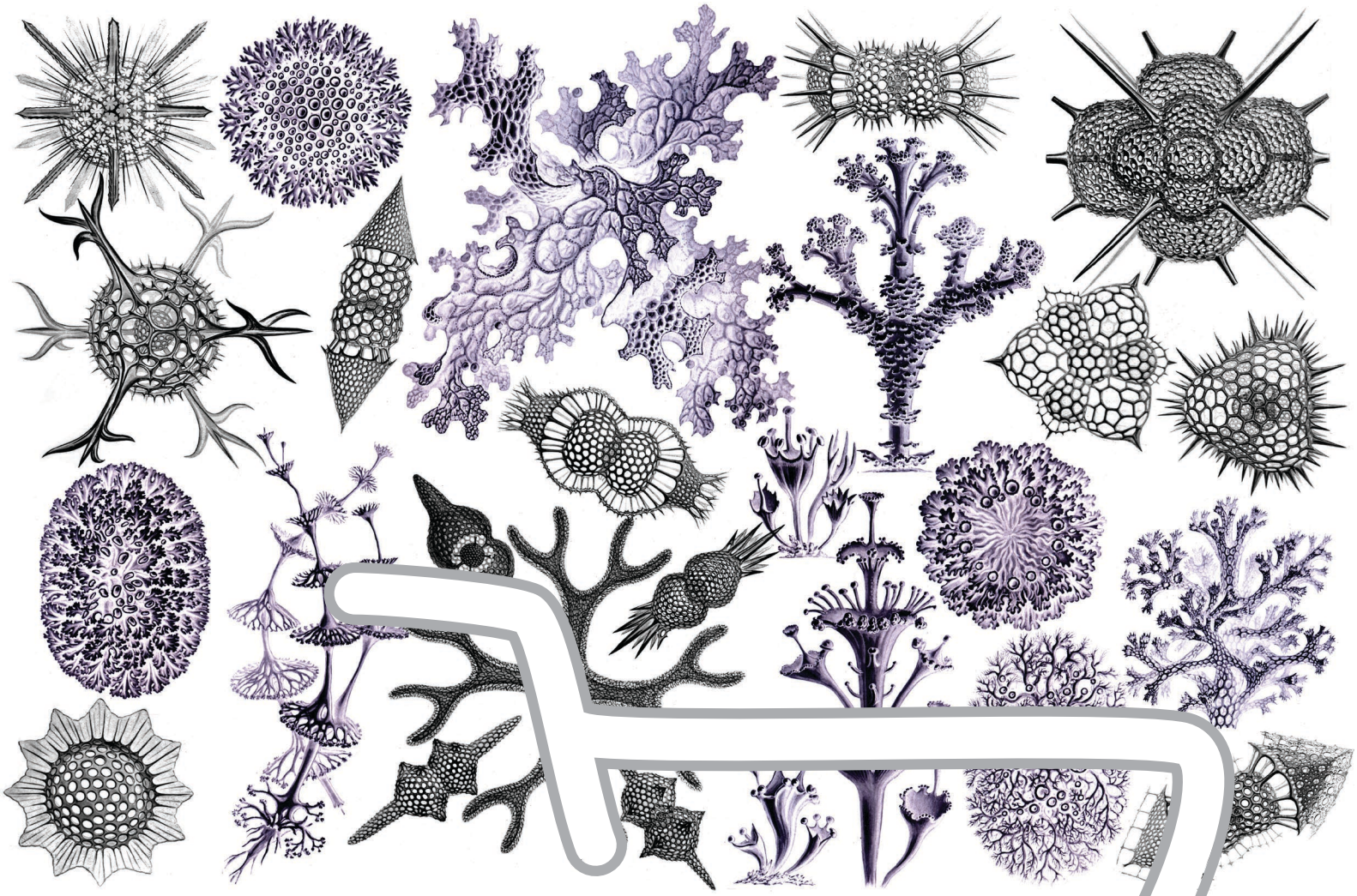
OBSERVING NATURE



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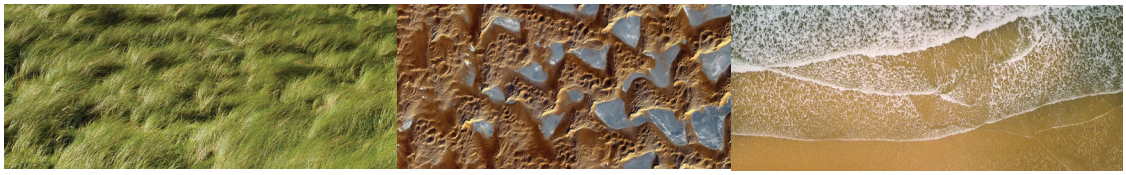
What are Nature's Patterns?



Have you ever looked closely at a rock and marveled at how much it resembled a mountain peak? Have you ever run your finger around the spiral of a snail shell or watched the ripples of water in the bathtub? Have you ever noticed that the windblown sand on the beach makes ripples that look like the bottom of a sandy stream? Have you ever stared at the veins of a leaf and seen the branching shape of the whole plant? Have you ever noticed how the wind rushing past a field of tall grasses makes patterns like the surface of water?

If you have, then you've noticed some of Nature's patterns.

Nature tries to do the most with the least. There are certain patterns that nature favors for their economy. If we look, we will see the same patterns come up over and over again in different scales, in different materials, and over different spans of time. Patterns sometimes reveal information about how objects were created. Objects that share similar patterns are often created through similar underlying mechanisms. This set of activities focuses on developing an appreciation for the beauty and resourcefulness of patterns found not only here on Earth, but throughout our universe.

Consider the top three images—which was taken from space? What was the clue?

