STEMscopes - Student Notebook – 2nd Grade
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Segment 1: Landscape Shapes

Mapping Our World

P.17 - Linking Literacy: Compare and contrast two maps using a Venn diagram. Map A is a list of the seven major rivers and eight major lakes in the United States. The seven rivers listed are:

1. Mississippi River
2. Ohio River
3. Columbia River
4. Yukon River
5. Missouri River
6. Tennessee River
7. Alabama River

There are multiple errors with Map A:

1) Only the lower Columbia River is shown on the map. The Columbia River begins in the Canadian Rockies in Canada and flows northwest before turning south and crossing the US-Canada border into the state of Washington. It then heads roughly west towards the coast. [Source: https://en.wikipedia.org/wiki/Columbia_River]
2) The Yukon River in Alaska is shown to start in the middle of Alaska. It actually starts in British Columbia, Canada, flows northwest through the Yukon Territory in Canada, where it then crosses the US-Canada border on the eastern border of the state of Alaska, then flows west through the entire state of Alaska where it empties into the Bering Sea. [Source: https://en.wikipedia.org/wiki/Yukon_River]
3) The Missouri River is identified as being just in Missouri, which is a gross error. The Missouri River actually starts in the Rocky Mountains in Montana, flows east across Montana and North Dakota, then south through South Dakota and demarks the borders of Nebraska, Iowa and Kansas before entering Missouri. Only the part of the river in Missouri, along with some of its tributaries, are shown on the map. [Source: https://en.wikipedia.org/wiki/Missouri_River]
4) The Tennessee River is actually a tributary of the Ohio River and not one of the longest or largest ten rivers in the United States. The location of the Tennessee River on Map A is also in error, showing only part of the River in the eastern half of Tennessee and northern Alabama, omitting all of the Tennessee river in the western part of Alabama,

along the border with Mississippi, flowing north up into Kentucky where it flows into the Ohio River. [Source: https://en.wikipedia.org/wiki/Tennessee_River]

It is unknown what criteria were used to identify these seven rivers as the “major rivers” of the US. They are not the seven major rivers as measured by river length or streamflow. The correct top seven major rivers by length in the US are:

1. Missouri RIver, 2,341 miles
2. Mississippi River, 2,202 miles
3. Yukon River, 1,979 miles
4. Rio Grande River, 1,759 miles
5. Colorado River, 1,450 miles
6. Arkansas River, 1,443 miles
7. Columbia River, 1,243 miles

[Source: https://en.wikipedia.org/wiki/List_of_longest_rivers_of_the_United_States_(by_main_stem)]

The Ohio River at 979 miles is the 10th longest, the Tennessee River at 935 miles is the 13th longest, and the Alabama River at 318.5 miles (per U.S.G.S.) is not in the top 38 longest rivers in the US.

The seven major rivers in the US as measured by average discharge (i.e. stream flow) are:

1. Mississippi River (593,000 cfs)
2. Ohio River (281,500 cfs)
3. St. Lawrence River (348,000 cfs)
4. Columbia River (273,000 cfs)
5. Yukon River (227,000 cfs)
6. Atchafalaya River (225,000 cfs)
7. Niagara River (204,700 cfs)

[Source: https://en.wikipedia.org/wiki/List_of_U.S._rivers_by_discharge]

The eight major lakes identified in Map A on page 13 are:

1. Lake Superior
2. Lake Michigan
3. Lake Huron
4. Lake Erie
5. Lake Ontario
6. Great Salt Lake
7. Lake Pontchartrain
8. Lake Okeechobee

While the locations of these lakes on Map A are correct, they are not the eight largest lakes in the United States as measured by normal surface area. That list is:

1. Lake Superior - 31,700 sq mi
2. Lake Huron - 23,000 sq mi
3. Lake Michigan - 22,300 sq mi
4. Lake Erie - 9,910 sq mi
5. Lake Ontario - 7,340 sq mi
6. Great Salt Lake - 2,117 sq mi
7. Lake of the Woods - 1,679 sq mi
8. Iliamna Lake - 1,014 sq mi

[Source: https://en.wikipedia.org/wiki/List_of_largest_lakes_of_the_United_States_by_area]

Lake Pontchartrain at 631 sq mi is the 11th largest lake, and Lake Okeechobee at 662 sq mi is the 10th largest lake by normal surface area in the US.

