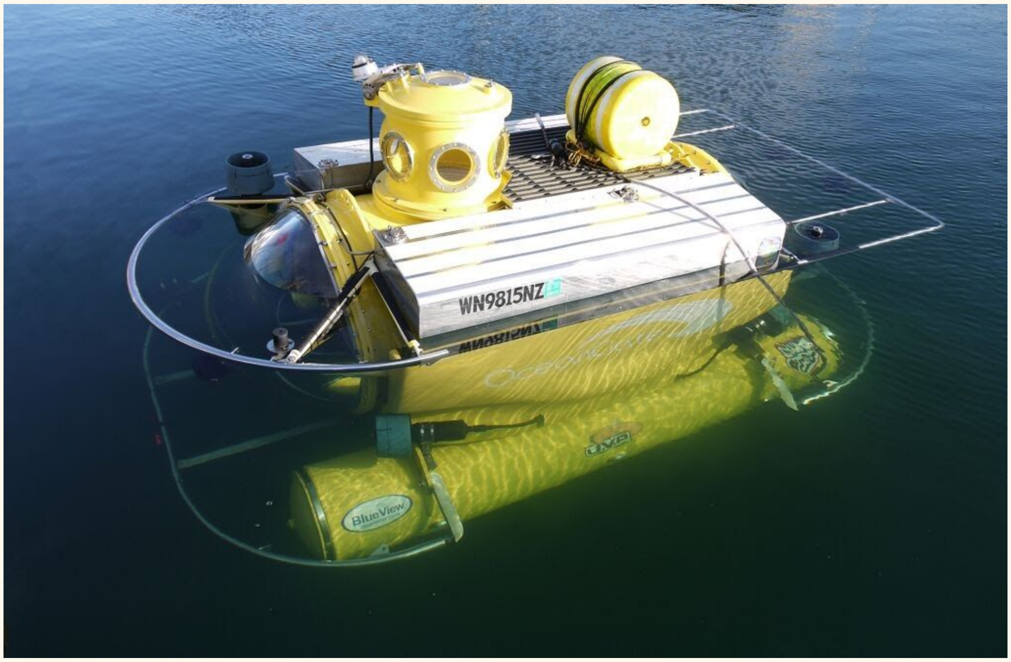
EARTH & SPACE SCIENCE
GRIFFIN & KING

THE OCEAN FLOOR

THE VAST WORLD OCEAN

- Nearly **70** percent of Earth's surface is covered by the global ocean.
- **Oceanography** is a science that draws on the methods and knowledge of geology, chemistry, physics, and biology to study all aspects of the world ocean.
- The world ocean can be divided into **four** main ocean basins- the **Pacific Ocean**, the **Atlantic Ocean**, the **Indian Ocean**, and the **Arctic Ocean**.
- The **topography** of the ocean floor is as diverse as that of continents.
- **Bathymetry** (*bathos*=depth, *metry*=measurement) is the measurement of ocean depths and the charting of the shape or topography of the ocean floor.
- Today's **technology-** particular sonar, satellites, and submersibles- allows scientists to study the ocean floor in a more efficient and precise manner than ever before.
- **Sonar** is an acronym for **so**und **n**avigation **a**nd **r**anging. Sonar calculates ocean depth by recording the time it takes sound waves to reach the ocean floor and return.

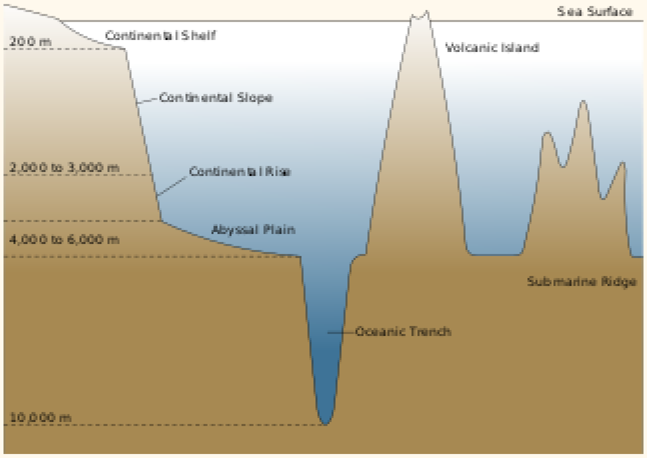
- A **submersible** is a small underwater craft used for deep-sea research. Submersibles are used to collect data about areas of the ocean that were previously unreachable by humans.



