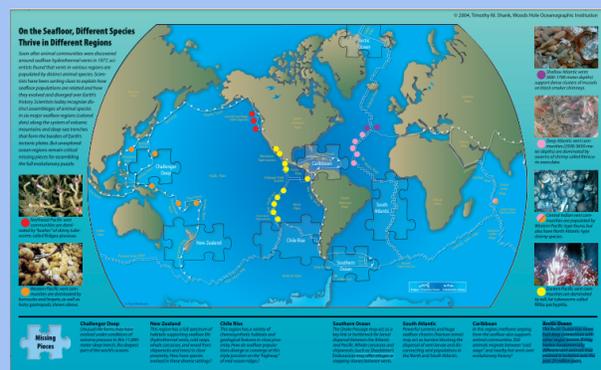


7 The ocean is largely unexplored.

https://oceanexplorer.noaa.gov/edu/learning/5_chemosynthesis/activities/puzzle.html

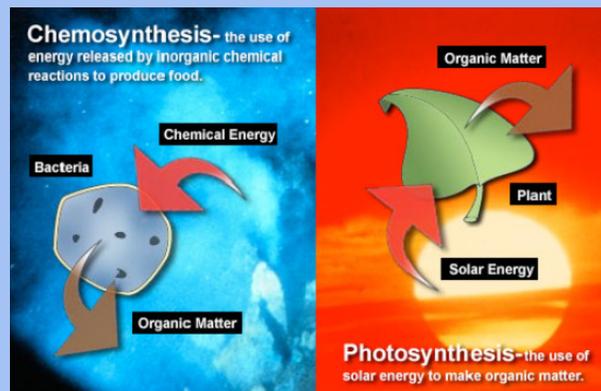
I am counting this resource and the one after it as one since they come from the same site.

This map ([Larger version](#)) does a great job of showing students how fossil evidence of lifeforms, and current lifeforms give us more information about the life systems on the ocean floor. The map highlights “missing pieces” in scientists' knowledge about life in different regions of the ocean.



https://oceanexplorer.noaa.gov/edu/learning/5_chemosynthesis/chemosynthesis.html#slide

This set of slides helped me understand adaptations around thermal vents more clearly. It clearly explains how sulfide becomes sugar molecules. I would use this resource in tandem with extreme adaptation lessons as well as lessons on energy transfer and transformation.



<https://sanctuaries.noaa.gov/vr/>

This resource is so incredibly engaging. Students have the ability to either watch a video, or hook up a virtual reality (VR) experience to see a dive in real time.

This can be incredibly helpful for my landlocked students. There are even prepared lesson plans for the different experiences.



<http://www.seasky.org/ocean-exploration/ocean-timeline-menu.html>

This interactive timeline allows students to research the history of ocean exploration. It creates authentic connections to global cultures, and engineering design. The reading level is high for 3rd graders, and ELL 4th graders. It is probably best used for 4th-7th grade. Some of the discoveries in the 1950s were surprising to me, because I didn't realize how recent deep ocean exploration was.

5000 BC

4500 BC

Ocean Diving Begins

Around this time, several coastal cultures like those in Greece and China begin diving into the sea to gather food and engage in commerce. Diving is possibly even used in warfare.

4000 BC

4000 BC

First Sailing Vessels

The ancient Egyptians develop the first sailing vessels. These vessels are probably only used for sailing in the eastern Mediterranean and near the mouth of the Nile river.

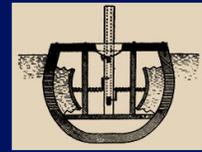


Wikipedia Public Domain Image

1578

First Plans for a Submarine

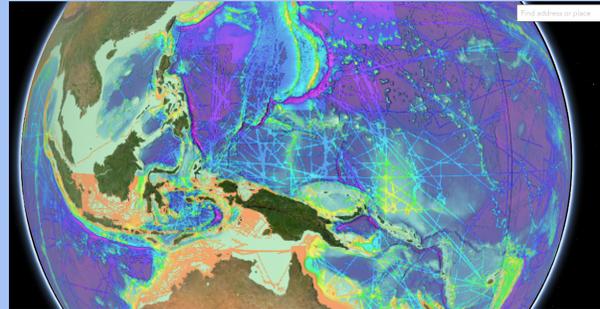
An English mathematician named William Bourne draws up the first known plans for an underwater boat. These plans call for a leather-covered wooden frame craft that would be rowed from the inside. There is no evidence to suggest that this craft was ever built.