While it looks like a Grand Canyon, this photo shows sand erosion on a beach that is only a few feet high. But even at this small scale, the patterns of sedimentary layers and weathering can clearly be seen. How old do you think these layers are? A few hours old? A few days? Months? Years? Millennia?

These are examples of erosion on a grand scale. Do you observe any similarities to the patterns seen in the photographs above?

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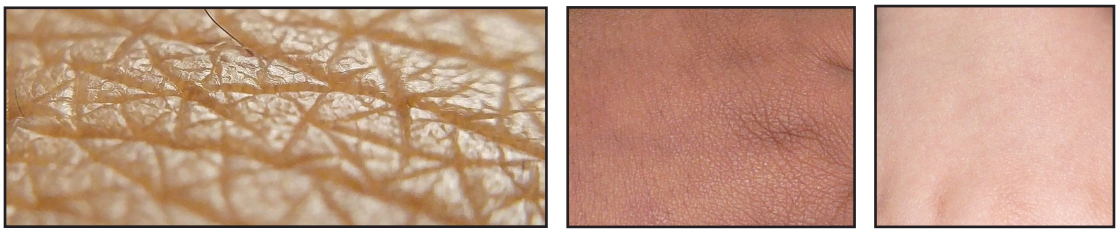
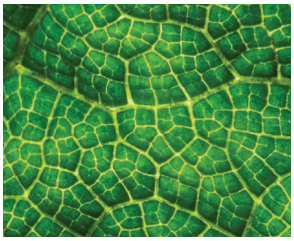
Thinking About Patterns

We're surrounded by patterns: swirls in clouds, ripples on water, branches of trees. While there can also be patterns in a song or a group of numbers, here we are only looking for visual patterns. An object's visual pattern can be a shape, but it is usually not the object's outline. A pattern can have a texture, but it's not about how the object feels to our fingers.

A visual pattern is something we see reduced to its simple form.



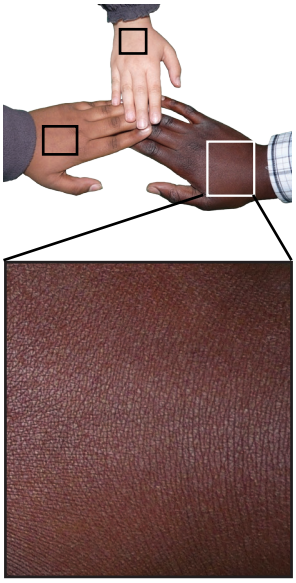
Above is human skin under magnifying glass, below is a magnified leaf. Yes, that's a little black hair sticking out.



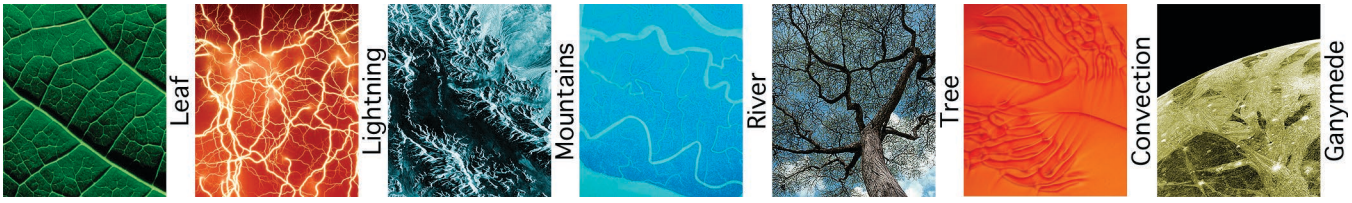
When you draw a picture of a person, the hands are usually just a few lines. Maybe that's the basic hand pattern. But take a look at your hand. There are all sorts of other patterns—little zigzags in your skin, curves where your fingernails begin, grooves on your knuckles, crisscross lines on your palm. If you looked with a magnifying glass, you'd see a lot of new patterns. And with a microscope, you'd see even more.

Nature seems to prefer some patterns because they can be seen over and over again in very different types of objects. One example is the branching pattern. Branching turns out to be a good way to spread things out. So you can find this pattern in really small places, like the veins of a leaf, and in really big places, like the surface of Jupiter's moon Ganymede.

Can you spot some more branching patterns? Start by looking at cracks in the dirt, twigs in the trees, or the lines on the palms of your hands.



What patterns do you see in the skin on the top of your hand?



Examples of Branching Patterns in Nature

There are many patterns in fire flames. Which do you see?

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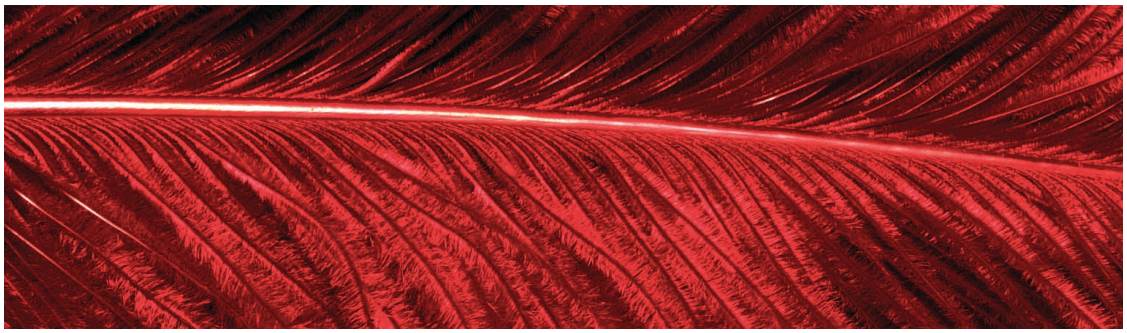
Hidden Patterns

Do you see a pattern in a goat's fur?

Do you see a pattern in a piece of crumpled paper?

Do you see a pattern in an elephant's skin?