OCEAN FLOOR FEATURES

- The ocean floor regions are the **continental margins**, the ocean **basin floor**, and the **mid-ocean ridge**.
- The zone of transition between a continent and the adjacent ocean basin floor is known as the **continental margin**.
- In the Atlantic Ocean, thick layers of undisturbed sediment cover the continental margin, an area with very little volcanic or earthquake activity.
- In the Pacific Ocean, the oceanic crust is plunging beneath continental crust. This force results in a narrow continental margin that experiences both volcanic activity and earthquakes.
- **Continental shelves** contain important mineral deposits, large reservoirs of oil and natural gas, and huge sand and gravel deposits.
- The **continental shelf** is the gently sloping submerged surface extending from the shoreline.
- **Trenches** form at sites of plate convergence where one moving plate descends beneath another and plunges back into the mantle.

- **Deep-ocean trenches** are long, narrow creases in the ocean floor that form the deepest parts of the ocean.
- The sediments that make up abyssal plains are carried there by turbidity currents or deposited as a result of suspended sediments settling.
- **Abyssal plains** are deep, extremely flat features. These regions are possibly the most level places on Earth.
- Submerged volcanic peaks on the ocean floor are **seamounts**.



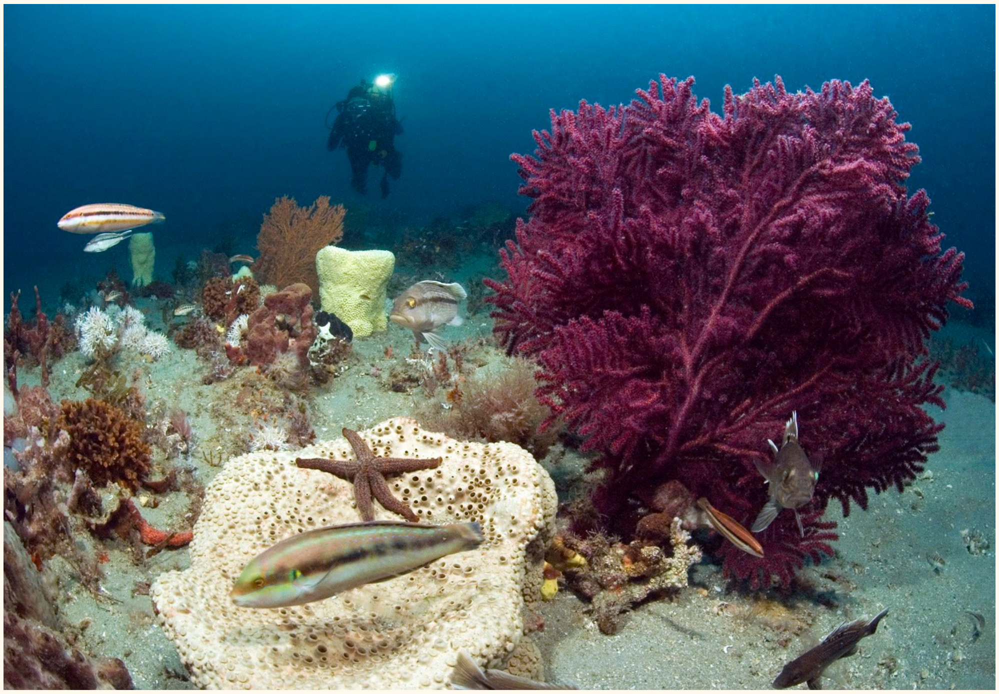
RESOURCES FROM THE SEAFLOOR

- **Oil** and **natural gas** are the main energy products currently being obtained from the ocean floor.
- Other major resources from the ocean floor include sand and gravel, evaporative salts, and manganese nodules.

QUESTIONS

1. How much of the earth's surface is covered by the global ocean?
2. What are the four main ocean basins?
3. What do the letters that spell sonar represent?
4. What are the ocean floor regions?
5. What is the difference between continental margin and continental shelf?
6. Describe a trench.
7. What is a seamount?
8. What energy products are obtained from the ocean floor?

