Creative Writing and the Water Cycle

by Rich Young, Jyotika Virmani, and Kristen M. Kusek

Albert Einstein once said that, "Imagination is more important than knowledge." He might also agree that the ability to combine the two is a powerful asset for any individual. Creative writing provides one strategy for helping students combine their powers of imagination with their arsenal of knowledge. Teachers also can use creative writing exercises to assess student understanding of science content.

Use the story "The Life of a Drop of Water" on pages 32–34 as a springboard for the following creative writing activity, which draws students in by taking advantage of our fascination with natural disasters. Ask the class to read the story about a water droplet that experiences a host of natural disasters during its adrenaline-pumping journey on land, through air, and under water. When students have finished reading the story, review the basic steps of the water cycle to familiarize them with related concepts, such as evaporation, condensation, and precipitation.

As a further review of the concepts they'll be working with during their assignment, ask them to research the types of natural disasters found in the story. You might want to create a study guide to make sure that they cover all the relevant concepts. The guide could ask them to

- identify each type of natural disaster found in the story;
- define tsunami, tornado, typhoon, and the other weather-related events;
- explain what type of conditions create these storms;
- describe the conditions that cause the water cycle to produce a hail storm; and
- answer any other guided questions that would help them with their writing assignment.

As an introduction to the actual assignment, ask students to imagine that they are droplets of water caught up in a natural disaster. Use specific questions to start the creative juices flowing. Which major storm would you want to be a part of? What forces would affect you? How would you be transported from a puddle on the ground to a cloud up in the atmosphere? What factors in the atmosphere cause you to form into a cloud? What causes your cloud to separate into many clouds? If it gets very cold, what happens to a liquid such as water? When water is heated, what state of matter does it change into? Why?

After you have introduced all the relevant background material, it is time for students to start writing. The assignment is for them to imagine that they are droplets of water caught up in a natural disaster of their choice. For example, students might imagine they are caught up in a spiral arm of a hurricane. They should first conduct basic research on hurricanes to gain knowledge on the science behind the disaster. Then they should write a creative, fictional story that explains how they formed (i.e., they being the arm of the hurricane), where they traveled, what damage they caused to towns, and when and under what conditions they were downgraded to tropical storm status. The possibilities for story ideas are limitless, as are the powers of the imagination.

SCILINKS

Dive into the water cycle at *www.scilinks.org.* Enter code SS30902.

The goal of this exercise is to simultaneously get students to express their understanding of a scientific concept such as natural disasters, while exercising their imaginations and having fun writing a creative story. This type of exercise can be adapted for use in conjunction with almost any science topic.

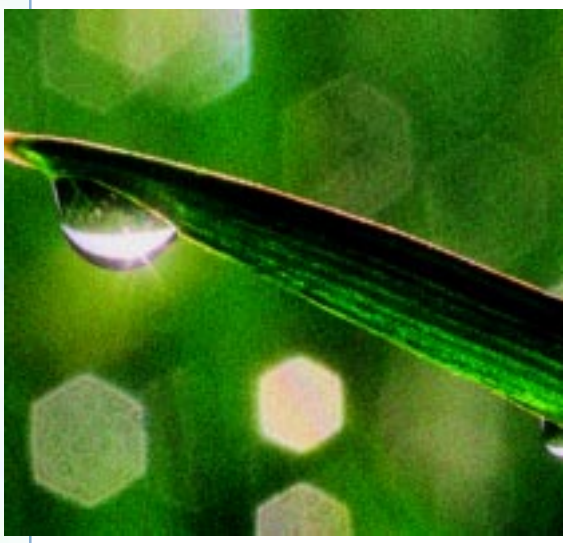
You might want to limit the length of the stories and request that each story include a specific number of concepts, depending on the length of time you want to devote to the project and the ability level of your students. At a minimum, students should have a weekend to work on their narratives, but I recommend that they have at least a week to develop them. During the week, give students time to research their topics. A starting point could be the basic sidebar information included in the online

Rich Young *is a PhD student in geochemical oceanography,* ***Jyotika Virmani*** *is a PhD student in physical oceanography, and* ***Kristen M. Kusek*** *is the director of the Science Journalism Center at the University of South Florida in St. Petersburg, Florida.*

The life of a drop of water

Your body and the Earth's surface have a lot in common. Both are mostly water, and the composition of your blood actually is not that different from seawater. Our Sun is like the Earth's heart: energy from the Sun pumps water from the tropics to the poles in a vast network of currents. However, occasional "hiccups" in the water world spawn hurricanes, floods, and tsunamis that slosh around mega-buckets of water in a way that disrupts the normal flow of the system, often with disastrous results.