P.27 - Reading Science - “Where are we going?” - In the story, the child asks his mom why the road curves on the family’s trip to a state park for a camping trip. The mom answers “The road has to curve. There are a few very big lakes between here and the state park.” This explanation is emphasized on p.29 in question 2 of the questions for students. While a road may be curvy to go around big lakes, the explanation is neither sufficient nor necessary. There are several reasons that roads curve, only one of which is to avoid geographic features like lakes. Curves in roads are also made to accommodate changes in elevation (i.e. most terrain is not flat and vehicles cannot handle steep grades so roads wind back and forth across a hill or mountain with a moderate grade), respect property lines, optimize paths between other road landmarks (e.g. bridges, intersections), minimize road construction cost (i.e. it is less expensive to go around a mountain than tunnel through it), and due to the fact that gently curving roads are safer than straight roads in terms of driver safety (i.e. curves demand more driver attention and provide control feedback to drivers that straight roads do not.)

Forms of Water on Earth

P.39 - Graphic Organizer - “Our Water: Solid, Liquid or Both?” The workbook oversimplifies the phases of water found on Earth, listing just solid and liquid. While the NGSS 2nd grade science standards include this categorization (i.e. 2-ESS2-3), it seems over simplified and a disservice to students. In the Science Content Standards for California Public Schools K-12 used prior to NGSS, students learned by 1st grade that materials come in three states -- solid, liquid and gas. Non-NGSS elementary curricula frequently teach elementary students that there are four or five states of matter (i.e. adding plasmas and Bose-Einstein condensates), and defer discussion of plasmas and BECs to higher grades. [Source: http://www.chem4kids.com/files/matter_states.html]

P.49 - Linking Literacy - “Fill my cup!” – The third activity asks students to draw a picture of the water cycle. Without seeing what is taught in 2nd grade (the STEMscopedia does not mention the water cycle and only talks about the solid and liquid states of water), it is difficult to conceive how the water cycle is taught without introducing the gaseous state of matter. The water cycle, even at the elementary level, is commonly understood to include the phase changes of evaporation and condensation. How this can be taught without teaching about the gaseous state of matter is baffling. In short, if it is deemed appropriate not to teach 2nd graders about the gaseous state of matter, then the water cycle should not be taught until it is.
NOTE: Later on in the *Student Notebook* on p.61 it is asserted that, “water can be found as gas in the air (water vapor) and as liquid in rivers and oceans.” So it is unclear why earlier in the curriculum, or in the NGSS 2nd grade standards, students are not told about the gaseous state of water, or matter in general.

P.55 - Reading Science - Bodies of Water – Statement 6 reads “Jim says there was a big lake in the mountains. ‘I got to see many animals at the lake,’ Jim says. “The animals use the lake to drink water. They find food in the lake, because it is **fresh** water.’” This statement implies aquatic animals live only in fresh water. This is a gross misconception. The thousands of species of sea creatures living in the oceans would beg to differ.

P. 56 - Reading Science - Bodies of Water. Statement 13 is an incomplete sentence: “I stayed home and played with my son. We played in”

P.59 - Reading Science - Bodies of Water. Question 13 reads “All the following are bodies of fresh water, except the-”. Possible answers are: a) lake, b) ocean c) stream, d) river. Based on the reading passage it is clear the question is answered most correctly by b) “ocean.” However, it should be noted that there are *endorheic* lakes that have salinity levels higher than the oceans. For example, Lake Vanda, Lake Assal, the Dead Sea,and Mono Lake all have salinity levels more than double that of the world’s oceans.
[Source:https://en.wikipedia.org/wiki/List_of_bodies_of_water_by_salinity] Similarly, there are saltwater rivers, though rare and perhaps beyond the scope of a second-grade science lesson attempting to establish the basic differences between freshwater and saltwater bodies. Saltwater intrusion in coastal rivers and estuaries, the lower Hudson River for example, are more saltwater than fresh towards the coasts. [Sources:
https://en.wikipedia.org/wiki/Saltwater_intrusion,
https://en.wikipedia.org/wiki/Hudson_River#Watershed]