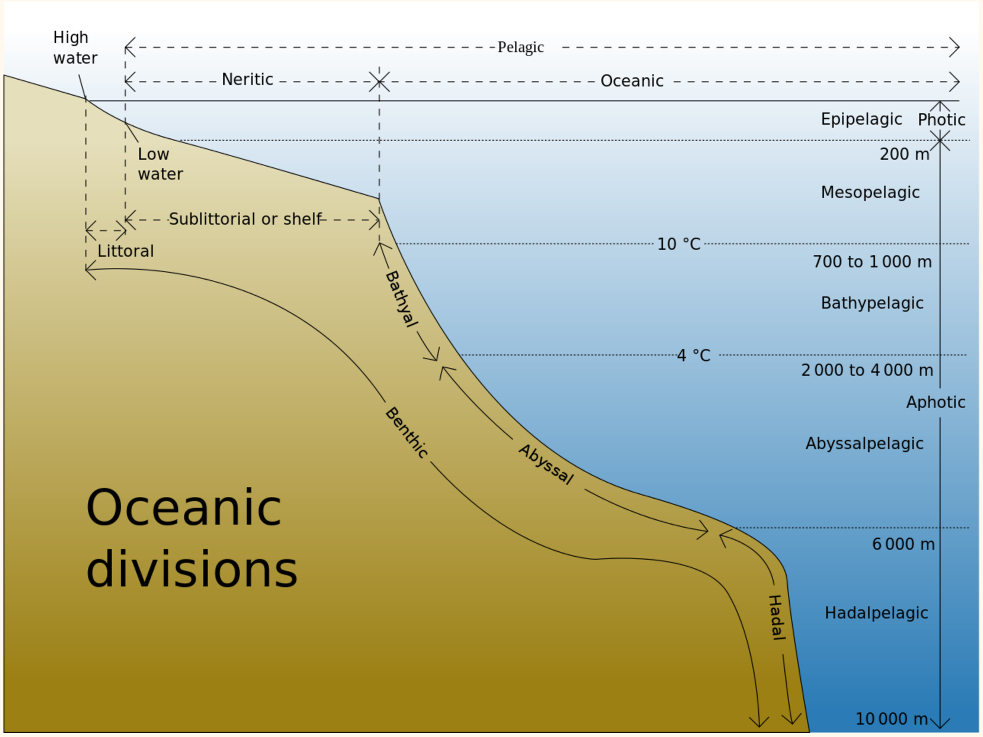
OCEAN WATER AND OCEAN LIFE



SEAWATER

- Because the proportion of dissolved substances in seawater is such a small number, oceanographers typically express salinity in parts per thousand.
- **Salinity** is the total amount of solid material dissolved in water.
- Most of the salt in seawater is **sodium chloride**, common **table salt**.
- The ocean's surface water temperature varies with the amount of solar radiation received, which is primarily a function of latitude.
- The **thermocline** (*thermo*=heat, *cline*=slope) is the layer of ocean water between about 300 meters and 1000 meters, where there is a rapid change of temperature with depth.
- The **pycnocline** (pycno=density, cline=slope) is the layer of ocean water between about 300 meters and 1000 meters where there is a rapid change of density with depth.
- Oceanographers generally recognize a three-layered structure in most parts of the open ocean; a shallow surface **mixed zone**, a **transition zone**, and a **deep zone**.

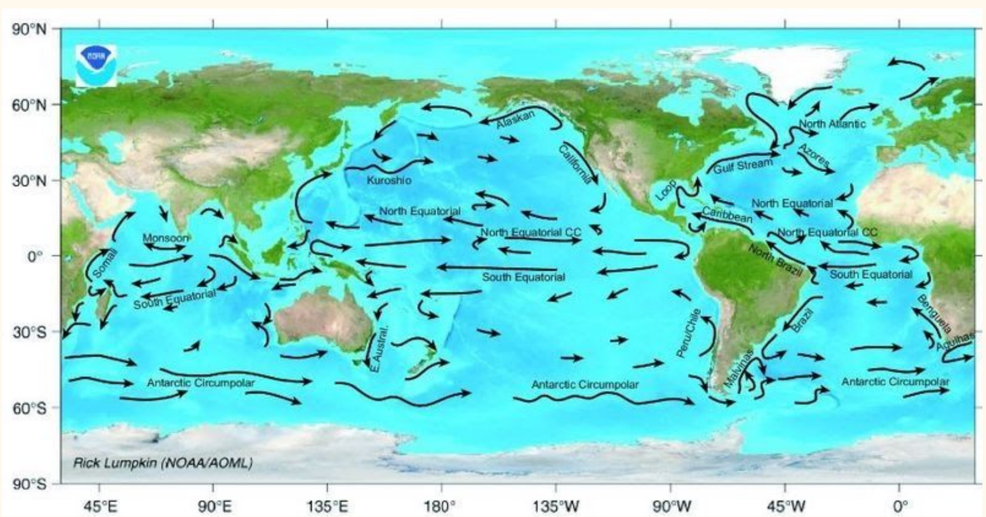
- The **mixed zone** is the area of the surface created by the mixing of water by waves, currents, and tides. The mixed zone has nearly uniform temperatures.
- The **transition zone** includes a thermocline and associated pycnocline.
- Sunlight never reaches the **deep zone**, which accounts for about 80 percent of ocean water.
- In high latitudes, the three-layered structure of the open ocean does not exist because there is no rapid change in temperature or density with depth.



OCEAN LIFE

- Marine organisms can be classified according to where they live and how they move.
- **Plankton** (*planktos*=wandering) include all organisms- algae, animals, and bacteria- that drift with ocean currents.
- Among plankton, the algae that undergo photosynthesis are called **phytoplankton**.
- Animal plankton are called **zooplankton** and include the larval stages of mane marine organisms.
- **Nekton** (*nektos*=swimming) include all animals capable of moving independently of the ocean currents, by swimming or other means of propulsion.
- The term ***benthos*** (*benthos*=bottom) describes organisms living on or in the ocean bottom.