Do you see a pattern in a bird's feather?



Do you see a pattern in a pile of leaves?

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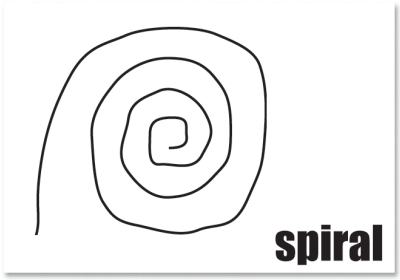
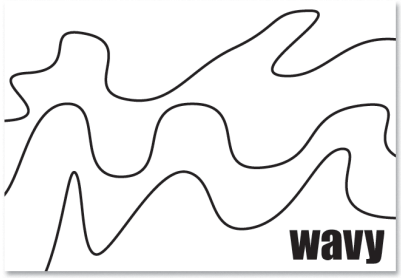
Looking for Spirals and Waves

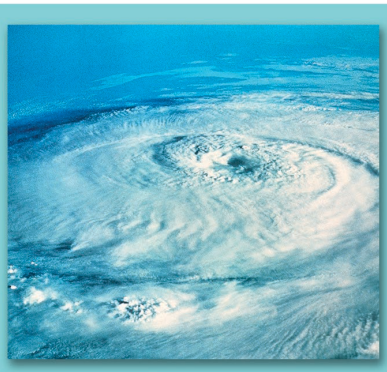




Spiral and wavy lines are two common patterns in nature.

Use a pencil to draw the patterns you found in the photographs below in the empty white boxes under each picture.

Rust



Storm

River

What You Need:

Do you see a spiral pattern in this picture of a plant?

Draw it directly over the photograph.

Can you think of other things in nature that have a spiral or a wavy pattern?

_____

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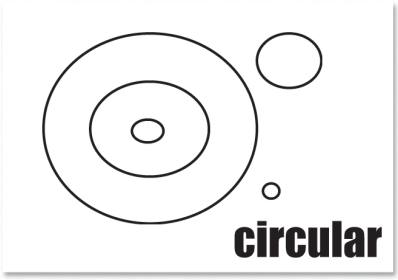
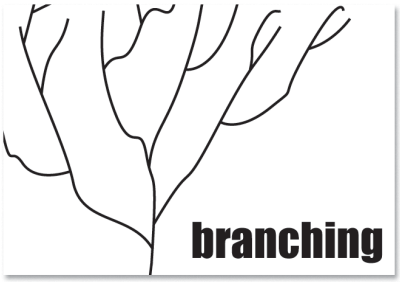
_____

DO

Looking for Circles and Branches





Circles and branches are two common patterns in nature.

Use a pencil to draw the patterns you found in the photographs below in the empty white boxes under each picture.

Fungi

Water

Lightning

What You Need:

Do you see the pattern in this picture of an ant nest?

Draw it directly over the photograph.

Can you think of other things in nature that have a circular or a branching pattern?

_____

_____

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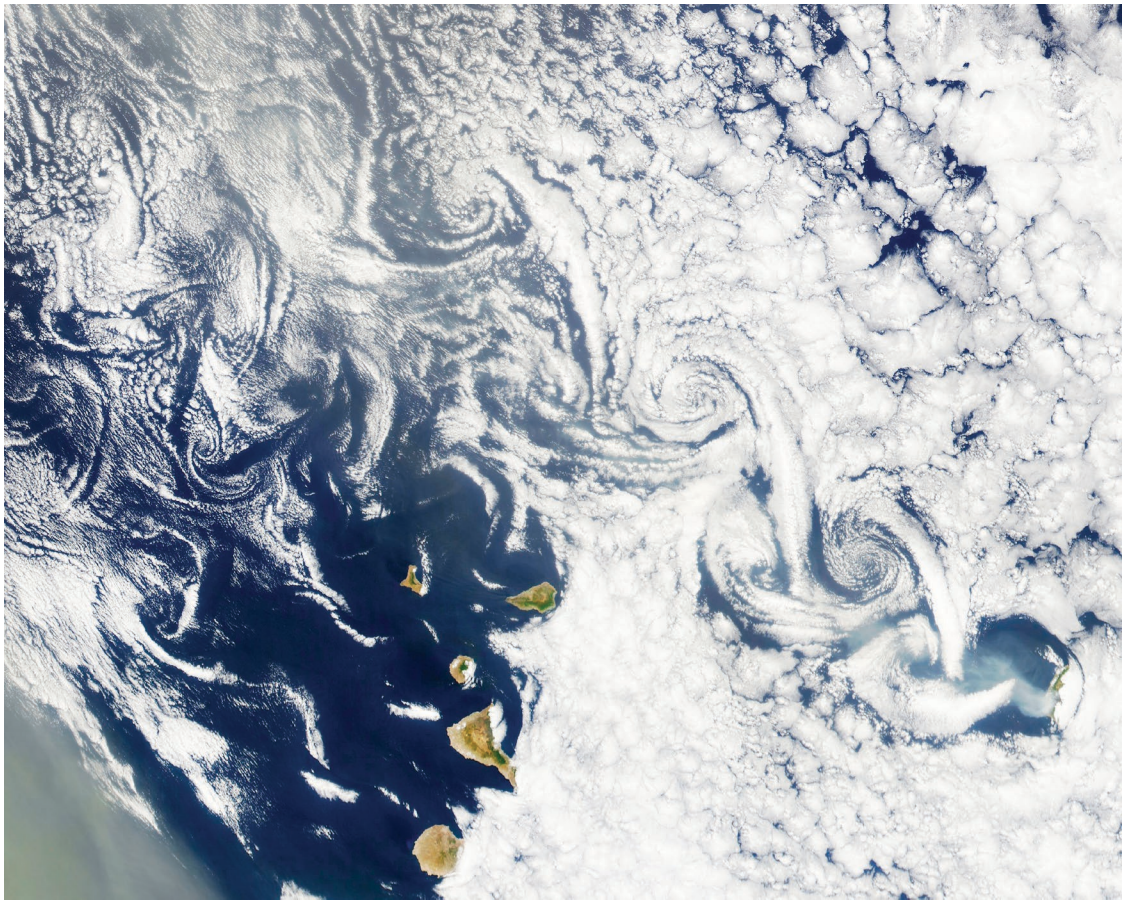
Cloud Patterns

When the wind blows clouds past Madeira and Canary Islands in the Atlantic Ocean, vortices are created as air hits the mountains and spins out. It's very easy to see these massive swirls from space. How many do you see?