Properties and States of Matter

P.99 - Reading Science - “A Snowy Day” - Sentence 3 states, “She wanted to look at the tiny, six-sided (snow) flakes.” While the vast majority of naturally occuring snowflakes are indeed six-sided, water molecules occasionally form ice crystals with 3 or 12 sides, leading to triangular

and 12-sided snowflakes. [Source: http://www.its.caltech.edu/~atomic/snowcrystals/unusual/unusual.htm]

Properties of Materials

P.111 - Graphic Organizer - “Matter Serves a Purpose” – This is poorly worded. Matter is. It does not serve a purpose. Humans use matter for different purposes depending on its properties. “Matter serves a purpose” implies design or intent. Matter is not designed.

P.117 - Explore 2 - Data Recording Table – The instructions in the *Procedure* are ambiguous. They read: “1. Remove one of your shoes. 2. Release your shoe right at the starting line.” Taken literally, instruction step #2 would result in the shoe being dropped at the starting line. If the intent is to slide the shoe across the floor, the student should be instructed to slide the shoe across the floor, releasing it at a pre-marked starting line.

P.119 - Explore 2 - Procedure step 6 reads, “Why is the shoe that slid the least best suited for its intended purpose?” Students have no certain way of determining the intended purpose of the various shoe types used in the experiment (i.e. “tennis shoes, flats or sandals”.) “Tennis shoe” has come to describe soft-soled shoes, usually with shoe laces, intended for casual or sporting use, not just for tennis. “Flats” and “sandals” are even more ambiguous in common English usage. It is surmised that the authors of the activity assume the “tennis shoe” will slide less than the “flat” or “sandal,” which would then lead to the conclusion that the “tennis shoe” is best suited for the purpose of playing tennis. This seems a reach built upon several assumptions that may not hold true for students performing the experiment. For example, a rubber-soled “flat” or “sandal” may not slide as far as some types of tennis shoes.

Building Blocks of Matter

No comments.

Changes from Heat

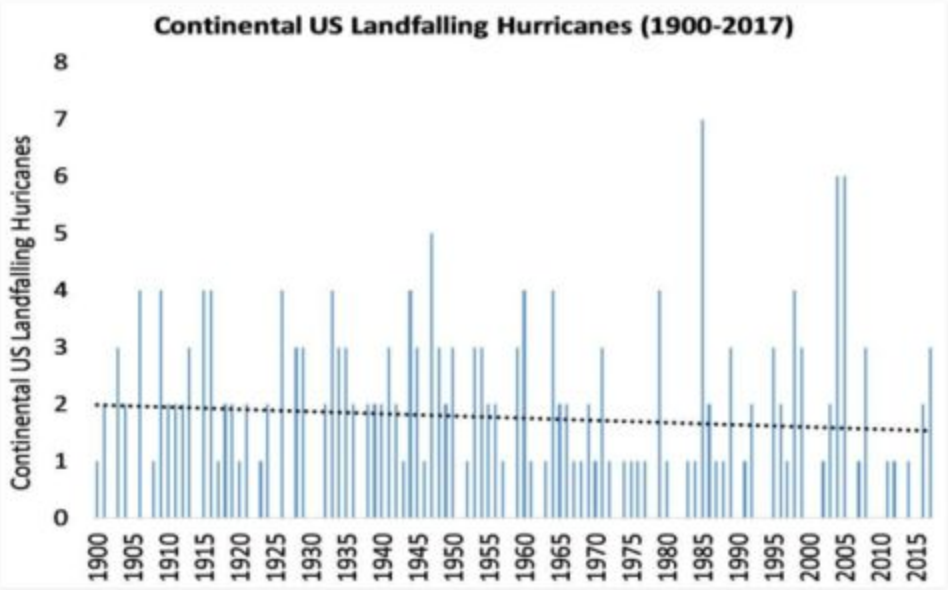
P.183 - A Summer Experiment - Reading Science - Question 5 asks, “What would happen if the boys returned the bowl in the kitchen to the freezer?” Available answers are: “a) The water would evaporate and become a gas. b) The water would stay in liquid form. c) The water would become ice. d) The water would turn into a popsicle.” The obvious answer is c). However, answer b) is also correct depending on how long the bowl is in the freezer. If the boys checked on the bowl in the freezer before it had a chance to freeze, it would still be in liquid form.