- Three factors are used to divide the ocean into distinct marine life zones; the **availability of sunlight**, the **distance from shore**, and the **water depth**.
- The upper part of the ocean into which sunlight penetrates is called the **photic zone** (*photos*=light).
- The area where the land and ocean meet and overlap is the **intertidal zone**.
- Seaward from the low-tide line is the **neritic zone**, which covers the continental shelf.
- Beyond the continental shelf is the **oceanic zone**.
- Open ocean of any depth is called the **pelagic zone**.
- The **benthic zone** includes any sea-bottom surface regardless of its distance from shore and is mostly inhabited by benthos organisms.
- The **abyssal zone** is a subdivision of the benthic zone and includes the deep-ocean floor.
- At hydrothermal vents, super-heated and mineral-filled water escapes into the ocean through cracks in the crust. At some vents, high water temperatures support organisms found nowhere else in the world.



OCEAN CIRCULATION

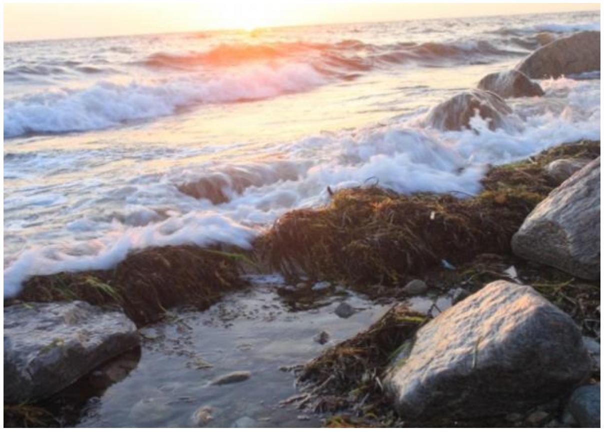
- **Surface currents** develop from friction between the ocean and the wind that blows across its surface.
- **Ocean currents** are masses of ocean water that flow from one place to another.
- **Surface currents** are movements of water that flow horizontally in the upper part of the ocean's surface.

- Because of Earth's **rotation**, currents are deflected to the right in the Northern Hemisphere and to the left in the Southern Hemisphere.
- **Gyres** are huge circular-moving current systems that dominate the surfaces of the oceans.
- The **Coriolis effect** is the deflection of currents away from their original course as a result of Earth's rotation.

QUESTIONS

1. What is salinity?
2. What is the difference between the thermocline and the pycnocline?
3. List and describe the 3 zones of the open ocean.
    a.
    b.
    c.
4. How do plankton move?
5. What are the two types of plankton?
6. What is the upper part of the ocean called?
7. What is the pelagic zone?
8. What are surface currents and how do they develop?

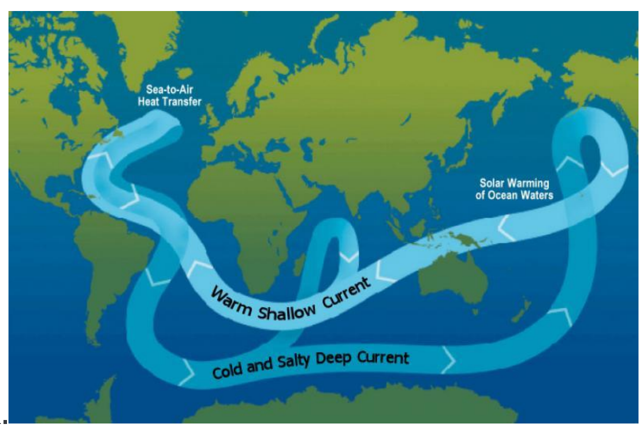
Currents, Waves, and Tides: The Ocean in Motion



At the entrance of most beaches, there is a bulletin board with notices about water conditions: maybe a faded sign warning about rip currents and a list of this week's tide tables. Most people pass them by without a second thought, but if you want to enter the ocean, it is important to know its movements, whether to avoid being caught in a riptide or to figure out when the waves will be at their best.

Current Affairs

A large movement of water in one direction is a current. Currents can be temporary or long-lasting; they can be near the surface or in the deep ocean. The largest ones shape the Earth's global climate patterns (and even local weather conditions) by moving heat around the world.