Winds don't only shape clouds. As air blows past expanses of sand in a desert, it picks up particles and moves them around, sorting them into light and heavy along the way—the heavy ones drop down sooner than the light ones. As the result, dunes take shape. This image looks like sand on the beach, but in fact it is taken from space just like the one above.

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Big and Small

From a large spiral galaxy to a hurricane off the coast of Florida to a whirling water in a cup, the basic rotational motion is the same only the scale is different.

When dealing with such different scales, it helps to use appropriate measuring sticks: light years for the galaxy, kilometers (or miles) for the hurricane, and centimeters (or inches) for the cup of water.

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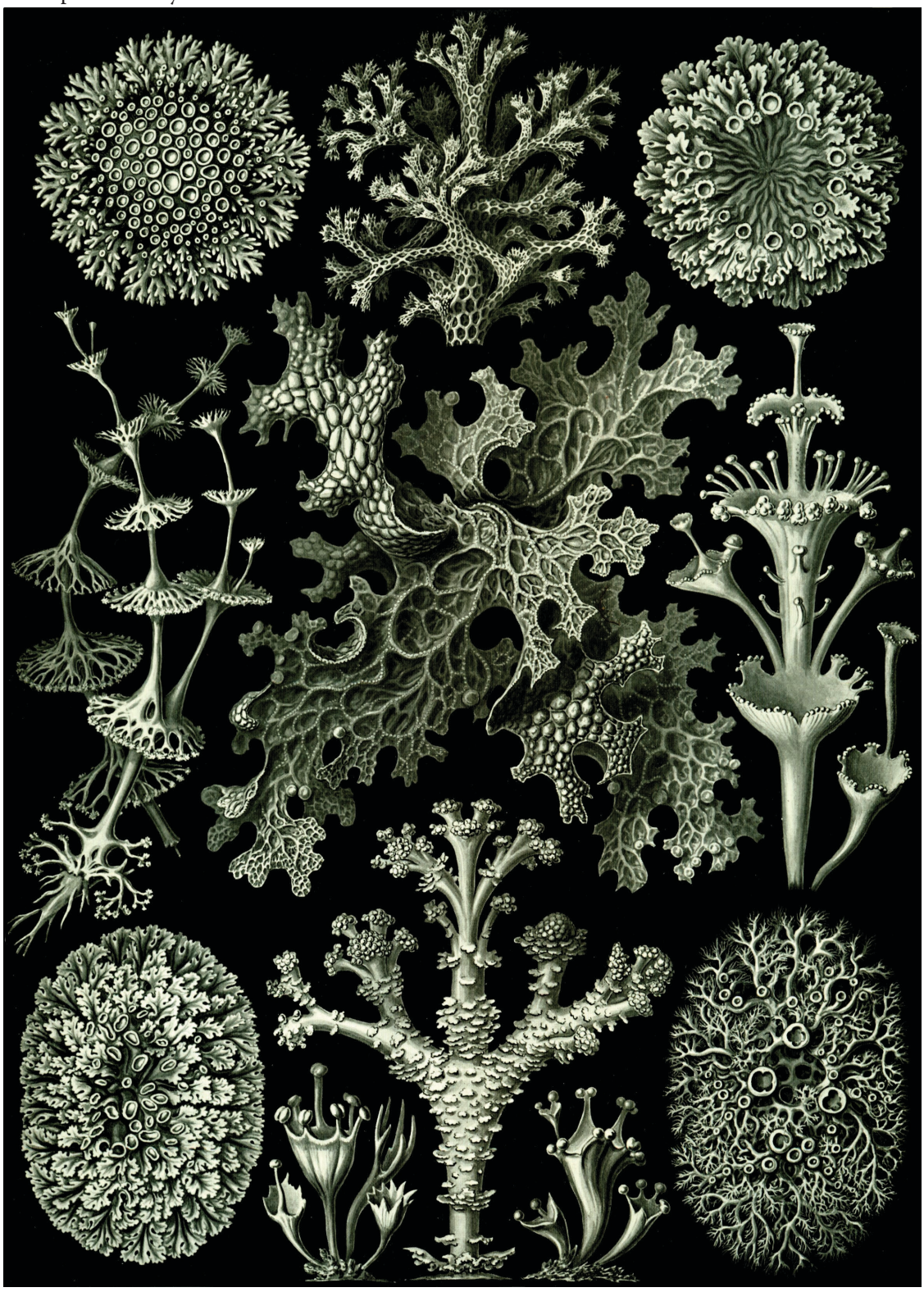
Nature's Patterns in Art

In 1904, Ernst Haeckel published a book of his art, documenting amazing patterns found in nature. The image below shows different types of lichens—a composite organism made of algae or bacteria living in partnership with filaments of fungi. Lichens comes in all different shapes, colors, and forms. While most people just walk by, if you look close, like Ernst Haeckel did, you will observe incredible diversity of shapes and patterns. Lichens are beautiful.

What patterns do you see in the artwork below?