Wikipedia Public Domain Image

<https://maps.ccom.unh.edu/portal/apps/webappviewer3d/index.html?id=575f088b7e1143c48b6e5c4bcbfa8004>

This resource is an interactive globe of the The General Bathymetric Chart of the Oceans (GEBCO) 2021 grid. The Seabed 2030 initiative wants to bring together all available bathymetric (Greek bathys "deep") data to produce a map of the Earth's ocean floor by 2030. It is really incredible to realize how much data is missing. As an educational tool this would hopefully inform students about the geomorphology of our ocean, as well as encourage further inquiry.

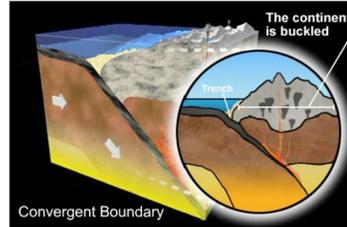


#2 The ocean and life in the ocean shape the features of Earth.

https://oceanexplorer.noaa.gov/edu/learning/1_plate_tectonics/plate_tectonics.html#slide

This slideshow by NOAA clearly explains the phenomena of changes in tectonic plates. This resource will support lessons around landforms. Specifically the 4th grade standard: Earth's systems- processes that shape the Earth.

The slides cover the prediction of these processes.



If one of the colliding plates is topped with oceanic crust, it is forced down into the mantle where it begins to melt. Magma rises into and through the other plate, solidifying into new crust. Magma formed from melting plates solidifies into granite, a light colored, low-density rock that makes up the continents. Thus at convergent boundaries, continental crust, made of granite, is created, and oceanic

<https://www.earthsciweek.org/classroom-activities/core-sampling>

This lesson has a lot of potential but needs some reworking to be helpful for 4th grade. The lesson has students making hands on layers of soil that they then can take a "core sample" with a straw. This could be interesting to show ages of landforms and different plates over time.

This lesson could incorporate a type of playdough instead of sand to try and show colors as sediment ages.

Materials

- 1 bag of dark sand
- 1 bag of light sand
- 1 bag of soil
- 1 bag of small gravel (aquarium size)
- 10 clear plastic straws
- 1 clear plastic cup per student (8 ounce)
- water in a spray bottle
- plastic spoons
- metric ruler

Procedure

1. Use the ruler to measure. Place a 1 cm layer of one of the earth materials in the cup with a spoon. Mist with
2. Place another earth material 1 cm deep on top of the first layer. Moisten this layer with water until damp.
3. Continue alternating layers of earth materials and water. The total of layers together will be four centimeter:

<https://www.usgs.gov/media/videos/usgs-erosion-simulation-video>

I included this simulation video for myself as a teacher. I want to use it as an engaging phenomena, OR as an inspiration for a hands-on lab.

The materials just consist of a tub, sand, water, and a larger fan.

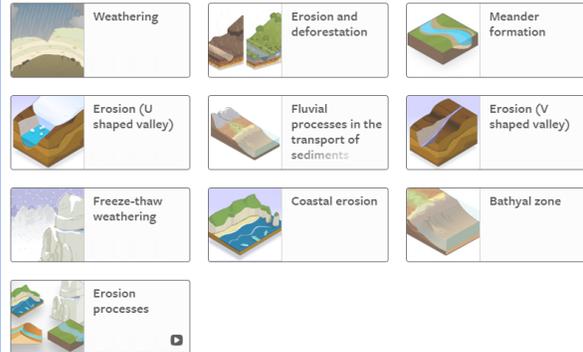


<https://www.edumedia-sciences.com/en/curriculum/7189-rocks-minerals-and-erosion>

I was very disappointed to find out that the majority of this content is behind a paid subscription.