The global conveyor belt moves water all around the world. *(US Global Change Research Program, **Wikimedia Commons**)*

Many large currents are driven by differences in temperature and salinity. In the Arctic, cold salty water is left behind when ice freezes, and this denser water sinks towards the seafloor. This starts off a planetary current pattern called the **global conveyor belt** that slowly moves around the world, taking 1000 years to make a complete circuit. Scientists worry that the melting ice caused by global warming may **weaken the global conveyer belt** by adding extra fresh water in the Arctic. A 2018 study found that the massive ocean current that courses around the Atlantic Ocean called the Atlantic Meridional Overturning Circulation has decreased in strength by about 15 percent since 400AD and is now the **weakest it has** been in 1,600 years. Ironically, despite an overall increase in global temperatures, many places in North America and Europe may get colder as a result. Other large currents at the surface of the ocean are affected by **global wind patterns and the Earth's rotation**, such as the Gulf Stream off the eastern United States and the Kuroshio Current off the east coast of Japan.

Rip currents are dangerous and fast moving. *(K.G. Schneider, **Flickr**)*

Not all currents occur at such a large scale. Individual beaches may have rip currents that are dangerous to swimmers. Rip currents are narrow channels of water that **form when waves of different intensities break** on the shoreline and generate currents that try to keep the water level even by pulling the large amount of water **brought to shore by the waves** back into the ocean. These rip currents can move faster than an Olympic swimmer, **at speeds as fast as eight feet (2.4 meters) per second**. At these speeds, a rip current can easily overpower a swimmer trying to return to shore. Instead of attempting to swim against the current, experts suggest not to fight it and to swim parallel to shore. For more safety tips visit **NOAA's guide to rip current safety**.

Wild Waves

Waves play an important role in the way coastal ecosystems function, and also provide tourism dollars because of their draw for surfers. *(Flickr user bluewavechris)*

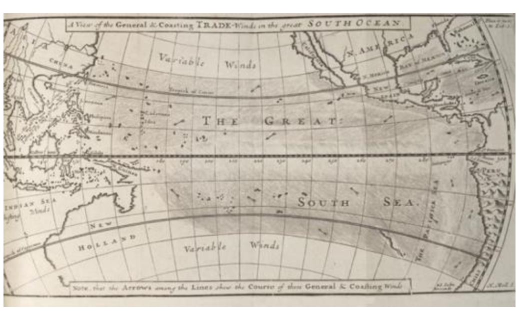
Sculpting seawater into crested shapes, waves move water and energy from one area to another. Waves located on the ocean's surface are commonly caused by wind transferring its energy to the water, and big waves, or swells, can travel over long distances. A wave's size depends on wind speed, wind duration, and the area over which the wind is blowing (the fetch). This variability leads to waves of all shapes and sizes. The smallest categories of waves are ripples, growing less than one foot (.3 m) high. The **largest waves** occur where there are big expanses of open water that wind can affect. Places famous for big waves include Waimea Bay, Hawaii; Jaws, Maui; Mavericks, California; Mullaghmore Head, Ireland; and Teahupoo, Tahiti. These large wave sites attract surfers, although occasionally, waves get just too big to surf.

When waves crash onshore they can make a significant impact to the landscape by shifting entire islands of sand and carving out rocky coastlines. Storm waves can even move boulders the size of cars above the high tide line, leaving a massive boulder hundreds of feet inland. Until recently, scientists attributed the placement of these rogue boulders to past tsunami damage, however, a **2018 study** upended this notion by carefully recording the movement of boulders along a swath of rocky coastline in Ireland over a time period in which no tsunamis occurred. In addition to over 1,000 mid-sized boulders, many reaching over 100 tons in weight, scientists recorded the movement of a 620-ton boulder (the same weight as 90 full-sized **African elephants**), showing that storm waves moved it over 8 feet (2.5 meters) in just one winter.

A tsunami is a set of waves created by a disturbance, likely an earthquake, which reaches the surface of the sea. *(Warren Antiola, **Flickr**)*

Giant waves don't just occur near land. '**Rogue waves**,' which can form during storms, are especially big—**there are reports of 112ft (34m) and 70ft (21m) waves**—and can be extremely unpredictable. To sailors, they look like walls of water. No one knows for sure what causes a rogue wave to appear, but some scientists think that they tend to form when different ocean swells reinforce one another. The **largest waves recorded** have been in the North Sea in the North Atlantic Ocean. One was recorded by a buoy in 2013 and measured 62.3 feet (19m) and another nicknamed the **Draupner wave** was a massive wall of water 84 feet (25.6m) high that crossed a natural gas platform on New Year's Eve, 1995.

