

ECOLOGY

2023 CALENDAR

 <p>Sugar Maple <i>Acer saccharum</i></p>	 <p>White Ash <i>Fraxinus americana</i></p>	 <p>Flowering Dogwood <i>Cornus florida</i></p>	 <p>Yellow Buckeye <i>Aesculus flava</i></p>	 <p>Pitch Pine <i>Pinus rigida</i></p>
 <p>Honey Locust <i>Gleditsia triacanthos</i></p>			 <p>American Persimmon <i>Diospyros virginiana</i></p>	
 <p>American Linden <i>Tilia americana</i></p>			 <p>Tulip Tree <i>Liriodendron tulipifera</i></p>	
 <p>Sassafras <i>Sassafras albidum</i></p>			 <p>Shagbark Hickory <i>Carya ovata</i></p>	
 <p>Eastern Hemlock <i>Tsuga canadensis</i></p>			 <p>Black Cherry <i>Prunus serotina</i></p>	 <p>Paw Paw <i>Asimina triloba</i></p>

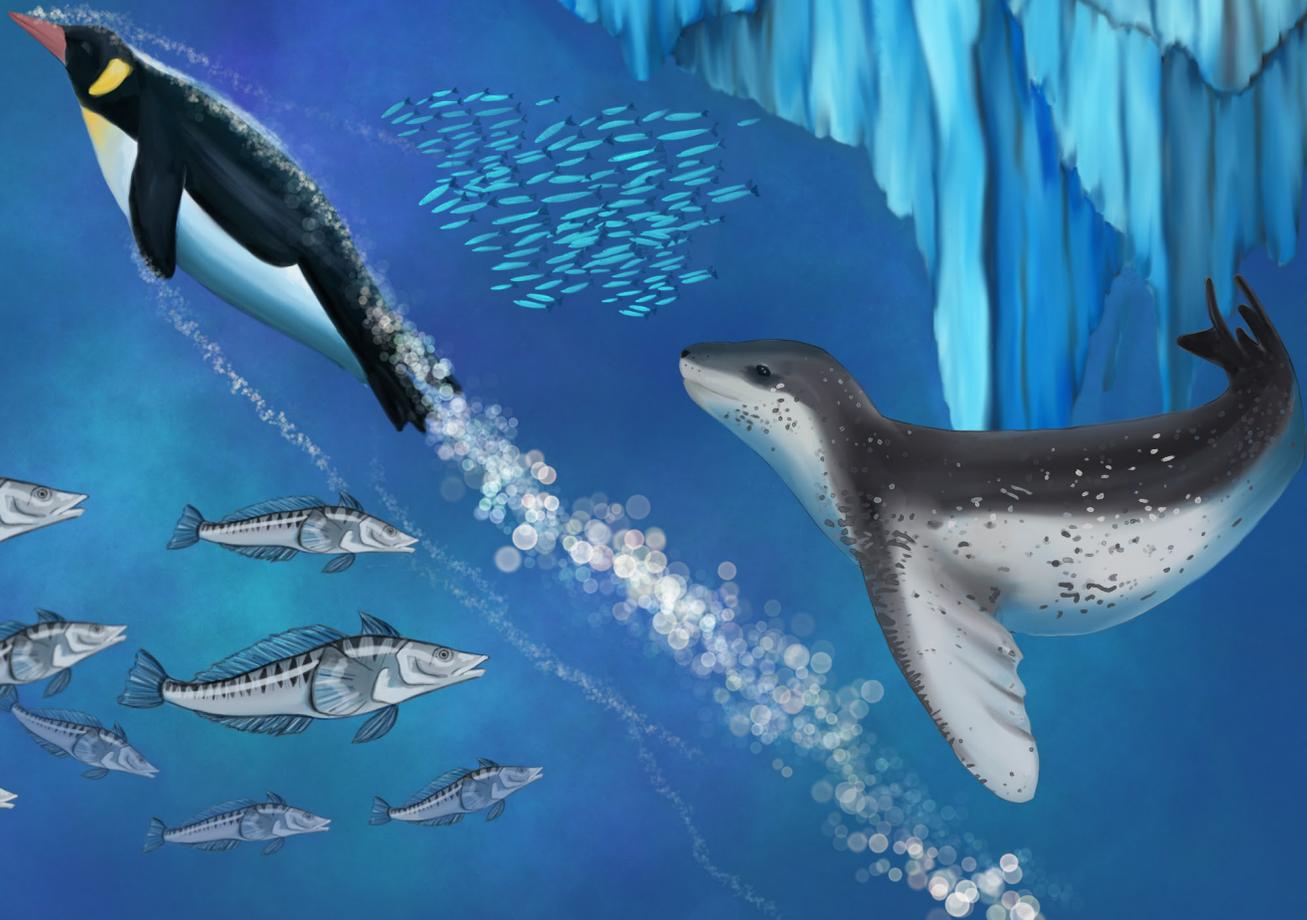



<p>Red Deer Grass <i>Themeda danica</i></p>  <p>Primary Producer Converts sunlight energy into food for grasses to eat.</p>	<p>Wildebeest or Gnu <i>Connochaetes taurinus</i></p>  <p>Habitat Quality Control Converts nutrients of grass to poop each year.</p>	<p>Dung Beetle <i>Herichthys spicatus</i></p>  <p>Waste Management Returns nutrients to the ground and aerates the soil.</p>	<p>African Bush Elephant <i>Loxodonta africana</i></p>  <p>Ecologist Engineer Maintains moist grassland and disperses seeds.</p>	<p>Lion <i>Panthera leo</i></p>  <p>Apex Predator Controls the size of the herbivore population as the grasses can thrive.</p>
---	--	--	--	--



KEYSTONE SPECIES
ANTARCTIC KRILL





JANUARY

2023

December 2022

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

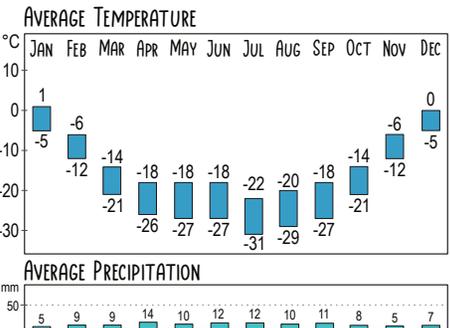
February 2023

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28				

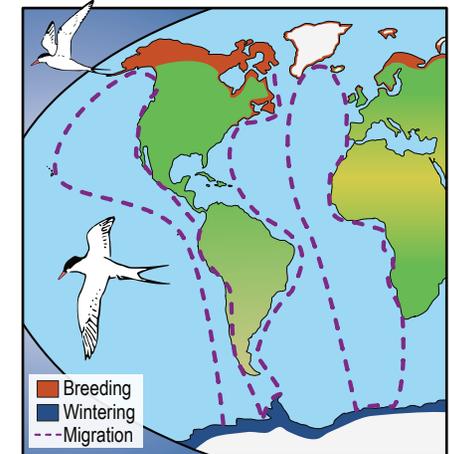
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1 New Year's Day	2	3 Quadrantids Meteor Shower	4	5	6 ☉ Wolf Moon	7
8	9	10 Houseplant Appreciation Day	11	12	13	14
15	16 Martin Luther King Jr. Day	17	18	19	20 National Penguin Awareness Day	21 ☾ New Moon
22 Chinese New Year	23	24	25	26	27	28
29	30	31	<p>Most of the 18 penguin species have declining populations. Penguin Awareness Day is a day to learn more about these amazing birds and how people can protect them.</p> <p>Did you know? The United States, Liberia, and a handful of island nations are the only countries that use Fahrenheit to measure temperature. All other countries use Celsius. To convert °F to °C, first subtract 32. Then multiply by 5 and divide by 9.</p> <p>The Quadrantids meteor shower is brief, with a peak of only a few hours. It is caused by fragments from 2003 EH1, an asteroid or possible "rock comet."</p>			

POLAR

McMURDO STATION, ANTARCTICA



The Arctic tern (*Sterna paradisaea*) has the longest migration of any animal on Earth. It spends the northern summer in the Arctic and then flies more than 20,000 km to reach Antarctica. In addition to experiencing more daylight than any other animal on the planet, Arctic terns are long lived animals. During their lifetime they can travel more than 2.4 million kilometers—that's 1.5 million miles!



The Antarctic krill (*Euphausia superba*) is a keystone species and one of the most abundant animals on the planet. Living in harsh, cold waters, they can survive for 200 days without food, shrinking from their adult form to a smaller juvenile body.