Quick Changes to Land

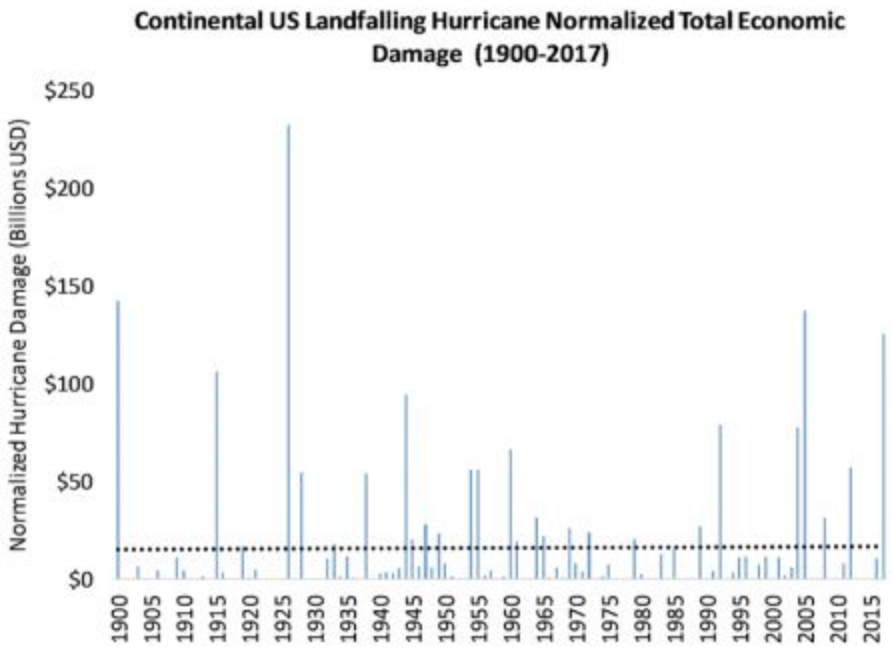
P.205 - Explore 2 - Land in Motion – Typo in directions. Step #6 should be step #5. The second half of step #4 was incorrectly labeled step #5.

P.207 - Explore 3 - Sturdy Structures – *The Problem* is defined as, “Due to the recent increase in natural disasters, your team has been hired by Better Built Structures Inc. to design new and improved buildings.” Sentence should be changed to “Due to ~~the~~ **a** recent increase in natural disasters…” It is a commonly held misconception that the number and severity of natural disasters is increasing. They are not:

1. **Hurricanes:**
   Shown below are the number of continental U.S. landfall hurricanes by year from 1900 to 2017 (dotted line represents the linear trend over the period)