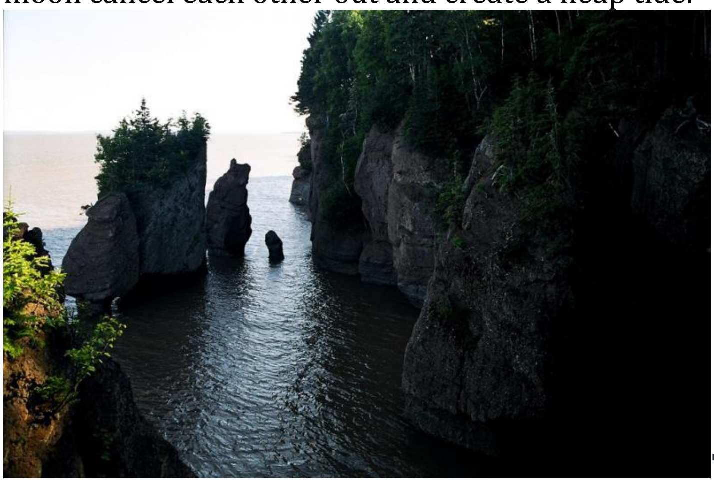
Wind is not the only cause of wild waves. A **tsunami** is a wave created by a disturbance that displaces a large amount of water, like an earthquake or a landslide, and they often occur in clusters or sets. Tsunami waves are capable of destroying seaside communities with wave heights that **sometimes surpass 20m (around 66ft)**. Tsunamis have caused over 420,000 deaths since 1850: over 230,000 people were killed by the giant earthquake off Indonesia in 2004, and the damage caused to the Fukushima nuclear reactor in Japan by a tsunami in 2011 continues to wreak havoc. Although tsunamis cannot be predicted in advance when an earthquake occurs, tsunami warnings are broadcast and any waves can be tracked by a global network of buoys – this early warning system is essential because tsunamis can travel at over 400 miles per hour.



The arrows show the direction of ocean currents recorded by William Dampier while crossing "La Grande Mer du Sud"—the Pacific Ocean. *(Courtesy of Smithsonian Institution Libraries, Washington, D.C.)*

Reliable Tides

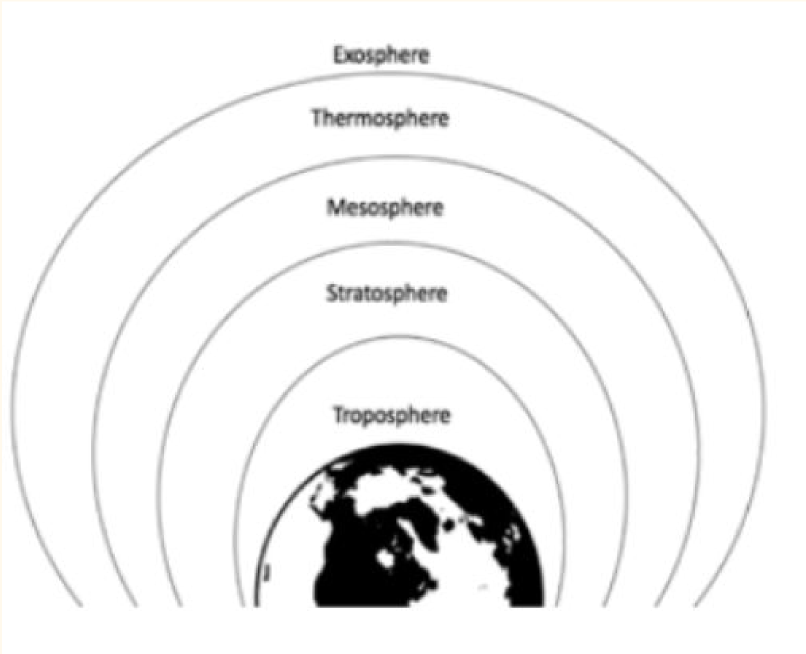
Tides are actually waves, the biggest waves on the planet, and they cause the sea to rise and fall along the shore around the world. Tides exist thanks to the gravitational pull of the moon and the sun, but vary depending on where the moon and sun are in relation to the ocean as the earth rotates on its axis. The moon and sun's pull cause two bulges or high tides in the ocean on opposite sides of the earth. The moon, being so much closer, has more power to pull the tides than the sun and therefore is the primary force creating the tides. However, when the sun and moon reinforce each other's gravitational pulls, they create larger-than-normal tides called spring tides. This happens when the moon is in line with the sun and Earth, either on the same side of the Earth as the sun or directly on the opposite side of the Earth. Smaller-than-usual tidal ranges occur when the gravitational force of the sun is at a right angle to the pull from the moon. The two forces of the sun and moon cancel each other out and create a neap tide.



The Bay of Fundy in New Brunswick, Canada has the highest tidal range. The tides range from 3.5m (11ft) to 16m (53ft) and cause erosion to the landscape, creating massive cliffs. *(Smulan77, **Flickr**)*

Tidal movements are tracked using networks of shore-based water level gauges, and many countries provide real-time information with tidal listings and tidal charts. Tides can be tracked for specific locations in order to predict the height of a tide and when low and high tide will occur in the future. **The Bay of Fundy** in Nova Scotia, Canada has the highest tidal range of any place on the planet. The tides there range from 3.5m (11ft) to 16m (53ft) and cause erosion, creating massive cliffs. This erosion also releases nutrients into the water that help support marine life. Currents associated with the tides are called flood currents (incoming tide) and ebb currents (outgoing tide). Having reliable knowledge about the tides is **important** for navigating ships safely, and for engineering projects such as **tidal** and **wave energy**, as well as for planning trips to the seashore.