Imagine that you're a droplet of water in the vast, tropical Sargasso Sea in the Atlantic Ocean. It's the end of August 1992; the sea is warm and salty, but not at all calm. A 160-km/h wind is whipping the waves into a seething cauldron. They'll call this Hurricane Andrew back in Miami, and you're a part of it, feeding it enough energy to make 12,000-meter-high clouds spiral into walls around a low-pressure "eye." You are a speck of froth on the water, and are swept across the Gulf Stream as you add warm moisture to the hurricane's fury. Driven by 230 km/h winds, you slam into south Florida as part of a 5-meter-high storm surge, destroying hundreds of homes and huge tracts of ecologically important mangroves. You now have the dubious honor of being part of the costliest storm in American history. Had you come ashore only 32 kilometers north and hit Miami squarely, you would probably have been part of the deadliest one too.



A 400-km/h tornado drops out of the sky and sucks you off the face of the Earth, spraying you 4,500 meters into the clouds. It's so cold that you freeze into ice and plummet thousands of feet until strong updrafts within the thunderstorm below waft you up another 10,000 meters. Along the way you pick up static charges that attract ice crystals. You grow into a pea-sized hailstone. After several more wild roller coaster rides through the clouds, you grow to the size of a golf ball. With the added weight of the ice, you break loose from the convection drafts and hurtle down to the Earth in central Florida, the lightning capital of the western hemisphere.

A 27,760°C bolt of lightning, five times hotter than the surface of the Sun, connects with the ground from 10,000 meters and discharges 100,000 amperes of electricity from the cloud. The stroke superheats the air and creates a shockwave that is heard as thunder for miles around. It ignites years' worth of accumulated forest debris and starts a brush fire. Ice doesn't stick around long in central Florida in the summertime, so you melt and mix into the falling rain, dousing the fire. Florida was lucky you were around to help put that fire out because wildfires consume hundreds of square miles of brushland, forests, and homes every year.

Now you are swept up in surging stream water that sends you into a lake already filled to the brim from the torrential rains. The lake doesn't normally receive that much water, so the

river draining it floods and forces you to take a leisurely flow through several homes built on the floodplain. Your meandering destroys homes—and the lives of their owners.

Next, you are sucked into a swirling sewer and pushed through an outfall back into the sea. An along-shore current washes you up and down the coast with the tides. You pick up some sand along the way, and erode pockets of the beach—one grain at a time.

An offshore breeze jets you into the Gulf Stream current, which carries you to the cold North Atlantic. After weeks of evaporation, you have become saltier and denser. You sink into the dark, cold depths to start your journey back to the equator along the sea-bottom. You thought it would be dark and desolate here, but a shower of tiny bioluminescent animals is putting on an exquisite light show. On the bottom, you're lucky enough to drift through beautiful gardens of white and red tube worms that stand three feet tall and surround 20-foot-high pipes of dark, sparkling minerals. The pipes spew scalding water heated by rising magma within the Earth.

You continue your slow drift southward over a submerged mountain range that runs down the middle of the Atlantic Ocean. You are hot from the lava spewing from undersea volcanoes that may someday become new islands like Iceland, Hawaii, and Montserrat. Without warning, the water shudders from a series of undersea earthquakes that help relieve the stresses caused by magma rising into the Earth's crust. Sometimes these quakes occur under land where the Earth's great plates collide and shake the ground hard enough to destroy buildings and bridges.

Suddenly the volcano over which you drift erupts into a boiling cauldron of seawater. You are caught in a mammoth bubble that carries you 2,500 meters up to the surface of the ocean. Superheated steam from the bursting bubble wafts you another 4,500 meters up into the troposphere where you are immediately swept eastward by the 320 km/h winds of the jet stream.

A week later and half a world away, you precipitate in a blizzard of snow over Mt. Redoubt in Alaska. The heat from this awakening volcano melts the ice and snow under you, and the whole white veneer starts sliding down the side of the mountain. Within minutes you're caught in a blinding white wall of powder moving at 160 km/h, ripping up trees by their roots, knocking down chalets, and covering everything in your path. Finally, the avalanche deposits you in a warm valley, where you melt and flow through a braided stream back into the Pacific Ocean. You've arrived here about 500 years sooner than if you had completed the same journey through the deep waters of the world's oceans.

But "Pacific Ocean" is a misnomer; it is not always pacific and peaceful. Besides the huge typhoons that seasonally stir its waters into a tempest, the surrounding "Ring of Fire" is the most seismically active region in the world; it is the birthplace of more volcanoes, earthquakes, and tsunamis than anywhere else on Earth.