Lichen photographed by Michael Maggs.

If you look at a tree in a deciduous forest, you can tell north from south by looking at which side of the tree lichen grows. In the nothern hemisphere, lichen usually grows on the north facing side of the tree trunk.



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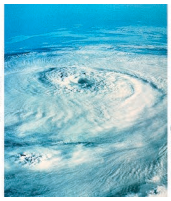
Shaping Planetary Landscapes

Wind and water can create the same shapes over time. Here are examples of mud ripples on the shore, a group of islands, and sand ripples in the desert. Can you put these photos in order of the increasing size of their subject matter?

Burl



Storm

Galaxy

Rust

Smoke

Shell

Whirlpool

The objects above have similar spiral patterns, but did they develop these patterns in similar ways?

Erosion relentlessly reshapes the landscape of our planet. On Earth, erosion is caused primarily by wind and water, aided by temperature, radiation, and gravity. These primal forces underlie most of the patterns visible in the USE pages cards. Forces that are similar often leave similar patterns on the objects they help form.

Wind is the flow of air. A spinning planet slips beneath its atmosphere. Air flows from areas of high to low atmospheric pressure. The gentle puff of an afternoon breeze doesn't hint at the power wind has to level mountains. But wind can pick up tiny particles and hurl them around like scouring powder or lift them up and transport those particles great distances. Sand from an African desert is raised up by the wind and dumped across the Atlantic Ocean onto coral reefs in the Caribbean. And a really strong wind can tear the roofs off buildings or lift boats out of the water and smash them onto the shore.

Erosion can whittle away entire mountains.

Water is another flowing force. Like wind, water can also move dirt and chisel mountains. Water flows through valleys, carving giant gorges like the Grand Canyon. Water beats against rocks, reducing them to sand. Water seeps into tiny cracks on cliff faces and then freezes, slowly widening the cracks. Sheets of glacial ice scrape like sandpaper across the land as they move. Beneath the glaciers, trapped rocks, pressed hard against the ground, grind long straight grooves in the stone.

Large impacts and explosions have also leave their mark on our planet. Much of Oregon is covered by huge lava flows from the distant past. 74,000 years ago, a volcanic eruption in Indonesia almost destroyed humankind by throwing up a giant dust cloud which, for awhile, blotted out the light from the Sun. A major asteroid impact 65 million years ago in the Gulf of Mexico is believed to have doomed the dinosaurs in much the same way.

These forces also shape other bodies in the solar system. On Mars, dust storms covering the whole planet move huge amounts of sand across the terrain. On Europa, impact craters are eroded by oceans of liquid methane. On Io, the closest moon to Jupiter, constant volcanic eruptions belch its core out onto its fiery surface, continually turning the turbulent moon inside out. On Venus, acid falls like rain, dissolving the mountains. On pockmarked Mercury, giant asteroid impacts sent shock waves through the planet to shatter the other side. And on our Moon, the radiation from sunlight alone has crumbled the hard surface of the rocks so that they seem to have been dusted with a fine powder.

At the beginning of the solar system, bombardment by asteroids was common. Here on the Earth, erosion has wiped away most of the traces of these early impacts. But on the Moon, without the eroding effects of water and air, scars of many asteroid impacts still remain.

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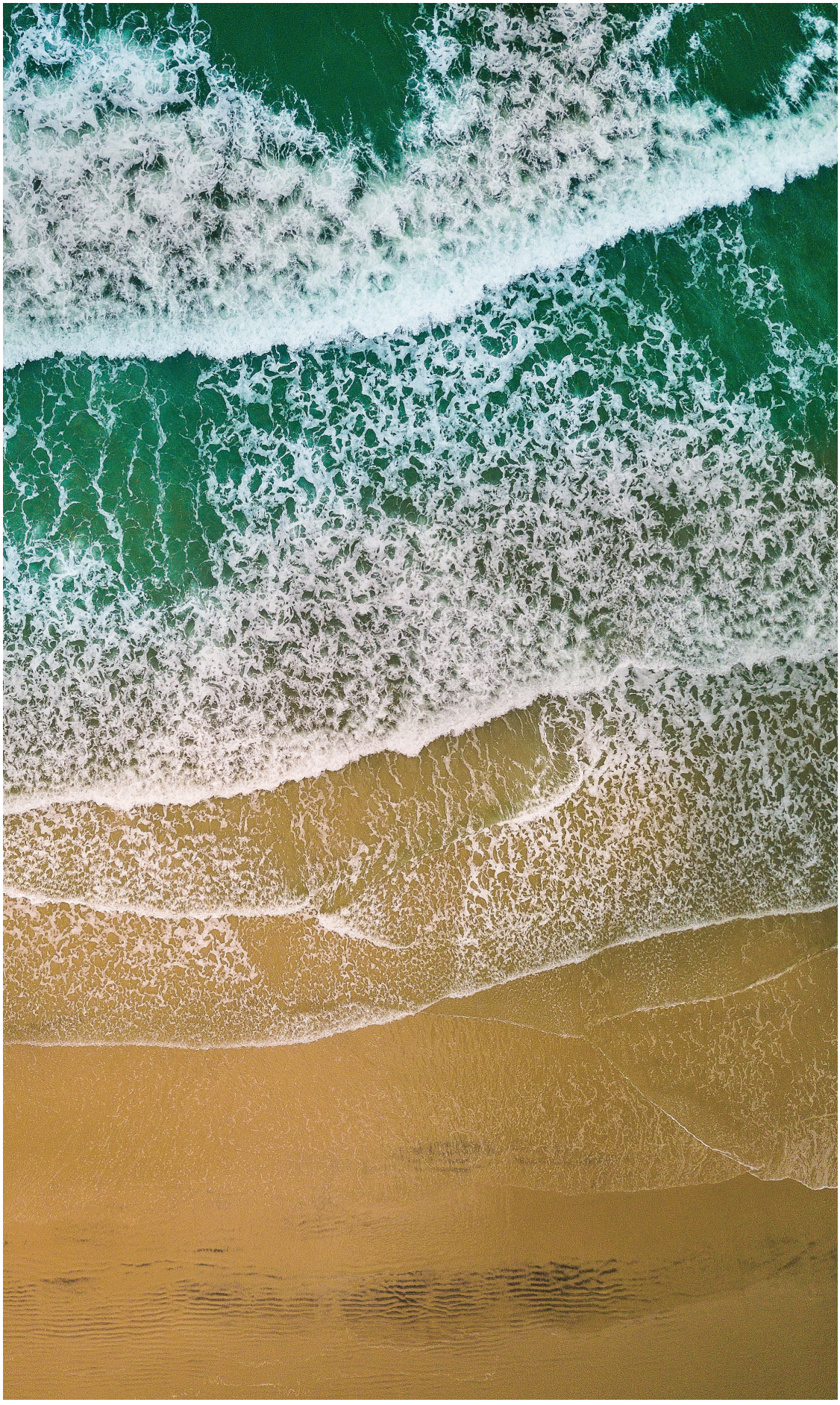
Where the Sand Meets the Sea