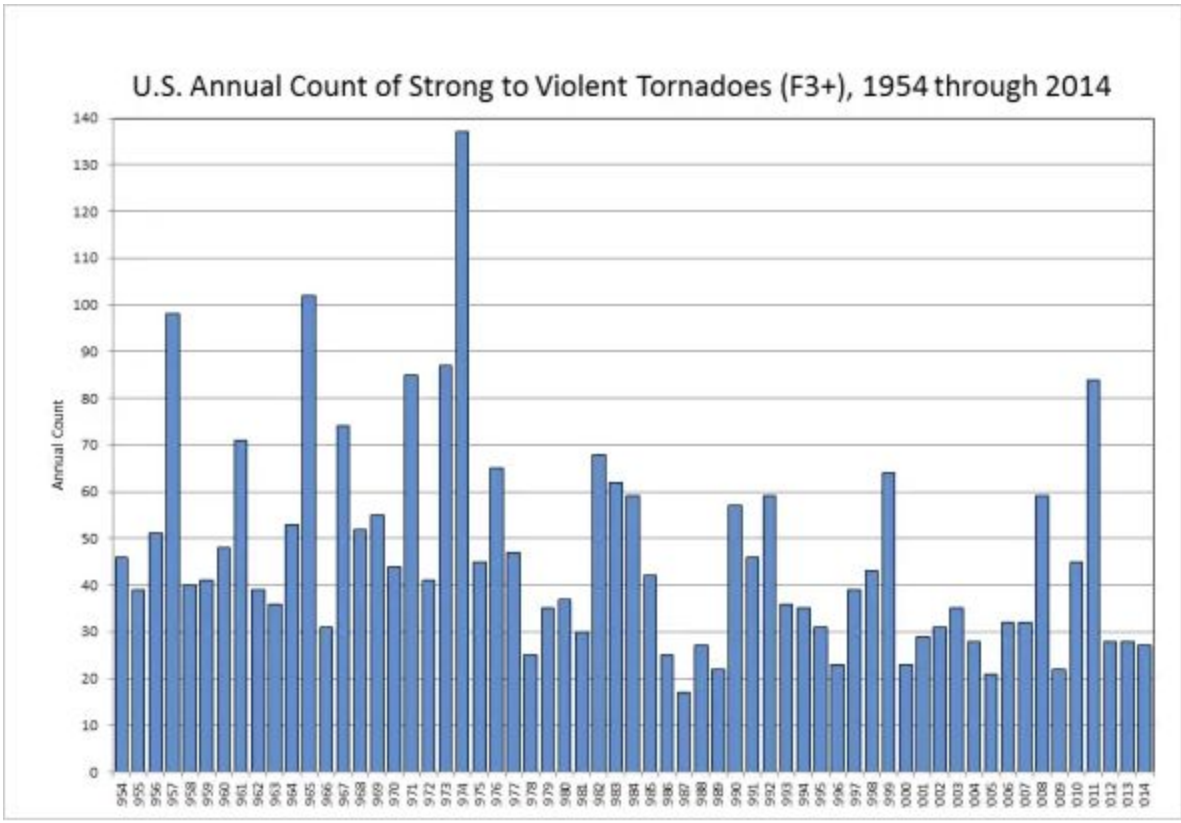


And below is the normalized total economic damage from continental US landfall hurricanes over the same period (i.e. 1900 to 2017):



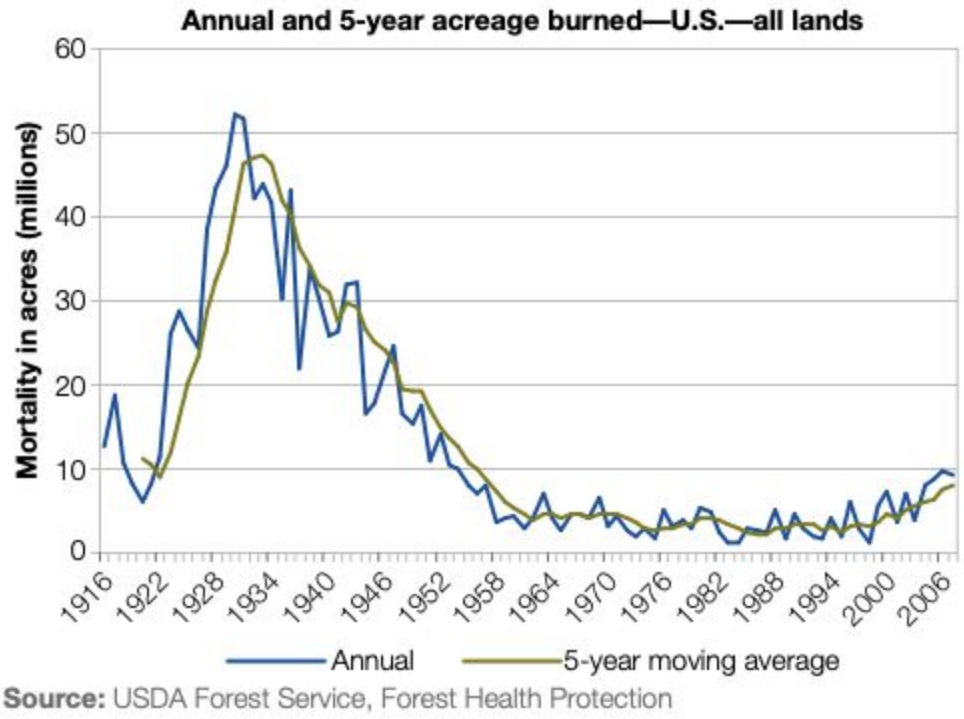
[Source: Klotzbach, P., Bowen, S, et al., "Continental U.S. Hurricane Landfall Frequency and Associated Damage: Observations and Future Risks," *American Meteorological Society*, July 2018. https://journals.ametsoc.org/doi/pdf/10.1175/BAMS-D-17-0184.1]