THE ACTIVE LAYER FREEZES AND THAWS

ICE WEDGE

PERMAFROST
IS FROZEN ALL YEAR LONG

THE TALIK LAYER
IS ALWAYS UNFROZEN

FEBRUARY

2023

January 2023

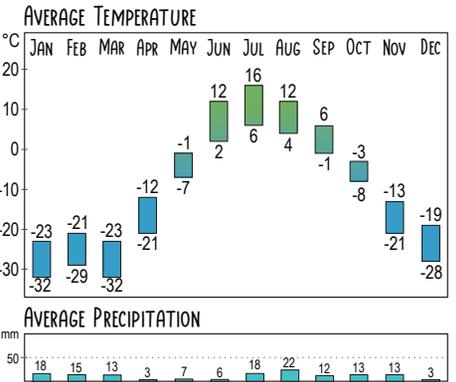
S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

March 2023

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
<p>Why does February have fewer days than the other months? Because the Roman King Numa Pompilius thought even numbers were unlucky! He designed a solar calendar where every month had either 29 or 31 days. But this caused a problem. <i>Adding odd numbers will always give you an even number!</i> Better to have an unlucky month than an unlucky year, so Numa gave February 28 days. The calendar went through many revisions and changes over the next thousand years, but February stayed the shortest month!</p>			1	2	3	4
5	6	7	8	9	10	11
○ Snow Moon		Periodic Table Day		Groundhog Day		
12	13	14	15	16	17	18
		Valentine's Day				
19	20	21	22	23	24	25
	Presidents' Day ● New Moon	Mardi Gras		National Chili Day		
26	27	28	<p>Native Americans named the full moons according to seasonal characteristics. The Snow Moon was also called the Hunger Moon because it occurred during the month with both the greatest snowfall and scarcest food.</p> <p>Ever wonder how the Periodic Table got its name? Each row in the table is called a period. Elements in the same periods have valence electrons in the same shell.</p> <p>Don't bother cooking chili peppers for the birds on National Chili Day. Birds have different taste receptors than mammals. They're immune to the heat of capsaicin!</p>			

TUNDRA NUIQSUT, ALASKA



Tundra is an ecosystem that is too cold for trees. One of its defining features is a layer of soil that is frozen year round, which is called *permafrost*.



ARCTIC TUNDRA

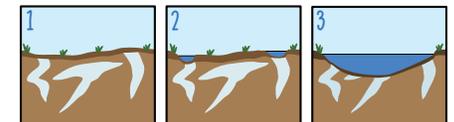


ALPINE TUNDRA

The musk ox is more closely related to sheep and goats than a cow. Its scientific name (*Ovibos moschatus*) means "musky sheep!" They have two distinct coats: an underwool layer called qiviut and an outer layer of hair that protects the downy wool.



When ice-rich permafrost melts, it forms freshwater ponds and an uneven terrain called thermokarst. Although these lakes and ponds are often temporary, they can cause further thawing.





Defining Characteristic:
Long cold winters.

MARCH

2023

February 2023

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28				

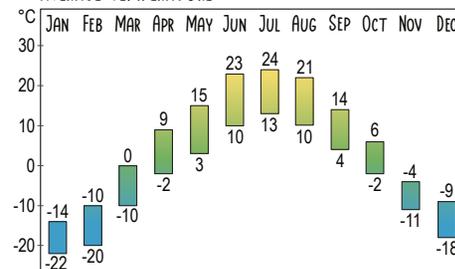
April 2023

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

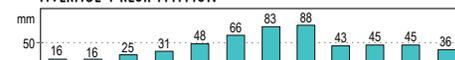
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
The Anishinaabe peoples named the March full moon the Sugar Moon (<i>Ziissbaakdoke Giizas</i>) since it corresponded with when the maple tree sap began to run. Earth Hour started in Sydney, Australia in 2007. Observed worldwide, it's marked by turning off all non-essential lights from 8 pm to 9 pm. During the March equinox the length of day and night are close to being equal for most locations on Earth.	1	2	3	4	5	6
5	6	7 ○ Sugar Moon	8 Holi	9	10	11 National Day of Unplugging
12 Daylight Saving Time Begins	13	14 Pi Day	15	16	17 St. Patrick's Day	18
19	20 March Equinox	21 ● New Moon	22 Ramadan Begins	23	24	25 Earth Hour
26	27	28	29	30	31	

BOREAL FOREST KRASNOYARSK, RUSSIA

AVERAGE TEMPERATURE

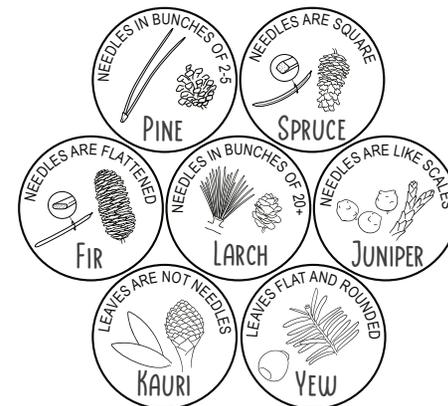


AVERAGE PRECIPITATION



The dominant trees in boreal forests are evergreen conifers (pines, spruces, and fir trees) and deciduous larches.

But conifers don't just grow where it's cold! There are more than 600 species, and many of them grow in temperate and tropical climates.



Siberia covers almost 9% of the total land area on Earth! Most of Siberia is boreal forest, or taiga. It also contains stunning national parks, and Lake Baikal, the deepest lake in the world.





Sugar Maple
Acer saccharum



White Ash
Fraxinus americana



Flowering Dogwood
Cornus florida



Yellow Buckeye
Aesculus flava



Pitch Pine
Pinus rigida



Honey Locust
Gleditsia triacanthos



American Linden
Tilia americana



Sassafras
Sassafras albidum



American Persimmon
Diospyros virginiana



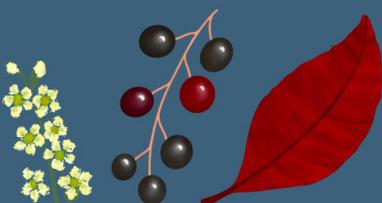
Tulip Tree
Liriodendron tulipifera



Shagbark Hickory
Carya ovata



Eastern Hemlock
Tsuga canadensis



Black Cherry
Prunus serotina



Paw Paw
Asimina triloba



Cucumber Tree
Magnolia acuminata



White Oak
Quercus alba

APRIL

2023

March 2023

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

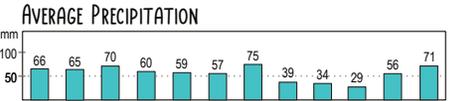
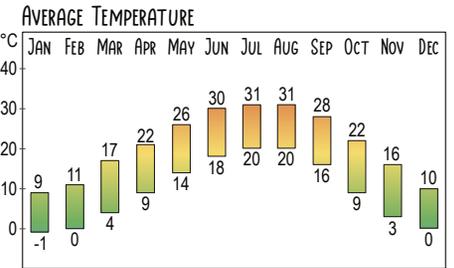
May 2023

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

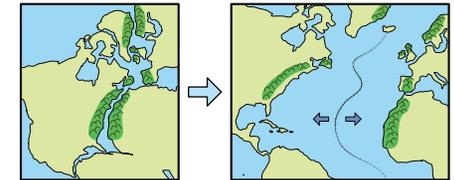
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
<p>The phrase "April showers bring May flowers" traces back to an English book published in 1557 by Thomas Tusser. But in the Northern Hemisphere, there are plenty of spring flowers that bloom in April too!</p> <p>The Pink Moon is named for creeping phlox, which has bright pink flowers.</p> <p>The path of totality for the April 20th solar eclipse travels over the Indian Ocean, part of North West Australia, Indonesia and parts of New Guinea. Most of Australia and Southeast Asia will see a partial eclipse.</p> <p>Earth Day is an international event recognized by more than 1 billion people each year. Many people celebrate by planting a tree, cleaning up trash, or making a change to reduce waste or conserve energy.</p>						1
2	3	4	5	6	7	8
			Passover Begins	○ Pink Moon		
9	10	11	12	13	14	15
Easter	Siblings Day			Passover Ends		
16	17	18	19	20	21	22
				● Solar Eclipse New Moon	Eid al-Fitr	Earth Day
23	24	25	26	27	28	29
30				Morse Code Day		

TEMPERATE FOREST

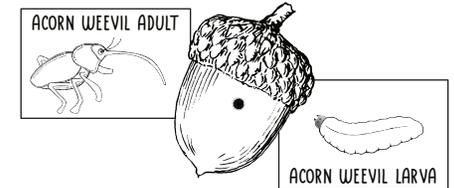
GATLINBURG, TENNESSEE



The Appalachian Mountains are older than the Atlantic Ocean! First formed 450 MYA in the supercontinent of Pangea, they are the remnants of an ancient mountain range that includes the Atlas Mountains in Africa and the Scottish Highlands.



Oak trees are a keystone species in North America because more than 100 different animals rely on them for food. In autumn, acorns can be over 25% of a deer's diet and one beetle (the acorn weevil) even uses them as a home.



The Appalachian Mountains are home to more than 150 different species of trees. Most of them are deciduous. Shedding leaves in autumn helps trees save water, conserve resources, and take less damage during winter storms.