EARTH'S ATMOSPHERE



EARTH'S ATMOSPHERE

- **Earth's Atmosphere-** thin layer of gases surrounding the Earth
- Contains the nitrogen, oxygen, carbon dioxide, and water necessary for life on Earth (elements of life).
- Insulates the Earth, keeping temperature at a survival rate.
- Protects from the sun's harmful rays
- Burns up meteors before they hit the Earth's surface.

LAYERS OF THE ATMOSPHERE

- **Troposphere-** layer closest to Earth's surface; warmest area is closest to Earth's surface
- **Stratosphere-** AKA "the ozone layer"- the atmospheric layer directly above the troposphere; greatest amount of ozone gas; protects Earth from ultraviolet rays that can kill plants, animals, and other organisms.
- **Mesosphere-** most meteors burn here

- ◦ **Ionosphere-** region that contains ions that reflect and transmit radio waves at ground level.
- ◦ **Auroras-** colored lights in spring and fall closer to North and South Poles due to sun rays striking air molecules.

- **Thermosphere-** very hot
- **Exosphere-** farthest from Earth's surface; low pressure and density; molecules move so quickly they absorb the sun's radiation.

AIR PRESSURE & ALTITUDE

- **Gravity-** force that pulls all objects to Earth
- Gravity pulls the atmosphere toward Earth
- Oxygen decreases as you move higher altitudes (the air is less dense); this is why mountain climbers need oxygen.

THE SUN'S ENERGY

- **Radiation-** transfer of energy by electromagnetic waves; mostly visible light, ultraviolet light, and infrared radiation.
- **Visible light-** majority of sunlight; the sun's light passes through the atmosphere for us to see; at Earth's surface it is converted into thermal energy (heat).
- **Near-Visible Wavelengths-** UV light and infrared radiation
  - **Ultraviolet light-** short wavelengths and will burn skin
  - **Infrared Radiation-** has longer wavelengths and you see it as warmth

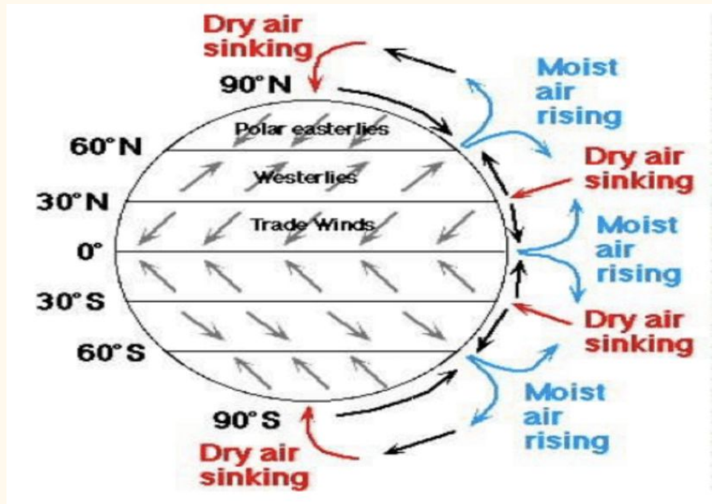
> Temperature changes within each layer of the atmosphere
>
> **Troposphere→** Temperature decreases as altitude increases
>
> **Stratosphere→** temperature increases as altitude increases due to high concentration of ozone
>
> Ozone absorbs the energy from sunlight, increasing the temperature
>
> **Mesosphere→** Altitude increases, temperature decreases
>
> **Thermosphere & Exosphere→** altitude increases, temperature increases due to large amount of energy from the Sun

ENERGY ON EARTH

- Energy on Earth **passes through the atmosphere** and is either absorbed or reflected
  - **Absorption-** 20% of gas and particles absorb solar radiation by atmosphere

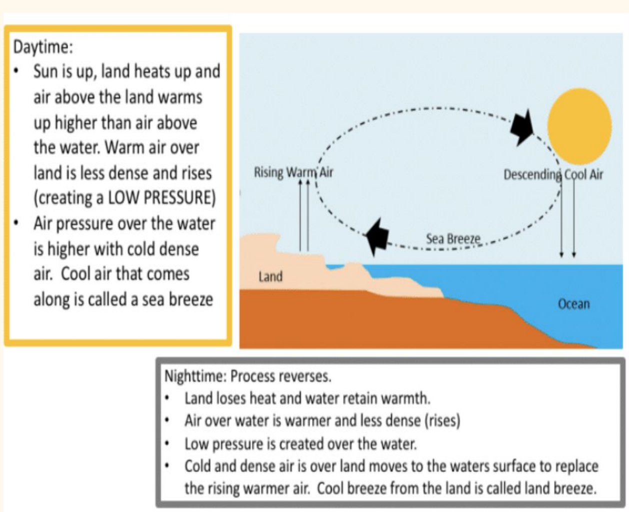
- **Reflection-** radiation is reflected by bright surfaces and clouds, some travels and is reflected by land and sea surfaces.