2. **Tornadoes**:
   Shown below is the annual count of violent tornadoes (F3+) in the United States from 1954 through 2014:



[Source: NOAA/ NWSStorm Prediction Center; https://www1.ncdc.noaa.gov/pub/data/cmb/images/tornado/clim/EF3-EF5.png]

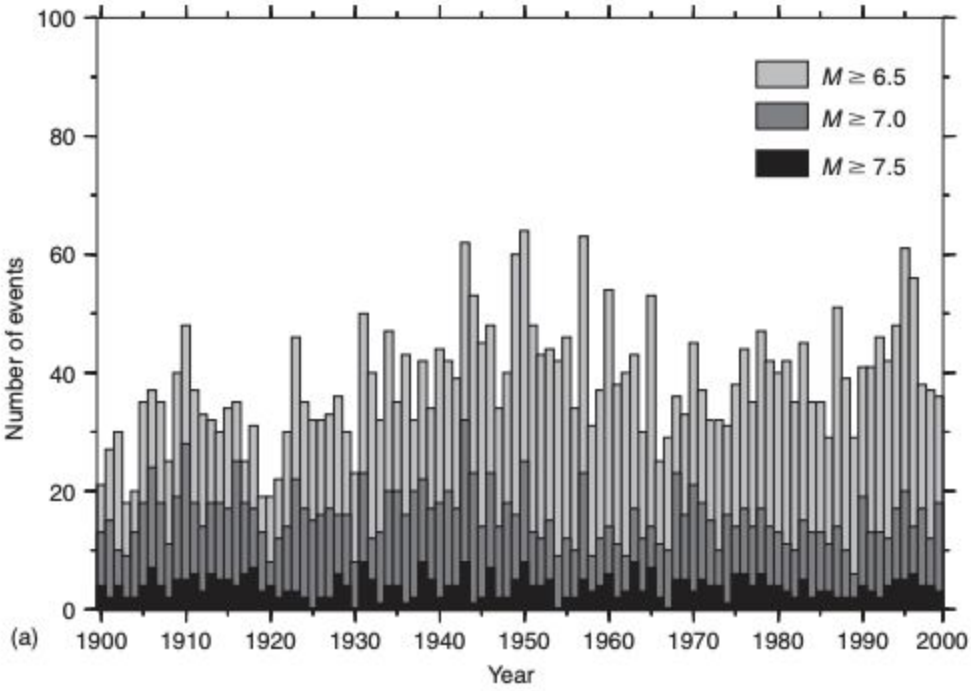
3. **Forest Fires:**
   Total acreage burned in forest fires in United States (annual and 5-year average):



[Source: *National Report on Sustainable Forests, 2010*, "Area and Percent of Forest Affected by Abiotic Agents (e.g., Fire, Storm, and Land Clearance)", USDA Forest Service, June 2011. https://www.fs.fed.us/research/sustain/docs/indicators/indicator-316.pdf]

4. **Earthquakes:**
   Shown below are the number of earthquakes globally as a function of time for three

magnitude levels as specified in the legend per year between 1900 and 1999:



[Source: Engdhal, E.R. and Villaseñor, A., “Global Seismicity,” International Handbook of Earthquake and Engineering Seismology, USGS, 2002. https://earthquake.usgs.gov/data/centennial/centennial.pdf]

As can be seen, there is no recent increase in natural disasters as stated in the text.