MAY

2023

April 2023

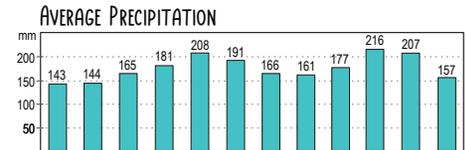
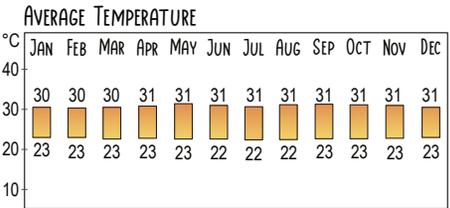
S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
						30

June 2023

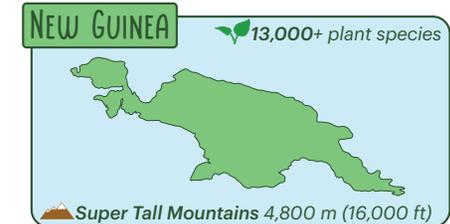
S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	1	2	3	4 Star Wars Day	5 Lunar Eclipse ○ Flower Moon	6 Eta Aquariids Meteor Shower
7	8	9	10	11	12	13
14 Mother's Day	15	16	17	18	19 Bike to Work Day ● New Moon	20
21	22	23 World Turtle Day	24	25	26	27
28	29 Memorial Day	30	31	<p>The Eta Aquariids meteor shower is caused by debris from the Halley's Comet, which circles the sun once every 76 years.</p> <p>World Turtle Day is a good day to remember that all tortoises are also turtles- reptiles encased in a bony shell.</p> <p>Fun fact: The first bicycles were called velocipedes. Traveling by bike provides advantages over motorized transport such as savings on fuel costs, reduced CO₂ emissions, and exercise.</p>		

TROPICAL FOREST WEWAK, PAPUA NEW GUINEA

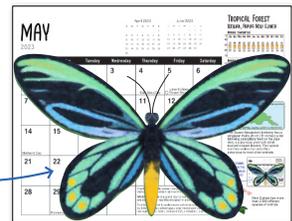


New Guinea is the second largest island in the world. Its tall mountains and high rainfall foster incredible biodiversity. Thousands of species in New Guinea are *endemic*, meaning they live nowhere else in the world.



The Queen Alexandra's birdwing has a wingspan that's 28 cm (11 inches) wide! Birdwing caterpillars feed on the pipe vine, a poisonous plant with white trumpet-shaped flowers. This special diet then makes the butterflies poisonous to most other animals.

IF A BIRDWING LANDED ON THIS PAGE, IT WOULD BE THIS BIG!



New Guinea has more than 2,000 different species of orchids.



Red Oat Grass
Themeda triandra



Primary Producer
Converts sunlight energy into food for grazers to eat.

Wildebeest or Gnu
Connochaetes taurinus



Habitat Quality Control
Converts thousands of tons of grass into poop each year!

Dung Beetle
Hundreds of species!



Waste Management
Returns nutrients to the ground and aerates the soil.

African Bush Elephant
Loxodonta africana



Ecosystem Engineer
Maintains mixed grassland and disperses seeds.

Lion
Panthera leo



Apex Predator
Controls the size of the herbivore population so the grasses can thrive.

JUNE

2023

May 2023

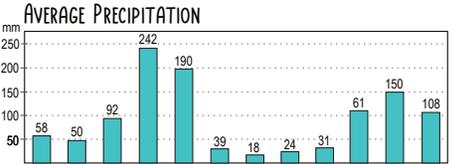
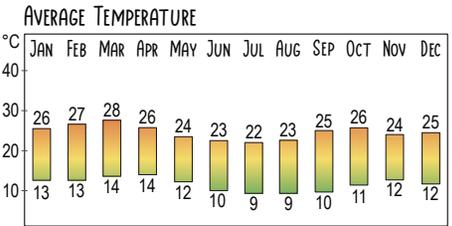
S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

July 2023

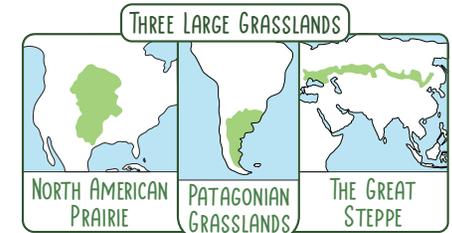
S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
<p>The June solstice occurs when the North Pole reaches its maximum tilt toward the Sun. It marks the first day of summer for the Northern Hemisphere and the start of winter for the Southern Hemisphere. Depending on whether you live above or below the equator, June 21st will be either the longest or shortest day of the year.</p> <p>The ocean covers more than 70% of Earth's surface and is essential to life on Earth. Use World Oceans Day to learn more about this incredible body of water or to clean up plastic waste. No matter where we live, we can help prevent more plastic from reaching the ocean.</p>				1	2	3
4	5	6	7	8	9	10
Strawberry Moon ☉ Moon				World Oceans Day		
11	12	13	14	15	16	17
			World Blood Donor Day			
18	19	20	21	22	23	24
Father's Day ☾ New Moon	Juneteenth		Solstice			
25	26	27	28	29	30	

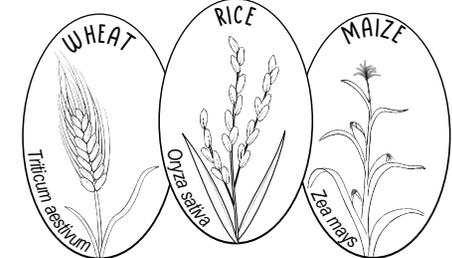
SAVANNA NAIROBI, KENYA



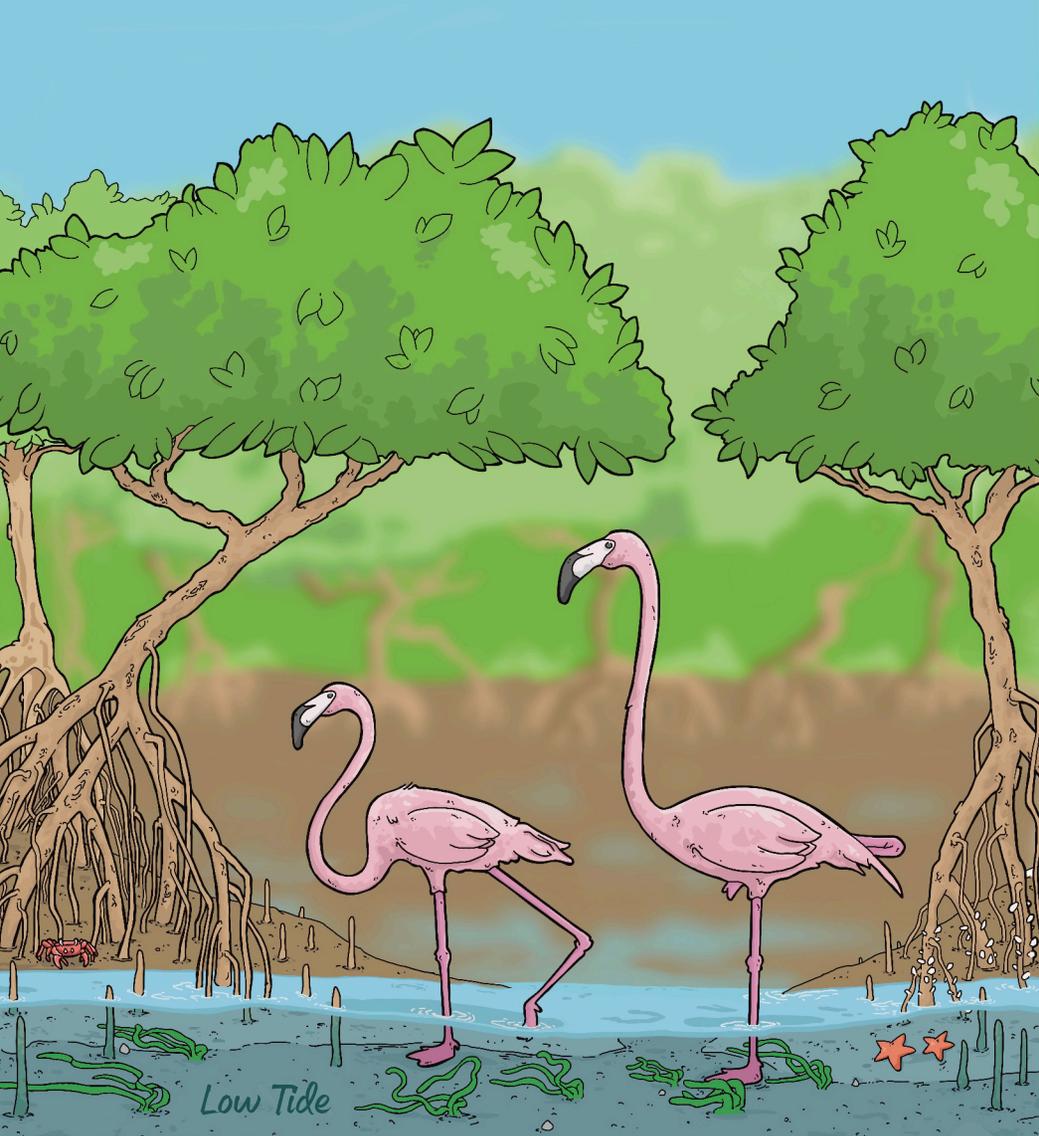
Grassland ecosystems are called many different names including savanna, prairie, steppe, and pampas. Prairies have virtually no tree cover (less than 10%). In savannas, up to 30% of the land is covered by trees. Steppes are often colder and have shorter grasses than prairies.