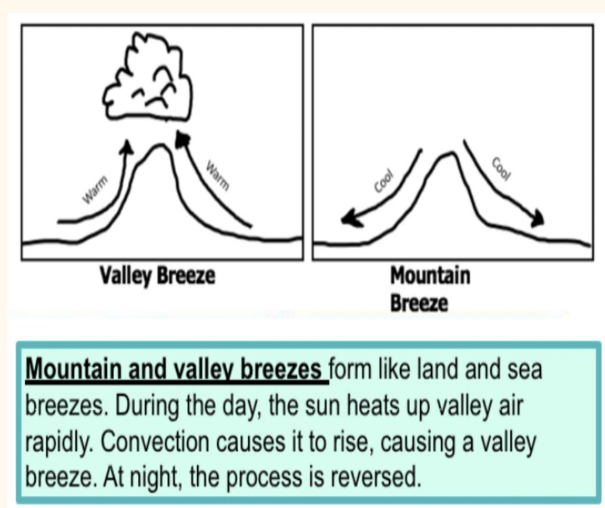
WINDS



- **Winds** are the movement of air from areas of high pressure to areas of low pressure
- The **Global Wind Belts** are the Polar Easterlies, Westerlies, and Trade Winds)
    - **Polar Easterlies-** are cold winds that blow from the east to the west near the North & South Poles from 60 degrees to the poles
    - **Westerlies-** steady winds that flow from west to east between latitudes 30 degrees N and 60 degrees N, and 30 degrees S and 60 degrees S.
    - **Trade Winds-** steady winds that flow from east to west between 30 degrees N latitude to the equator and 30 degrees S latitude to the equator

BREEZES





QUESTIONS

1. What is Earth’s atmosphere?

2. List and describe the three layers of Earth’s atmosphere.
    a.
    b.
    c.

3. What pulls the atmosphere toward Earth?

4. What is radiation?

5. What does all energy on Earth pass through?

6. Where are the Westerlies located?

7. What is the cool breeze that comes along in the daytime next to water?

8. What causes mountain breezes to rise?

A fun experiment (if you have time) that will help you learn the LAYERS OF THE ATMOSPHERE…

Layers of the Atmosphere

Liquid Density Lab

I am so fascinated by the sky and clouds. I love photos of clouds. I love a nice clear blue sky. My son's fascination is with space. He loves reading about the planets and the moon. One day, a little while ago, he was asking about the sky. He wondered when the sky ended and space began. I did not know, so we began a project for learning the layers of the atmosphere! We learned about the atmosphere layers by doing an interactive lab with kitchen materials (honey, corn syrup, dish soap, water, and vegetable oil). For this lab, we used the things I have in my kitchen to recreate the different layers of the atmosphere.

Ingredients Needed for the Atmospheric Layers Lab

Here's what we used to create our atmosphere layers model.

- Dirt
- Honey
- Corn syrup
- Dish soap
- Water
- Clear container
- Food coloring (optional)

A Lab for Learning the Atmosphere Layers

After we assembled it all together, it was pretty easy to put together. I choose to add food coloring to a few of the layers.

You must add the items into a clear (so you can see it) cup **in the order below**. We ended up using a slightly shaded cup, so it is more difficult to see the layers, as it all is rather dark.

Note: I found [Steve Spangler's density chart] to be very helpful as I decided which items to use for each layer. You could use different liquids if you desire, but make sure the densities of the liquids go from heaviest (or most dense) on the bottom to lightest (least dense) on the top.

I added layers of the atmosphere as follows:

- **Dirt = the earth.** Make sure you pack this down in the cup so dirt won't float around in the liquids.
- **Honey = Troposphere (orange).** This is were we live and where clouds and weather are.
- **Corn syrup = Stratosphere (food coloring added to make it blue).** This is where airplanes fly, just above the clouds. We added a small eraser to ours that looked like an airplane; although it did float between the honey and the corn syrup, it was too difficult to see in our pictures due to the deep blue from the food coloring.

- **Dish soap = Mesosphere (green).**
- **Water = Thermosphere (food coloring added to make it red).** Many of the earth's satellites are in this level. We added a small rubber band to represent a satellite. Again, you can't see it very well.
- **Vegetable Oil = Exosphere (light/clear yellow).** This is the level of the atmosphere that is very thin and blends in to space. It seemed appropriate that the vegetable oil left bubbles on top; there is very little to distinguish between the exosphere and space.