When seen from above, a typical beach becomes a cornucopia of visual patterns. There are waves in the water and in the sand. There are streams of foam deposited on the sand and slipping back out to sea.

Each wave picks up sand and redistributes it in a new pattern on the beach.

Waves collide and join and collapse, creating complex patterns in sea foam.

What patterns do you see?



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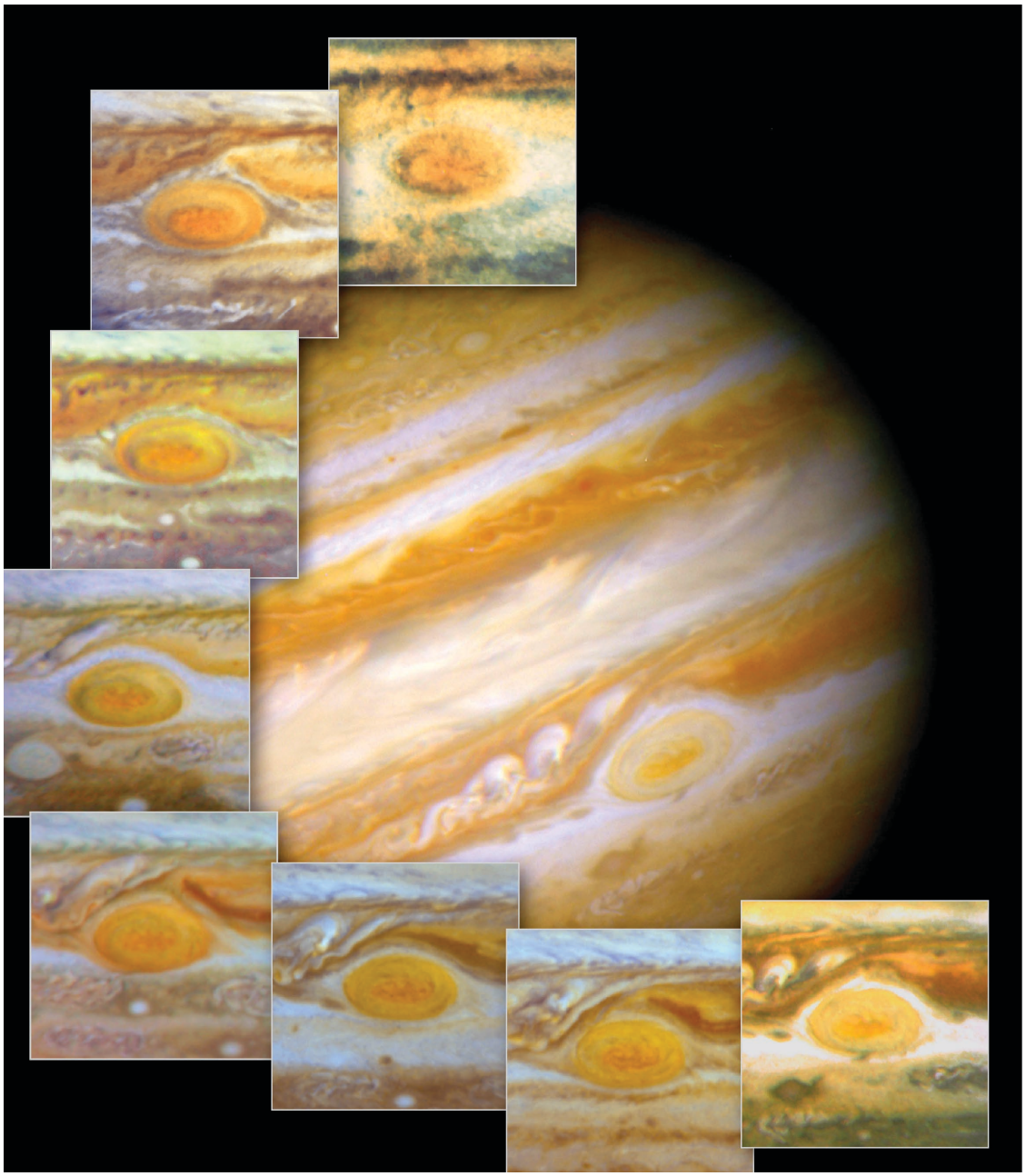
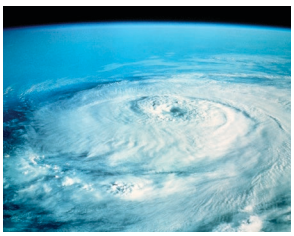
Stormy Weather