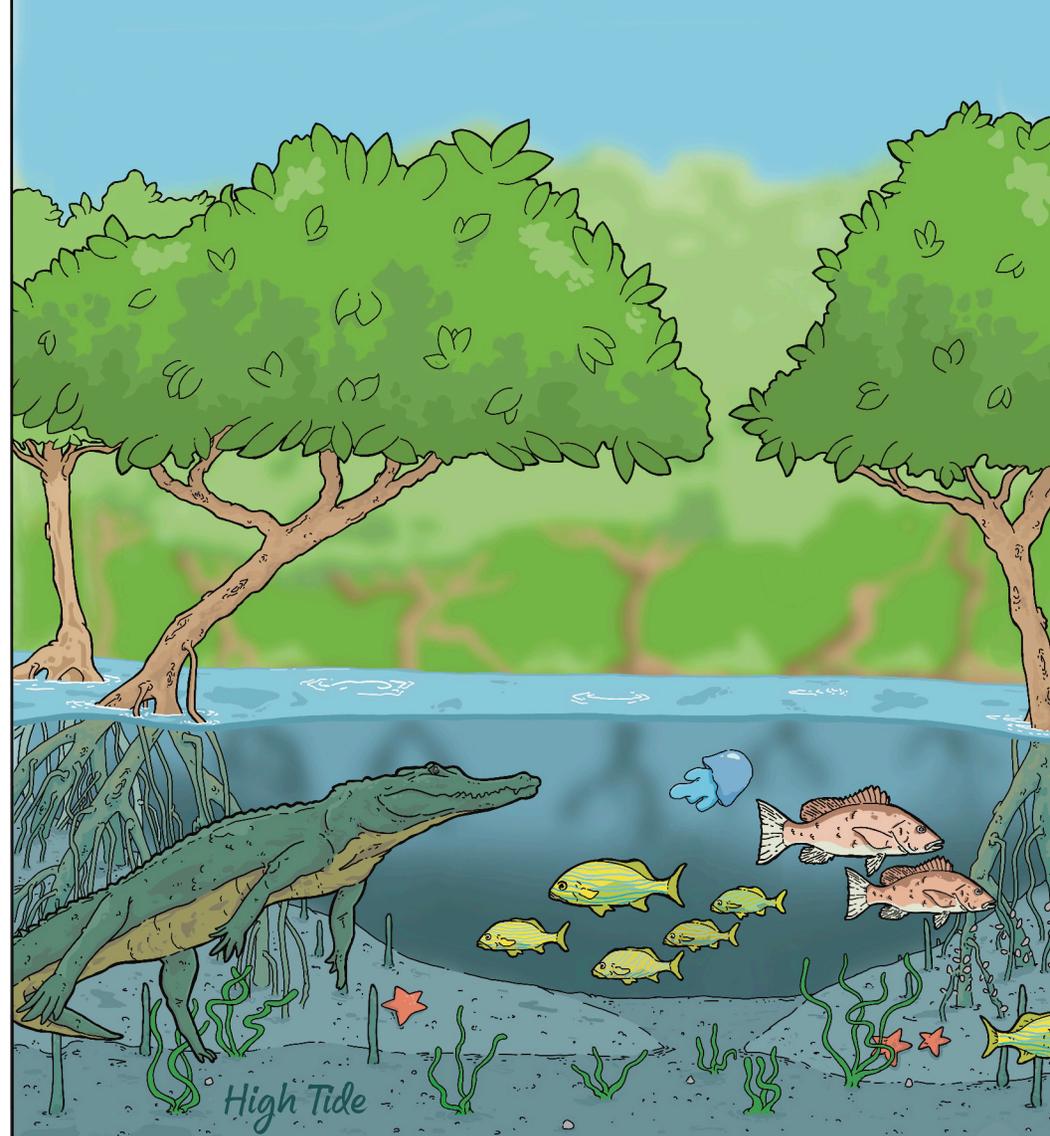
Grasses are essential for both savanna ecosystems and human beings. Cereal crops such as rice, wheat, corn, barley, and millet make up over 50% of the global human diet.



Grasses are found on every continent. The largest species, *Dendrocalamus giganteus* or giant bamboo, can grow up to 40 meters (131 feet) tall!



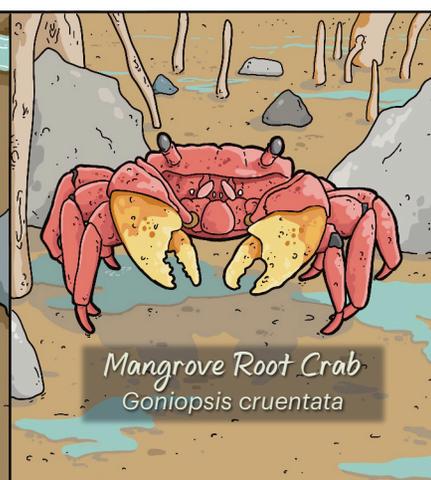
Low Tide



High Tide



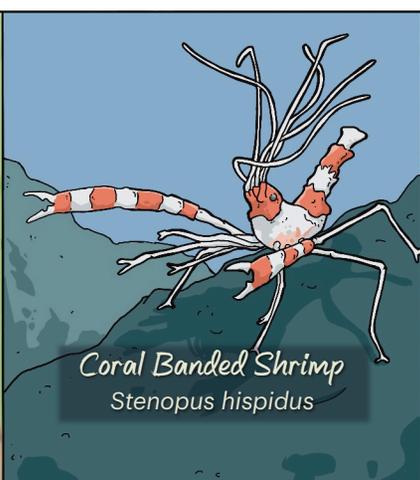
Pile Worm
Alitta succinea



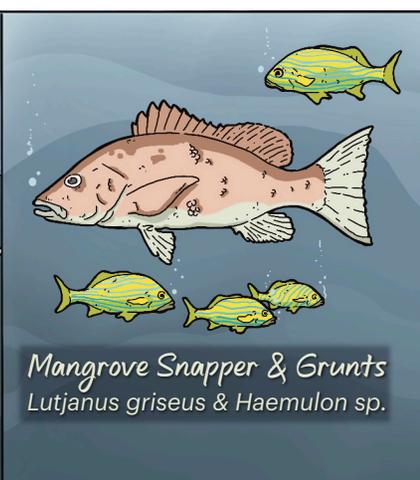
Mangrove Root Crab
Goniopsis cruentata



Mangrove Oyster
Crassostrea rhizophorae



Coral Banded Shrimp
Stenopus hispidus



Mangrove Snapper & Grunts
Lutjanus griseus & *Haemulon* sp.

JULY

2023

June 2023

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

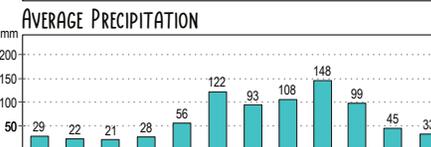
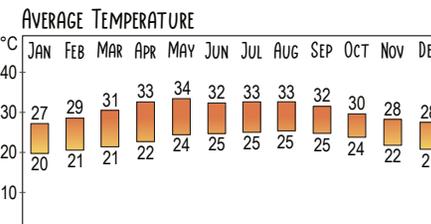
August 2023

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
<p>The July moon has been called the Buck Moon because it coincides with the time of year when deer grow antlers. The Tlingit and Haida people called it the Salmon Moon. It also has been called the Halfway Summer Moon, Hay Moon, and Thunder Moon.</p> <p>July 20th is the 54th anniversary of the Apollo 11 moon landing.</p> <p>The comet of origin for the Southern Delta Aquariids meteor shower is unknown. Their radiant is near the constellation Aquarius.</p> <p>International Chess Day is a chance to celebrate the oldest and most widely-played game in the world. One reason for the game's impressive popularity is how much variety there is when playing. The number of unique chess games (10^{120}) is greater than the estimated number of atoms in the known universe!</p>						1
2	3	4	5	6	7	8
	○ Buck Moon	Independence Day				
9	10	11	12	13	14	15
16	17	18	19	20	21	22
	● New Moon			International Chess Day		
23	24	25	26	27	28	29
30	31		Mangrove Conservation Day			Delta Aquariids Meteor Shower

MANGROVE

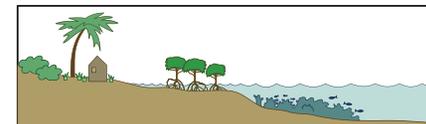
RÍO LAGARTOS, MEXICO



Mangroves are *halophytes*. They're the only trees that can grow in ocean water.