P.216 - Reading Science - The Cornfield Volcano – Paragraphs 7-10 are a repeat of paragraphs 3-6 on page 215.

P.218-219 - Reading Science - The Cornfield Volcano - Questions 4 and 5 cannot be answered from the reading passage on pages 215 & 216. I suspect paragraphs 7-10 are missing and were inadvertently copied from paragraphs 3-6 and questions 4 and 5 are based on what should have been printed in paragraphs 7-10.

P.223 - Claim-Evidence-Reasoning – The *scenario* is based on before and after photographs in part 2, “External Data.” The text in the *scenario* reads, “You get to Hawaii and visit the park, but it looks different from your friend’s picture. You don’t see any grass, but just smooth, black rock.” Grass cannot be seen in the first photograph -- the resolution and clarity of the first photograph is insufficient to discern grass.

Slow Changes to Land

P.243 - Linking Literacy - Causes of Slow Change - *Weathering* is defined as “when natural forces break rocks into smaller pieces. The natural forces that do this are wind, water, and ice.” *Weathering* in more common usage is limited to changes to rocks at Earth’s surface, and is distinguished by three types of processes: physical, chemical or biological. Only the physical processes are described in the text. The omission of chemical or biological processes from disintegrating or altering rocks, and restriction of weathering to at the Earth’s surface may be an age-appropriate simplification for second graders, but is scientifically incomplete. Physical and chemical alteration of rocks occurs under the Earth’s surface, but through different processes (e.g. metamorphism.) The restriction of sources of physical rock degradation to just wind, water and ice is also a gross oversimplification. For example, omitted from this simplified definition of weathering are several other major sources of physical weathering: thermal expansion and contraction of rock, the release of pressure upon rocks by erosion of overlaying materials, and the growth of crystals, plants and living organisms in rocks. [Source: https://www.britannica.com/science/weathering-geology]

P.247 - Reading Science - Cave Formation - The second sentence of the first paragraph reads, “As long as 17,000 years ago, people created paintings on the walls of caves.” A 2018 discovery reports that the oldest known cave paintings are more than 64,000 years old, though they are believed to have been created by *Neanderthals,* which could be considered not to be people, strictly speaking. However, several discoveries place the date of the oldest cave paintings of modern humans at 44,000 years ago, found both in the Franco-Cantabrian region of western Europe, and in the caves in Sulawesi, Indonesia. [Source: https://en.wikipedia.org/wiki/Cave_painting]

The cave formation process described in the reading passage is just for limestone caves formed through dissolution. However, there are other types of caves, formed by different processes. For example:

- Primary caves are formed at the same time as surrounding rock and are formed through volcanic activity, the most common type being lava tubes.
- Littoral or sea caves are formed along coasts and are caused by ocean waves.
- Corrasional caves form entirely through erosion by flowing streams and not chemical dissolution.
- Glacier caves are formed by melting ice and flowing water within and under glaciers.
- Fracture caves are formed when layers of more soluble minerals, such as gypsum, dissolve out from between layers of less soluble rock. These rocks fracture and collapse in blocks of stone.

[Source: https://en.wikipedia.org/wiki/Cave]

P.249 - Reading Science - Question 1 reads, “The formation of a cave would most likely take about…” with the possible answers of, “a) 1 year, b)100 years, c)10,000 years, d) 100,000 years.” Given the provided reading passage describes only caves formed through limestone dissolution, the answer can range from a few tens of thousands of years to a few millions of years, depending on the size of the cave and rate of dissolution. [Source: https://www.britannica.com/science/cave/Solution-caves]

Effects of Wind and Water

P.275 - Reading Science - Save the Yard! - The reading passage defines a ***bay*** as “a body of water partially enclosed by land but with a wide mouth, affording access to the sea.” Two problems with this definition: first, bays connect to larger bodies of water, which in addition to a sea can also be a lake or a larger bay, and second, the inlet does not have to be wide. A *cove*, is an example of a bay with a circular inlet and narrow entrance. [Source: https://en.wikipedia.org/wiki/Bay]