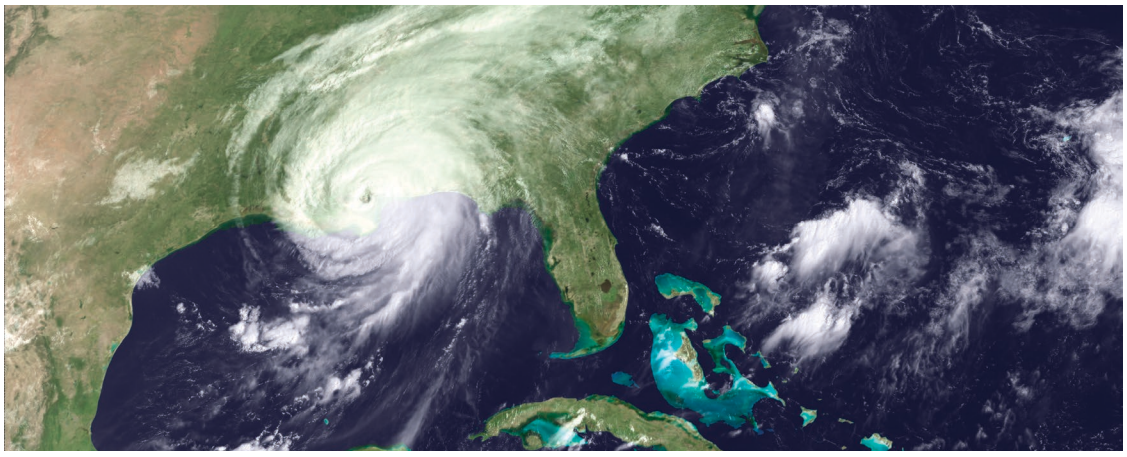
The Red Spot on Jupiter is a 300 year-old storm. These photographs of the storm were taken by NASA's Hubble Heritage Team (STScI/AURA/NASA) and Amy Simon (Cornell University) over a period of several years from 1992 to 1999. It's easy to see the changes in the shape of this storm over the years. The Red Spot is almost twice the size of the Earth's diameter, measuring 15,400 miles. The winds inside reach 270 miles per hour!



Hurricanes on Earth are not nearly as big or last as long as the ones on Jupiter. In a typical hurricane season in the South Atlantic Ocean, there are about six storms that reach the wind's speed large enough to be called hurricanes.



The storm on the right is Hurricane Katrina hitting New Orleans in August, 2005.



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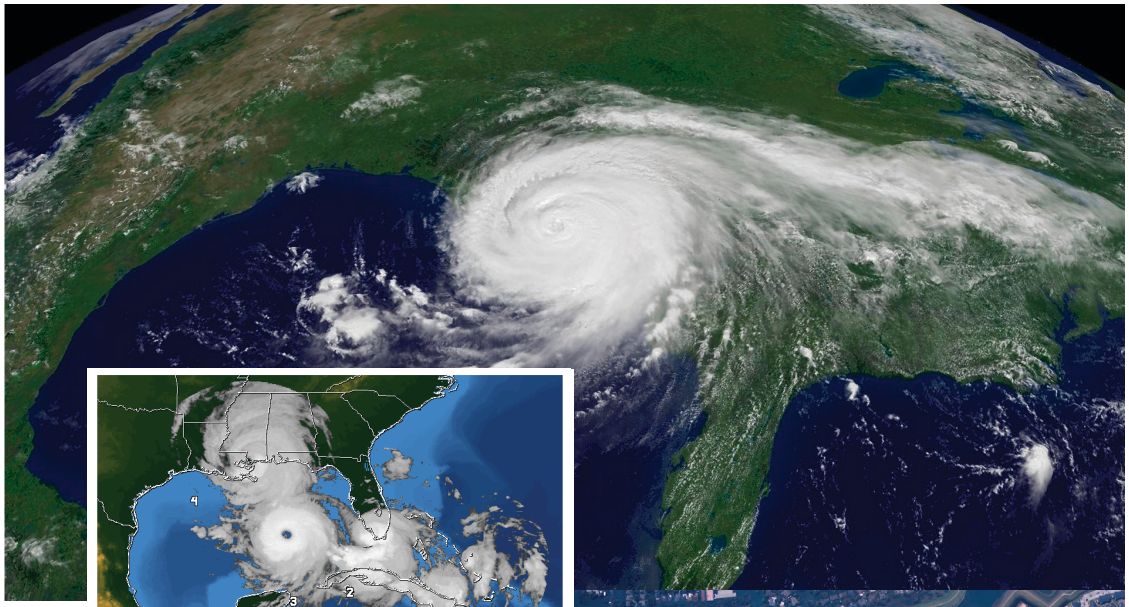
Hurricane Katrina

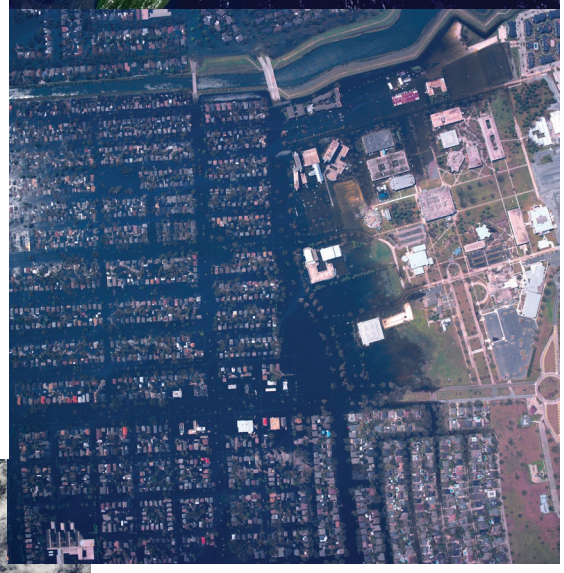
Hurricane Katrina was one of the worst natural disasters in American history! The killer hurricane hit the city of New Orleans on Sunday, August 29th, 2005.