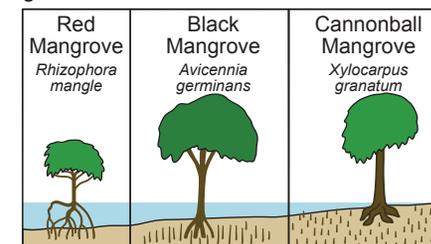
Mangroves protect coasts from storm surge and waves. They also act as a nursery for fish and improve the health of coral reefs.



Mangroves grow along the coasts of more than 100 tropical and subtropical countries. The largest mangrove forest in the world is the Sundarbans.



There are more than 50 species of mangrove trees. Their size and traits vary, but all of them share the ability to grow in the tidal zone.





Wadi/Arroyo



Alluvial Fan



Playa or Dry Lake Bed



Oasis



Desert Pavement



Dune or Erg



Rock Pedestal

formed by water

formed by wind



AUGUST

2023

July 2023

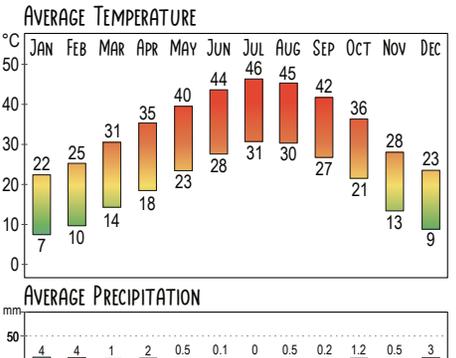
S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

September 2023

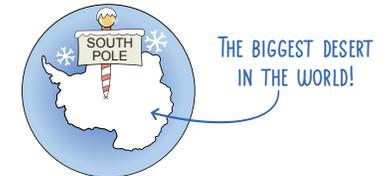
S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
<p>A supermoon occurs when a full moon coincides with the moon's <i>perigee</i>, the closest part of its orbit around the Earth.</p> <p>When two full moons occur in the same calendar month, the second one is called a "blue moon." This occurs every 2 to 3 years and can happen in any month except February.</p>	1	1 Supermoon ○ Sturgeon Moon	2	3	4	5
6	7	8 Infinity Day	9	10	11	12
13 Perseids Meteor Shower	14	15	16 ● New Moon	17	18	19 National Potato Day
20	21	22	23	24	25	26
27	28	29	30 Supermoon ○ Blue Moon	31	<p>The colocynth in the above illustration is a small plant related to the watermelon. The bitter flesh is non-edible but used in traditional medicine. The edible seeds can be ground into flour for bread.</p> <p>Like other plants of the Sahara, <i>Citrullus colocynthis</i> can survive extreme heat and drought.</p>	

DESERT IN SALAH, ALGERIA

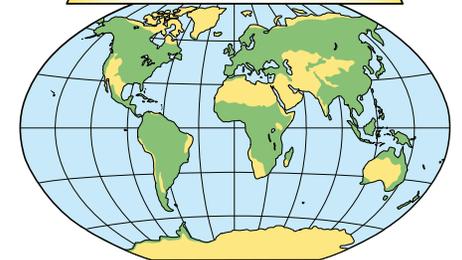


Deserts are always dry, but they can be either hot or cold. While the Sahara is the largest hot desert, Antarctica is the biggest desert overall!

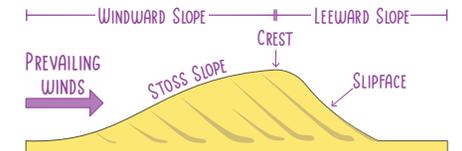


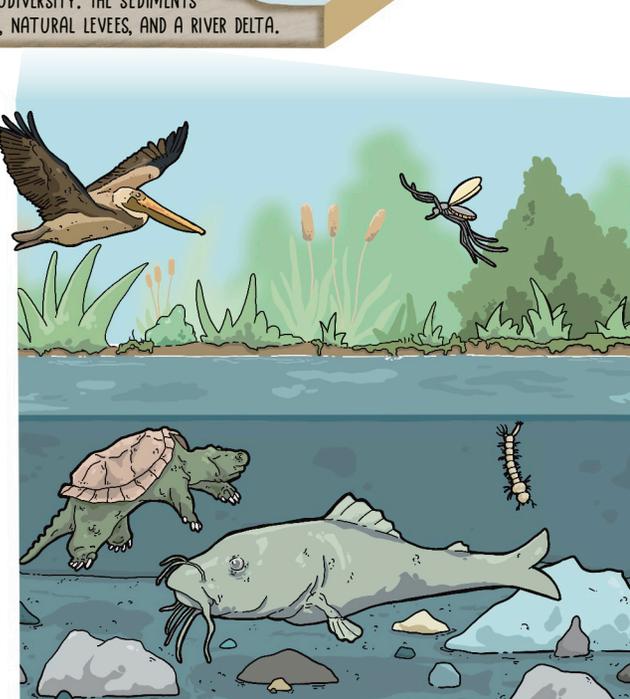
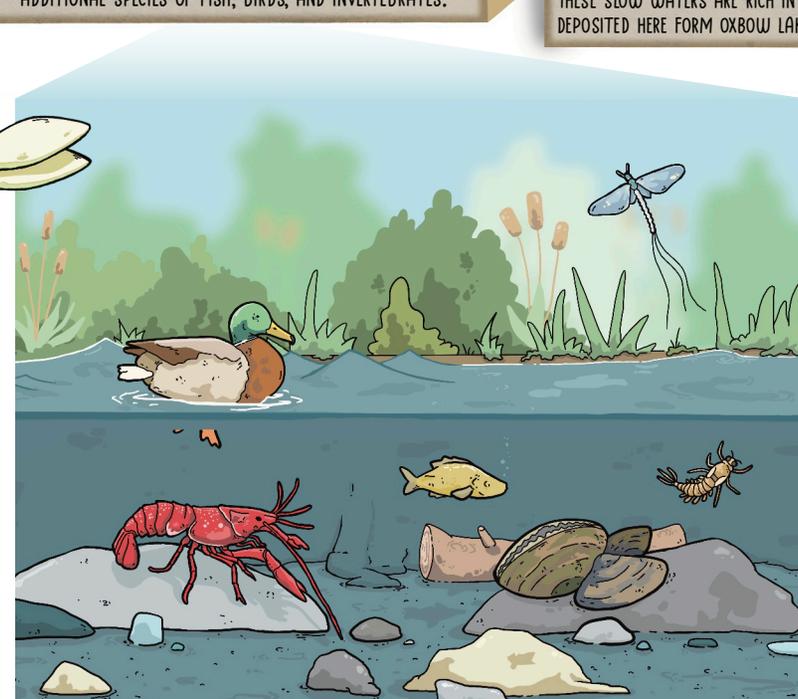
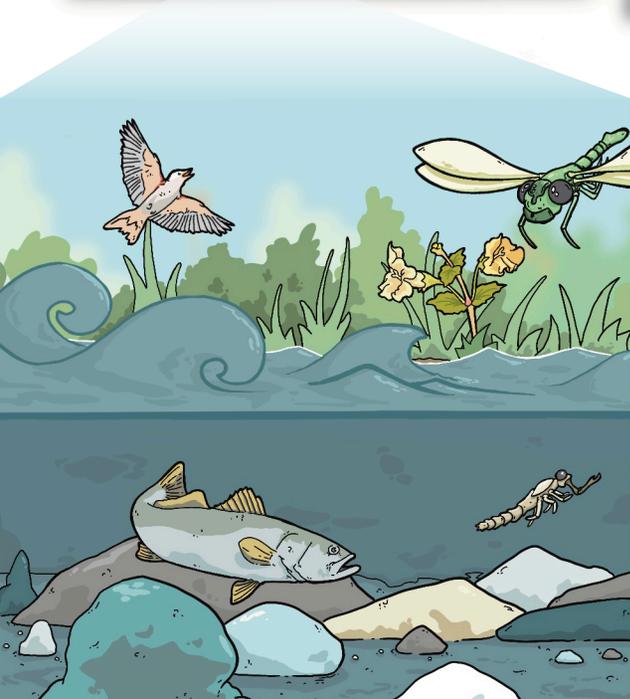
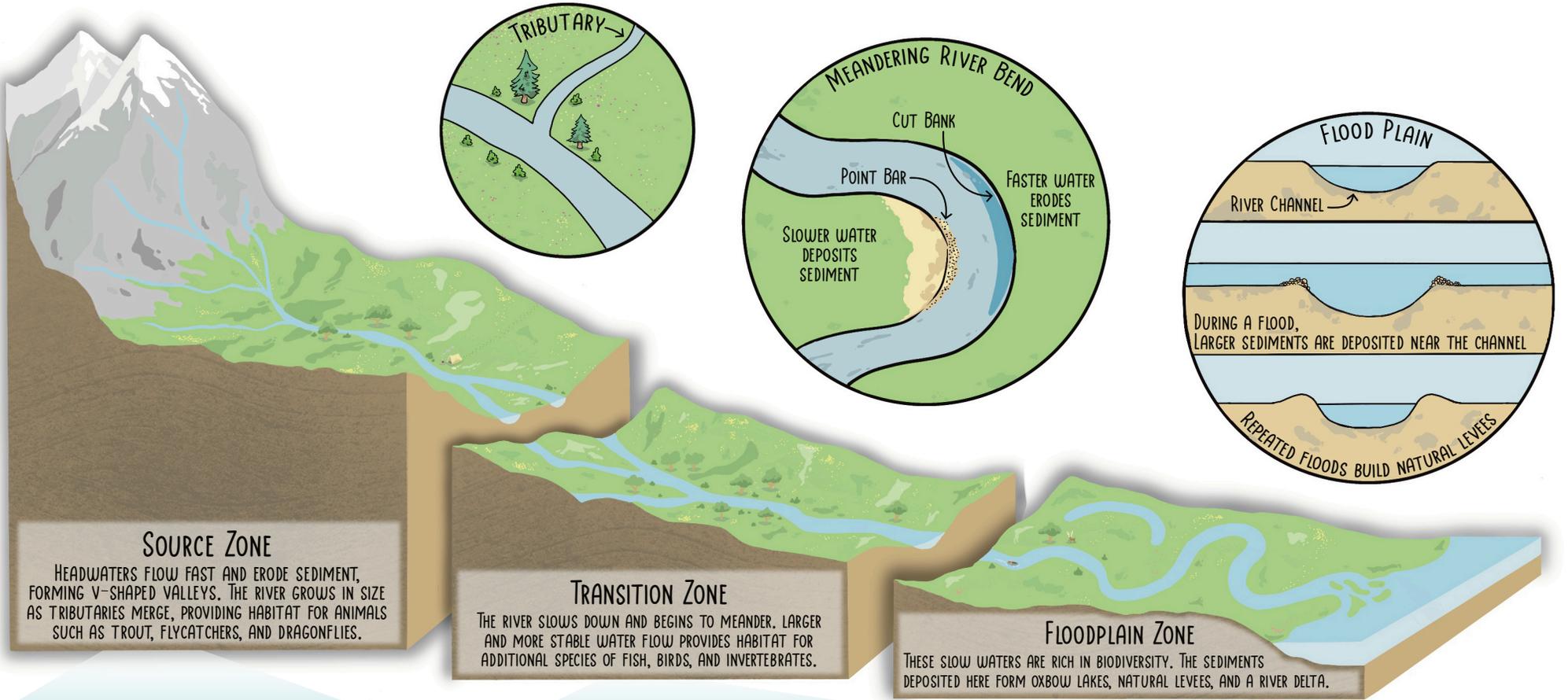
29% of Earth's surface is land, and 1/5 of that land is arid, meaning it receives less than 250 mm of precipitation each year. Deserts support few plants or animals compared to grasslands and forests, but they play an important role in global cycles of heat and nutrients.