P.283 - California Instructional Segment - Action Plan - The exercise discusses invasive species and uses the *milk thistle* plant as an example. However, the photograph on p.283 is not milk thistle. *Milk thistle* is a common name for *Silybum marianum*, which have purple flowers. The photograph appears to be of *Lactuca serriola*, which is also sometimes referred to as “milk thistle”, though more frequently as “prickly lettuce.” *Silybum marianum* is on the list of invasive plant species of California, while *Lactuca serriola* is not. Thus the photograph is of the wrong species of plant. [Source: https://en.wikipedia.org/wiki/Silybum_marianum, https://commons.wikimedia.org/wiki/File:Lactuca_serriola_(4971032357).jpg, https://en.wikipedia.org/wiki/List_of_invasive_plant_species_in_California]

Under “Here’s what we know,” the text states, “the plants and animals in the habitat were happily living together, and all their needs were being met.” This is a tortured description of an outdoor habitat and an example of the *Anthropomorphic fallacy* (see https://www.alleydog.com/glossary/definition.php?term=Anthropomorphic+Fallacy.) It is also an example of the *appeal to nature fallacy* (see https://en.wikipedia.org/wiki/Appeal_to_nature), assuming that native species of flora and fauna are good, while introduced species are bad. Flora and fauna in a habitat are constantly in flux and compete with each other for resources to survive. What is native to a habitat at one point in time may disappear after the appearance of predators or other species competing for scarce resources. Many agricultural staples grown in California are non-native species, intentionally introduced by humans from other habitats. For example, 80% of the world’s supply of almonds are grown in California, though almonds are native to Iran.

Even then, though *Silybum marianum* is on California’s invasive plant species list, its effect on the native habitat is not all negative. Dense clumps of milk thistle provide shelter for rabbits. Milk thistle invasions provide increased food supply for rodents and birds. More than 47 species of

insects have been found to feed or reproduce on milk thistle, only 26 of which are economically damaging to crops, many of which themselves, as was discussed earlier, are non-native species. [Source: https://www.cal-ipc.org/plants/paf/silybum-marianum-plant-assessment-form/] Thus, the impact of non-native plant species is not always negative as the text implies. It is a much more complicated question with different moral interpretations. But without question, *Silybum marianum* should not be mistaken for *Lactuca serriola*.

P.285 - California instructional segment - Take action - Question asks, “when the other plants realized a new plant was in their habitat, how did they react? How did milk thistle react?” This is another inane example of the *anthropomorphic fallacy* -- plants don’t think or react.

P.287 - California instructional segment - Mission log - This photograph of milk thistle (*Silybum marianum)* is correct!

What Plants Need

Pp.291-325 – In the unit’s discussion on what plants need for survival, the only resources identified are water and sunlight, which though consistent with the NGSS 2nd grade standard 2-LS2-1, omits other resources necessary for plant survival, most glaringly carbon dioxide, which is as important to photosynthesis as water. This seems an egregious omission even for 2nd graders.

Animal and Plant Dependence

P.341 - Linking Literacy - Relationships: True or False - Students are asked to classify whether the following six statements are true or false:

1. Animals need plants to live.
2. Plants and animals depend on each other in many ways.
3. Squirrels hide food only in the ground.
4. Plants spread seeds through wind.
5. Insects and birds do not need plants.
6. Plants do not make fruits.

Without seeing the answer key, it is not known how students are expected to answer these questions. However, there appear to be over-simplifications which may be appropriate for 2nd graders. That being said, statements #1, #4, #5, and #6 can be considered partially true and partially false. Not all animals need plants to live. Obligate carnivores cannot digest plants properly and survive solely on animal prey. [Source: https://en.wikipedia.org/wiki/Carnivore#Obligate_carnivores] Statement #5 is both true and false because there are species of carnivorous birds (e.g. birds of prey) and carnivorous insects (e.g.

dragonflies) that do not need plants, but the majority of insect and bird species need plants for food. Statement #6 is true because some plants do not make fruit (e.g. gymnosperms), but also false because other plants do bear fruit.

Diversity of Living Things

No comments.