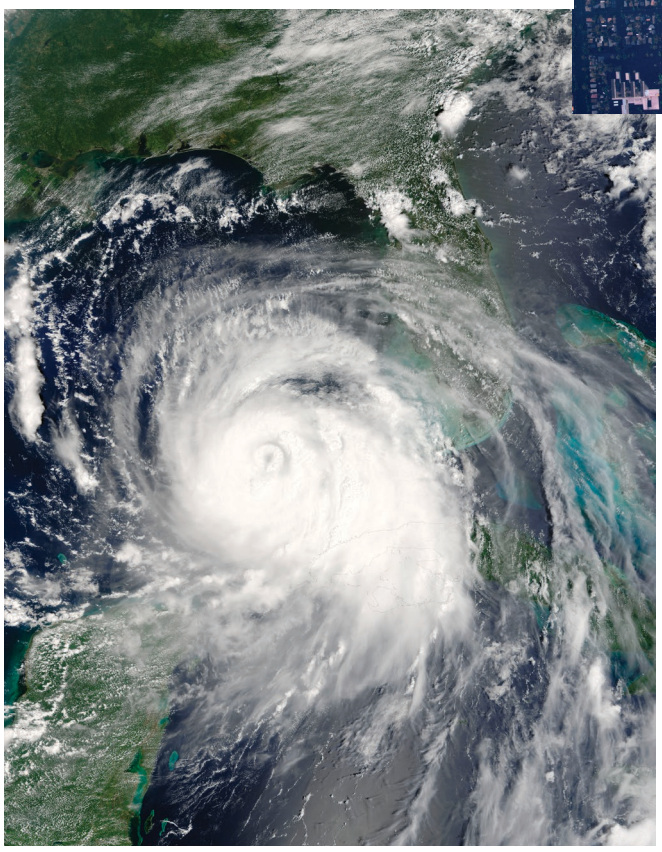
Hurricane Katrina caused massive damage to the city of New Orleans. Its intense winds drove the waters of the gulf into the city streets. With most of New Orleans built below sea level, its citizens climbed onto the roof tops to escape the rising waters.

The images on this page were taken by the National Oceanic & Atmospheric Administration: NOAA. noaa.gov



Above is the path Hurricane Katrina took as it entered the Gulf of Mexico. The numbers indicate the strength of the hurricane along its path. Notice that it hits 5 as it smashes into the coast of New Orleans!





Hurricane Katrina was one of the strongest storms on record with the winds topping 175 miles per hour when it became a category 5 storm. It was also large, covering 90,000 square miles! It the satellite image on the left, Hurricane Katrina covers most of the Gulf of Mexico.

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Discover Patterns

What pattern does a hurricane take?

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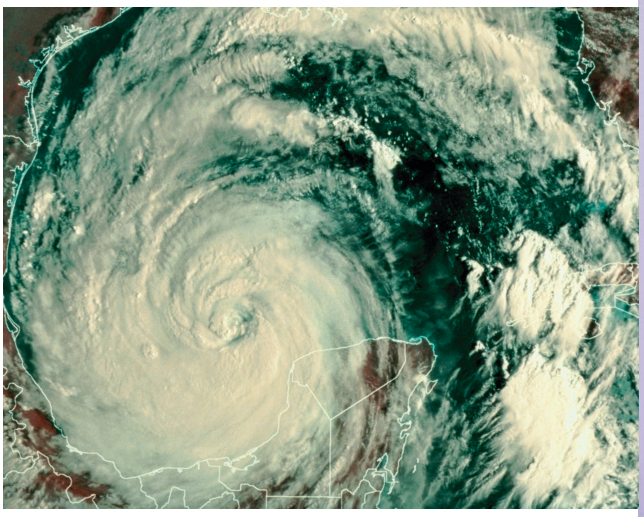
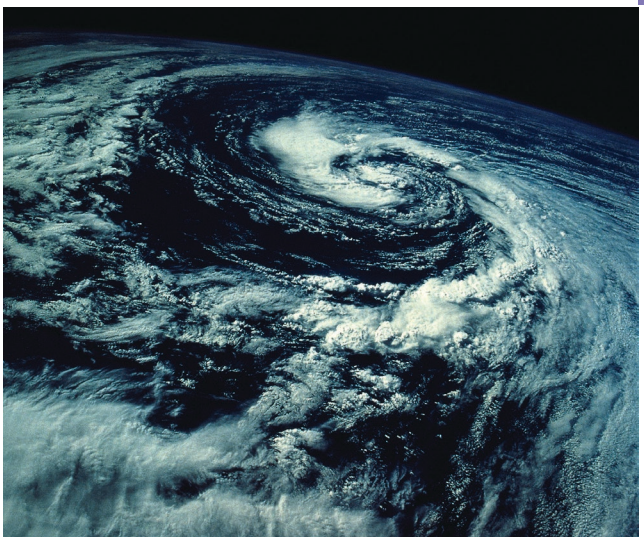


A hurricane's ferocity is rated on a 5 point scale according to the wind strength:

Category 1:	74 to 95 mph
Category 2:	96 to 110 mph
Category 3:	111 to 130 mph
Category 4:	131 to 155 mph
Category 5:	higher then 155 mph



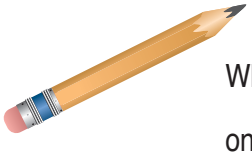
What pattern does a dead octopus make?

_____

_____

What pattern do you see on this avocado pit?

_____



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