ARID REGIONS OF THE WORLD



The shape of the dune tells you how it was built and in which direction the wind most often blows!





SEPTEMBER

2023

August 2023

S	M	T	W	T	F	S	
			1	2	3	4	5
6	7	8	9	10	11	12	
13	14	15	16	17	18	19	
20	21	22	23	24	25	26	
27	28	29	30	31			

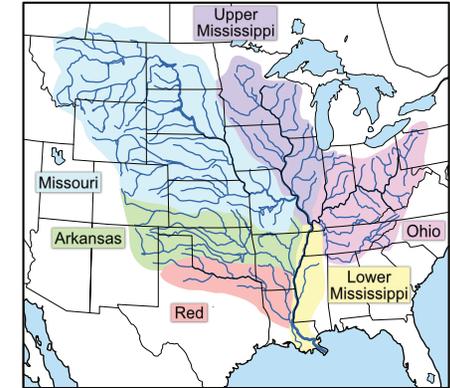
October 2023

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
<p>The Earth rotates on a tilted axis, but twice a year that axis is directly perpendicular to the Sun. This is called an equinox! In the Northern Hemisphere the September equinox marks the start of fall, when days become shorter than nights. In the Southern Hemisphere, it marks the start of spring.</p> <p>World Car Free Day is held each year on September 22. The car is a popular form of transportation in many developed countries, but it comes with significant costs to health, safety, and the environment. Car free days can be a good way for communities to explore alternative methods of transportation.</p> <p>Created in 1894 to honor and recognize the American labor movement, Labor Day is one of the oldest US holidays. Thanksgiving didn't become an official federal holiday until 1941, nearly 50 years later.</p>					1	2
3	4	5	6	7	8	9
	Labor Day					
10	11	12	13	14	15	16
					Rosh Hashanah ● New Moon	
17	18	19	20	21	22	23
		National Talk Like a Pirate Day			World Car Free Day	Equinox
24	25	26	27	28	29	30
Yom Kippur					○ Harvest Moon	

LOTIC MISSISSIPPI RIVER

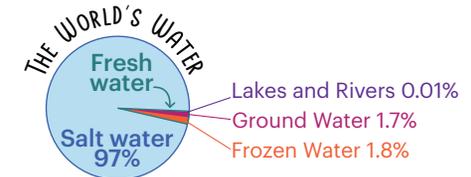
THE DRAINAGE BASIN (WATERSHED)



Covering 3.2 million km², or 1.2 million mi², the Mississippi watershed is the largest drainage basin in North America.



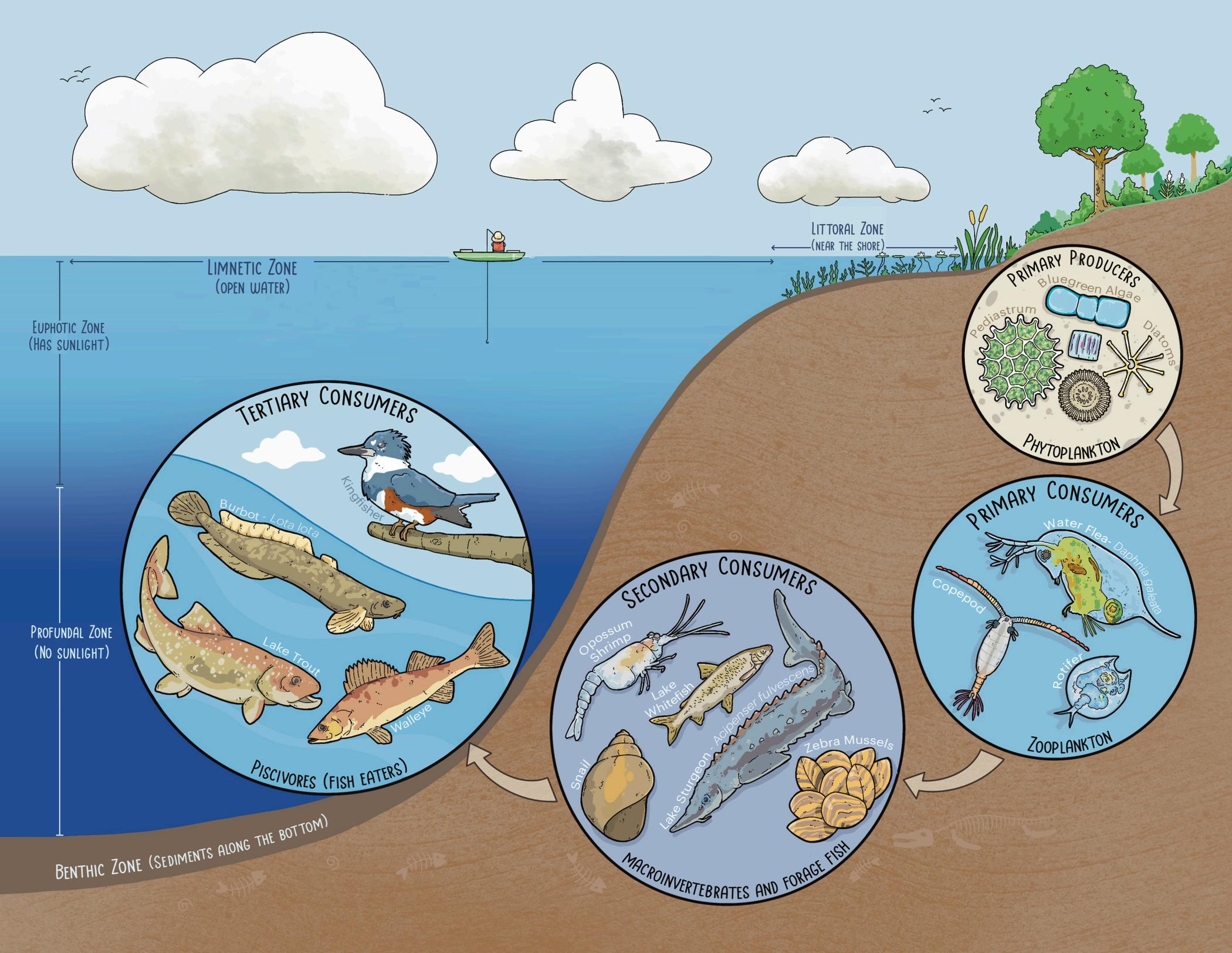
Rivers are important transportation systems in geology. They are constantly moving rock and dirt (sediment) from one location to another.