Luckily, the beginnings of the videos are still viewable and can be used to illustrate erosion and deposition processes.

Erosion and deposition



<https://www.nationalgeographic.org/interactive/walters-travels-weathering-and-erosion/>

Walter's travels is a new animated game series from "Legends of learning." This platform was created by National geographic for schools and families. There is a pro version, but I think the only thing it unlocks is lesson planning supports. The weathering and erosion game with Walter has different mini "games" where students learn about the processes.

The first game is more like a quiz, and the others don't really hold a game element, they are more like "click throughs."

I thought the ice erosion one was the most engaging and informative.

The wave erosion doesn't actually have consequences if you let the timer run out. I thought that was disappointing.

<https://app.legendsoflearning.com/teachers/games/learning-objective/943>

Legends of learning has other games and quizzes as well. I thought the earthgate puzzle was reminiscent of "MYST" from 1993. I wanted it to be longer.



Instructional 7 Min
CHANGES OF EARTH (ELEM)

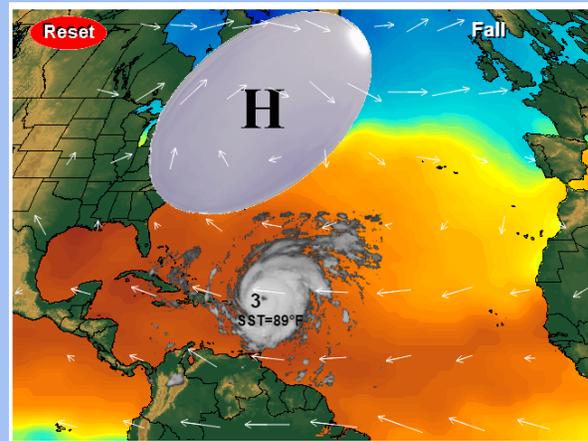


Instructional 7 Min
EARTHGATE

#3 The ocean is a major influence on weather and climate.

<https://scijinks.gov/hurricane-simulation/>

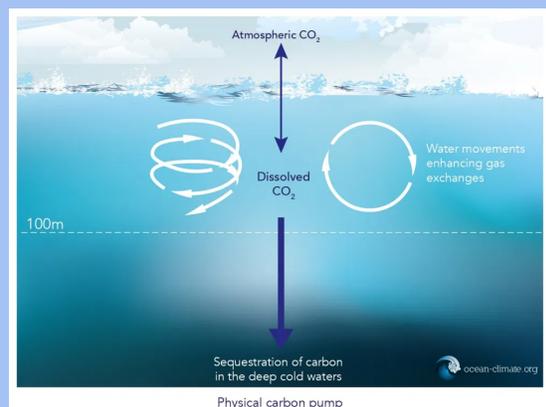
This simulator allows students to change the sea surface temperature with the seasons, as well as where there are high pressure zones. This allows students to see how those variables affect a hurricane's formation.



<https://ocean-climate.org/en/awareness/the-ocean-a-carbon-sink/>

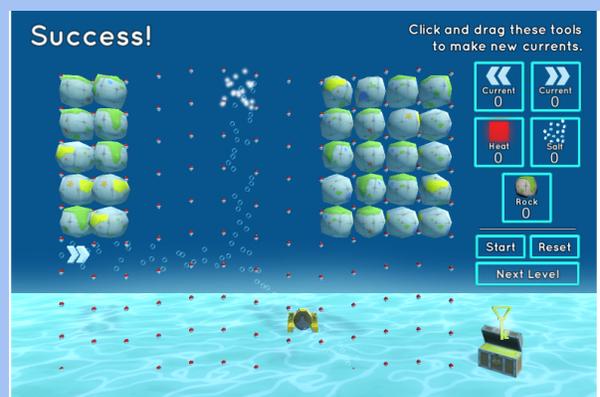
This article does a great job of clarifying the two ways carbon is stored by the ocean. I think this resource would support teachers in their own analogies for students.