Lakes and rivers makes up less than 1% of the world's water, yet they are home to almost half of the world's 30,000 species of fish!



Throughout history, people have lived by rivers because they provide drinking water, transportation, and irrigation for crops. The 10 biggest cities in the world are all located by rivers – except Mexico City, which buried its 45 rivers.



LITTORAL ZONE
(NEAR THE SHORE)

LIMNETIC ZONE
(OPEN WATER)

EUPHOTIC ZONE
(HAS SUNLIGHT)

PROFUNDAL ZONE
(NO SUNLIGHT)

BENTHIC ZONE (SEDIMENTS ALONG THE BOTTOM)

PRIMARY PRODUCERS
Bluegreen Algae
Diatoms
Pediastrum
PHYTOPLANKTON

PRIMARY CONSUMERS
Water Flea- Daphnia Galeata
Copepod
Rotifer
ZOOPLANKTON

SECONDARY CONSUMERS
Opossum Shrimp
Lake Whitefish
Lake Sturgeon - Acipenser fulvescens
Zebra Mussels
Snail
MACROINVERTEBRATES AND FORAGE FISH

TERTIARY CONSUMERS
Kingfisher
Burbot - Lota lota
Lake Trout
Walleye
PISCIVORES (FISH EATERS)

OCTOBER

2023

September 2023

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

November 2023

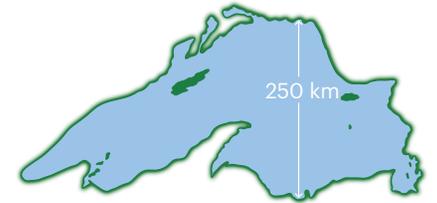
S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2	3	4	5 International Teachers' Day	6	7
8 Draconids Meteor Shower	9 Indigenous Peoples' Day	10	11	12	13	14 Annular Solar Eclipse ● New Moon
15 National Chemistry Week	16	17	18	19	20	21 International Observe the Moon Night
22 Orionids Meteor Shower	23	24	25	26	27	28 Partial Lunar Eclipse ○ Hunter Moon
29	30	31 Halloween	<p>International Observe the Moon Night is held annually in September or October when the Moon is at first quarter. A first-quarter Moon offers excellent viewing opportunities along the terminator (the line between night and day), where shadows enhance the Moon's cratered landscape. If clouds interfere with your ability to observe the Moon on this night, you can join one of NASA's virtual events.</p> <p>The Draconids meteor shower is caused by debris from the periodic comet 21P/Giacobini-Zinner, while the Orionids are caused by the trail of Halley's Comet.</p>			

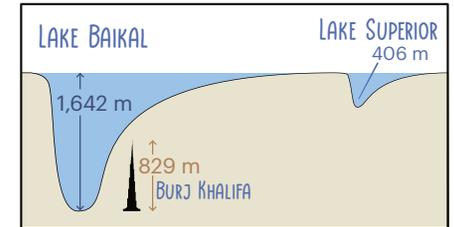
LENTIC

LAKE SUPERIOR, US & CANADA

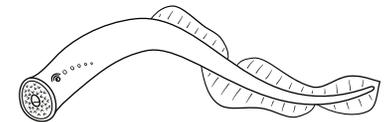
THE LARGEST FRESHWATER LAKE



The largest lake in the world by surface area is Lake Superior, which covers 82,103 km² (31,700 mi²).



A lake is a body of water that fills a basin. Over geologic time, all lakes are temporary. The rivers deposit sediment in the basin until it fills up. Some of the deepest lakes in the world are caused by tectonic activity. In the case of Lake Baikal, rifting is widening the basin faster than sediment can fill it.



The lamprey is a jawless fish and one of the most invasive species in the Great Lakes. Native to the Atlantic Ocean, they made their way to the lakes by canals and devastated fish populations.



Of the estimated 117 million lakes in the world, only 30 are salty. The saltiest are the Dead Sea (34% salinity) and the Great Salt Lake (5 to 27% salinity). For comparison, the ocean has an average salinity of just 3.5%.



NOVEMBER

2023

October 2023

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

December 2023

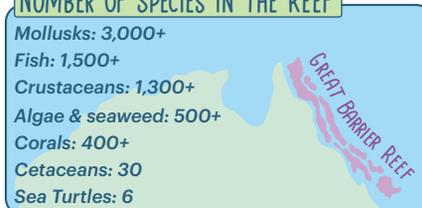
S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
<p>National Bison Day is dedicated to this charismatic animal that can run 35 mph and jump more than six feet. While they may not live near coral reefs, bison are excellent swimmers.</p> <p>The Beaver Moon, also called the Frost Moon, often coincided with the first hard frosts of winter.</p> <p>The Taurids meteor shower is caused by debris from the comet Encke. The Leonids come from the Tempel-Tuttle comet.</p>			1	2	3	4
						National Bison Day
5	6	7	8	9	10	11
Daylight Saving Time Ends		Election Day				Veterans Day
12	13	14	15	16	17	18
Taurids Meteor Shower Diwali	World Kindness Day ● New Moon					Leonids Meteor Shower
19	20	21	22	23	24	25
				Thanksgiving Day		
26	27	28	29	30		
	○ Beaver Moon					

CORAL REEF GREAT BARRIER REEF, AUSTRALIA

NUMBER OF SPECIES IN THE REEF

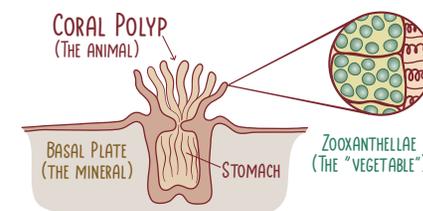
- Mollusks: 3,000+
- Fish: 1,500+
- Crustaceans: 1,300+
- Algae & seaweed: 500+
- Corals: 400+
- Cetaceans: 30
- Sea Turtles: 6



The Great Barrier Reef is made of more than 2,000 individual reefs. Altogether, it's the world's largest living structure and covers 348,700 km² which is about the same size as Italy or half the size of Texas!



The giant triton (*Charonia tritonis*) plays an essential role in the Great Barrier Reef because it keeps populations of crown-of-thorns starfish in check.



Stony corals are one of the only things that can claim to be animal, vegetable, *and* mineral. Reef building corals have a basal plate of calcium carbonate which can *literally* become rock.



In Lake Champlain Vermont, you can see remnants of the oldest reef in the world. While the Chazy Reef had some corals, the main reef builders 480 million years ago were sponges and bryozoans. Today the remnants of the ancient reef are a limestone formation with abundant fossils.



CHEMOSYNTHETIC BACTERIA



DECEMBER

2023

November 2023

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

January 2024

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
<p>In the Northern Hemisphere, the December solstice is the longest night of the year and the day when the sun reaches its lowest elevation in the sky. The date has been celebrated for millennia by many cultures.</p> <p>The Geminids meteor shower is caused by the object 3200 Phaethon which is thought to be an asteroid. It is one of the most active and reliable meteor showers of the year with 160 meteors per hour. Years when the Geminids coincide with a new moon are especially good for viewing.</p> <p>National Letter Writing Day is a great day to explore the history of human correspondence or send a message to a friend.</p>					1	2
3	4	5	6	7	8	9
				National Letter Writing Day		
10	11	12	13	14	15	16
		● New Moon	Geminids Meteor Shower			
17	18	19	20	21	22	23
				Solstice	Ursids Meteor Shower	
24	25	26	27	28	29	30
31	Christmas	○ Cold Moon		Call a Friend Day		
New Year's Eve						

DEEP SEA HYDROTHERMAL VENT

VARIOUS LOCATIONS WORLD WIDE



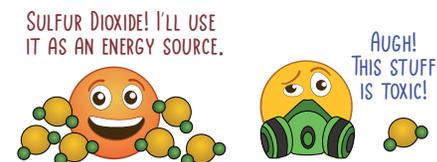
Hydrothermal vents come in two distinct types. Black smokers have water rich in iron and sulfur. White smokers have water with a high concentration of calcium, barium, and silicon.



Chrysomallon squamiferum, the scaly foot snail, has a super strong shell made of iron sulfides. The snail foot is also armored with hundreds of small sclerites made of iron and pyrite.



The ocean dandelion is a colony of individual animals (zoooids) that live together as one body (a siphonophore) similar to a Portuguese man-of-war.



CHEMOSYNTHETIC BACTERIA **EVERY OTHER LIVING THING ON THE PLANET**

Hydrothermal vent ecosystems are one of Earth's only ecosystems without a direct input from sunlight. Bacteria that use sulfur dioxide and methane as energy sources are the basis of the entire food chain.

ECLIPSES IN 2023

Apr 20	Solar Eclipse (Total)	Visible in the North West Cape of Australia, parts of Indonesia, and West Papua.
May 5	Lunar Eclipse (Penumbral)	Visible in Europe, Africa, Asia, and Australia.
Oct 14	Solar Eclipse (Annular)	Visible in North and South America.
Oct 28	Lunar Eclipse (Partial)	Visible in Europe, Africa, Asia, and Australia.

A **lunar eclipse** occurs when the Earth moves between the Sun and the Moon, blocking the Sun's light from reaching the Moon.

During a total lunar eclipse, the Moon appears to have a red color because the only light reaching the Moon is indirect light that has passed through the Earth's atmosphere, which filtered out much of the blue light.

A **total solar eclipse** occurs when the Moon moves between the Sun and the Earth and it blocks all light coming directly from the Sun. When an eclipse is observed from the "path of totality," the viewer will experience a dramatic drop in temperature. The entire horizon will look like a sunrise, and the Sun itself looks like a black circle in the sky surrounded by a halo of soft light.

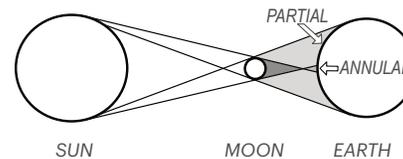
NOTES

Did you know?

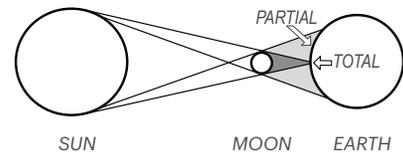
A solar eclipse always occurs about two weeks before or after a lunar eclipse. Usually, there are two or three solar eclipses each year, but there can be as many as five!

SOLAR ECLIPSE

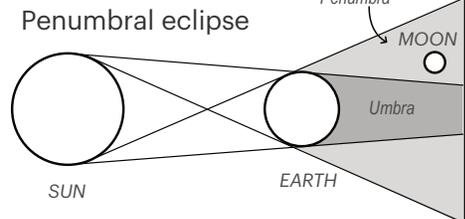
Annular eclipse



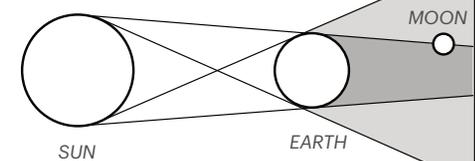
Total eclipse



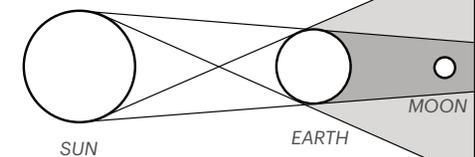
LUNAR ECLIPSE



Partial eclipse



Total eclipse



NOTES

Earth and Moon drawn to scale:



On average, the Moon is 384,400 km (238,857 miles) away from Earth - that's about the length of 30 Earths!



NOTES

FEATURED SPECIES

The art for each calendar page was inspired by specific species that live in these diverse ecosystems. Here's a list to inspire further exploration!

January - Polar

Antarctic Krill, Emperor Penguin, Leopard Seal, Icefish, Elephant Seal, South Polar Skua

February - Tundra

Musk Ox, Caribou, Arctic Fox, Arctic Cottongrass, Arctic Willow, Pasqueflower, Shrubby Cinquefoil, Moss Champion, Blueberry, Lowbush Cranberry

March - Taiga or Boreal Forest

Brown Bear, Moose, Siberian Weasel, Siberian Blue Robin, Siberian Zokor, Siberian Larch, Siberian Birch, Siberian Pine, Haskap Berry

April - Temperate Forest

Eastern Grey Squirrel, Black Walnut (in center panel)

May - Tropical Forest

Greater Bird of Paradise, New Guinea Trumpet Vine, Spotted Cuscus, Queen Alexandra's Birdwing, Great Flying Fox, Pipe Vine (*Pararistolochia dielsiana*), *Bulbophyllum phalaenopsis* (an orchid with carrion-scented flowers)

June - Savanna

Masai Giraffe, Plains Zebra, Umbrella Thorn Acacia

July - Mangrove

Black Mangrove, American or Caribbean Crocodile, American Flamingo, Red Cushion Sea Star

August - Desert

Colocynth (also called bitter apple or egusi)

September - Lotic (River)

Flycatcher, Dragonfly Nymph and Adult, Trout, Crawfish, Mayfly Nymph and Adult, Mallard Duck, Pelican, Snapping Turtle, Catfish, Mosquito Larva and Adult

October - Lentic (Lake)

Kingfisher, Lake Trout, Walleye, Opossum Shrimp, Lake Whitefish, Lake Sturgeon, Zebra Mussel, Copepod, Water Flea, Rotifer, Bluegreen Algae, Diatoms, Green Algae (*Pediastrum*)

November - Coral Reef

Butterfly Fish, Blue Tang, Clown Fish, Anemone, Long-Snouted Seahorse, Nudibranchs (including the Blue Sea Dragon), Blue-ringed Octopus, Pygmy Seahorse, Bluestreak Cleaner Wrasse, Sea Squirrels, Brain Coral, Table Coral, Titan Snail, Eel, Blacktip Reef Shark, Dolphin, Sea Turtle, Stingray

December - Hydrothermal Vents

Giant Tube Worms, Limpets, Crabs (*Bythograea thermydron*), Pink Vent Fish, Scaly Foot Snail, Octopus (*Vulcanoctopus hydrothermalis*), Alvinocaridid Shrimps, Sea Dandelion, Giant White Clam, Sea Fans and Anemones (including the sometimes purple *Relicanthus daphneae*)

MEET THE ARTISTS

We loved making this calendar and exploring so many interesting topics. Working on it gave us a sense of wonder and awe for how incredible the natural world is.

We hope it does the same for you!



Jenny Ballif (Science Mom) runs the Science Mom YouTube channel and creates science and math classes with her partner Serge Ballif (Math Dad). Learn more at www.science.mom

While Science Mom designed the calendar overall, special thanks goes to **Amber Chesser** and **Liza Bishton** for their wonderful help with research and proofreading. And the credit for the artwork on the beautiful main pages goes to these three amazing artists!

The Polar, Temperate Forest, Tropical Forest, Savanna, Desert, Coral Reef, and Hydrothermal Vent pages:

Rae Ward is a homeschooling autistic mom with a deep love of learning- especially about science. Art and music are her creative outlets. She loves spending time with family, nature, books, and crochet.

RuhRoseRae@gmail.com

The Tundra, Mangrove, Rivers, and Lakes pages:

Tim Farrell earned a degree in biology and went to work in a laboratory (as one tends to do). He then left the laboratory to become a stay at home dad to his four awesome kids. At home, he further cultivated his love of drawing and began illustrating. He loves comics, Legos, and tacos.

[@farrell_illustrations](https://www.instagram.com/farrell_illustrations) on Instagram

farrellillustrations@gmail.com

The Boreal Forest page:

Shannon Wedge has loved to draw since her earliest memories with her grandma: watching Bob Ross and drawing on the backs of grocery ads. She now has her own little family of creatives, and enjoys illustrating, hand-lettering, and designing chalk boards.

www.facebook.com/shannonwedgeartist

shannonwedge@gmail.com



POLAR



TUNDRA



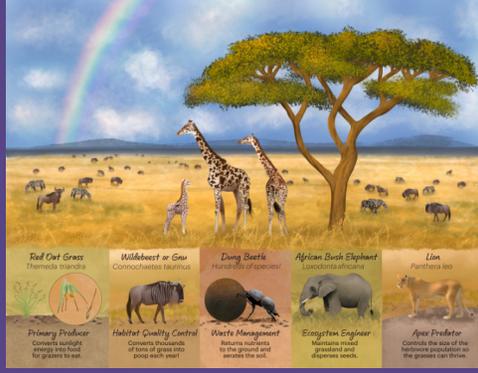
BOREAL FOREST



TEMPERATE FOREST



TROPICAL RAINFOREST



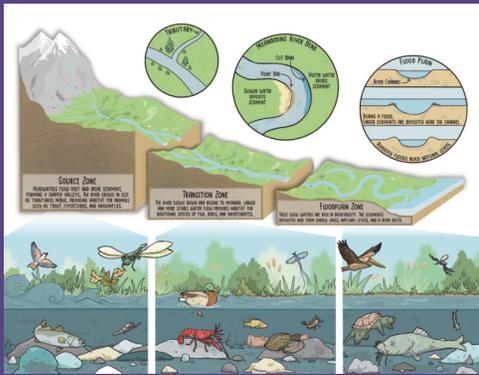
SAVANNA



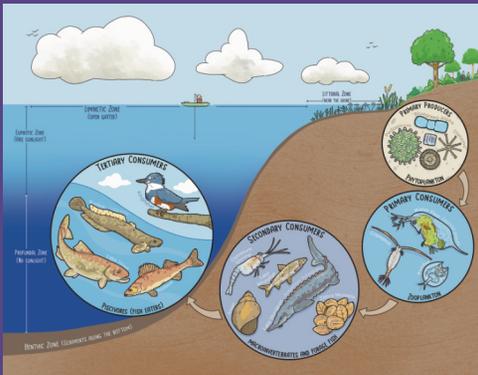
MANGROVE



DESERT



LOTIC (RIVER)



LENTIC (LAKE)



CORAL REEF



DEEP SEA VENT