This becomes incredibly important when thinking about using stored carbon for fuel. Students should realize how long it took for that process to occur, and the balance that it offsets.



<https://spaceplace.nasa.gov/ocean-currents/en/>

This game has it ALL! Cause and effect relationships between variables in the ocean AND coding! (Also the music is pretty) By needing to set up all of the elements for your path before you push "start" you are in fact prepping a code for it to follow. Here are the two rules to remember: Students will see that salt makes water heavier, so it sinks and heat makes water lighter, so it rises.



#1 Earth has one big ocean with many features.

https://phet.colorado.edu/sims/html/waves-intro/latest/waves-intro_en.html

This interactive simulation is really engaging and informative. It can be used to collect data on the behavior of waves. You can use measuring tools, as well as preloaded graphs.



<https://www.nationalgeographic.org/media/global-conveyor-belt/>

This resource is FULL of great content for teachers. There is a large infographic that supports understanding of rising and falling currents, as well as lesson ideas and connections. Finally there are some attached lesson labs that can be completed in class, as well as related multimedia.



- Density is defined as the measure of a material's mass (e.g. grams) divided by its volume (e.g. milliliters).
- Mixing of seawater influences the density of seawater thereby affecting ocean circulation. Seawater mixing also has an effect on ocean life.

- Essential Questions:**
- Can oceans be too salty, or not salty enough?
 - What is a perfect? Is ocean salinity a perfect?
 - Is salty water heavier than fresh water?
 - What is the relationship of salinity to other properties of oceans?
 - How do oceans affect climate changes?

- Knowledge and Skills:**
- Explain the relationship between temperature, salinity, and density.
 - Compare the density of salt water and fresh water.
 - Measure the density of water and define the units of measurement, a gram is the mass of one milliliter of pure water.
 - Compare and contrast results of experimentation with hypotheses.
 - Explain the role of mixing of seawater in density-driven vertical ocean circulation.
 - Describe the role of a temperature - salinity (T-S) diagram in seawater density studies.
 - Read a T-S diagram and an ocean salinity map.

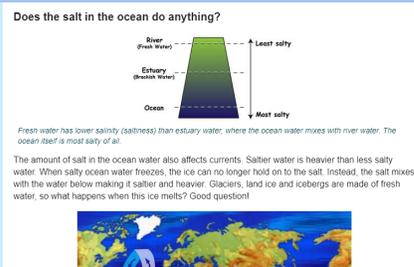
- Prior Knowledge:**
- The salt in seawater comes from the weathering of earth's land surface.
 - Salinity is the measure of the amount of dissolved salts in seawater.
 - Temperature affects the density of fresh water. Cold water sinks below warm water.
- Common Preconceptions:**
- Weight and density are not differentiated but are both defined by a sense of "heaviness".
 - An object, such as a pebble, is light for a human, but heavy for water.
 - An object floats because it is lighter than water.
 - The conception of density is related to the denseness (loose or tight) in the packing of particles, i.e. mass and

I attached this video to support my own instruction. It accompanies this article well.

<https://www.youtube.com/watch?v=LkRQjTdTvFE&t=78s>

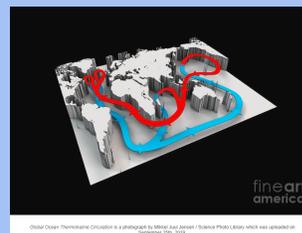
<https://climatekids.nasa.gov/ocean/>

This excellent resource is accessible for 4th graders as it meets their reading level. It covers many features of the ocean including: pH, carbon, food chains, ice melt, water levels, salinity, and more. I think it does a great job introducing how the ocean is multi-faceted.



<https://pixels.com/featured/global-ocean-thermohaline-circulation-mikkel-juul-jensen-sciences-photo-library.html>

I attached this link and illustration to support the content in the national geographic article.



I think it illustrates the "conveyor belt" well :)