Floating placidly now in Blying Sound along the western shore of the Gulf of Alaska, you hear a growing roar in the distance that sounds like a bursting dam. A huge wave traveling up the inlet sucks the water out of the bay and pulls you out in the strongest current you've ever felt. Fish are left flapping helplessly on the dry seafloor as you rush past. You are lifted towards the sky by a tsunami 12 meters tall and growing as it approaches the shore at more

The life of a drop of water (continued)

than 95 km/h. It starts to curl over the town of Seward, and then crashes down on the streets and buildings 20 meters below. You smash through the town driven by the great weight of water behind you, battering everything in your path. In a few minutes that seem to last forever, you toss and tumble over the landscape, and turn the town into a trash heap. As you surge inland over the highways, buildings and neighborhoods, the water around you fills up with big chunks of trees, homes, and entire vehicles.

The energy packed into this great wave (and the ones to follow) is unbelievable. It rips up or knocks down everthing in its path.

The energy packed into this great wave (and the ones to follow) is unbelievable. It rips up or knocks down everything in its path. When the valley in which the town lies finally fills to its brim, the water recedes slowly at first, then in a gathering rush. Everything that was ripped up by the incoming surge is now carried out to sea by the ebbing maelstrom.

This tsunami, spawned 10 hours ago by an earthquake 8,000 kilometers away, moved through the water at 800 km/h. It started out only a couple feet high in a deep open ocean trench, and moved unnoticed past ships. But as it scraped the ocean floor closer to shore, energy-packed water piled up on itself. Fortunately, an alert issued by the Pacific Tsunami Warning System allowed most people to reach the safety of high ground.

Ultimately, you are sucked back into the cold waters of the Gulf of Alaska, and you meander into a great current of water circulating slowly across hundreds of miles of the North Pacific Ocean. Overhead, a low-pressure trough off the Canadian coast churns up the wind and sea to produce a thick, dank haze of microscopic water droplets draping the ocean; air and water become indistinguishable, and the horizon indiscernible. You are one of the droplets that evaporate and is carried southeastward by the gathering storm to warmer climes. As you approach the rugged coast of the western United States, you rise with the wind to scale the high mountains. You cool down, condense, and fall on the slopes of the Cascades as rain.

You filter down through the normally arid soils until you reach rock, and you flow ever downward along its surface. The dirt above the rock slowly absorbs you and turns into mud. The Earth begins to slip, slip, slip down the hill with the added weight and lubrication. As it gains speed, it grows into a catastrophic landslide that sweeps houses off their foundations and dumps them into the valley below.

One good thing about landslides is that they deliver new topsoil to the valley floor, creating an environment where life can bloom. You are content now in your new surroundings and with your new role—encouraging new plant life to poke through the fresh topsoil. It's satisfying to be helpful at last after wreaking so much havoc in your journey around the world.

version of "The Life of A Drop of Water" located at *waves.marine.usf.edu/disaster_menu/disaster_menu_article.htm*. Clicking on the names of past natural disasters will bring you to additional information about each event.

Integration and assessment

This activity is a great opportunity to involve teachers in other subject areas. Such interdisciplinary activities stress the interconnectedness of the disciplines and encourage students to integrate skills developed in other classes. Students are also eager to work on projects that they can receive credit for in more than one class.

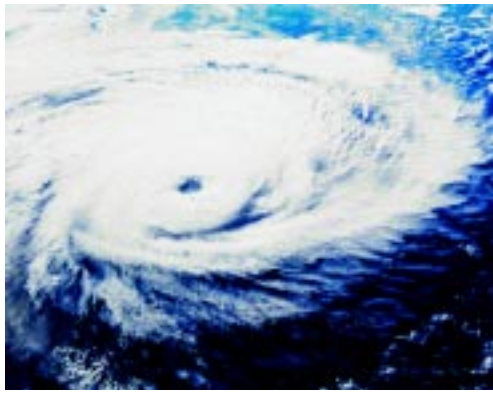
Each teacher that participates should develop a rubric based on his or her own subject area. For example, the language arts rubric should assess students' grammar, spelling, and composition. You, of course, will focus on the scientific accuracy of the story. Assessment by the social studies teacher would make sure that the correct parts of the world have been identified during the water droplet's travels over land formations and bodies of water. The social studies staff could also insist that students refer to specific real-life events, such as Hurricane Andrew or the eruption of Mount Pinatubo in the Phillipines. Art teachers could judge the creativity and presentation of any graphics created to accompany the stories. The math department could check the accuracy of any statistics, measurements, and graphs that are included.

Internet resources

Hit the Making Waves website at *waves.marine.usf.edu* to read more adrenaline-pumping facts about tornadoes, earthquakes, floods, wildfires, and tsunamis.

Fact sheet

Hurricanes



- Costliest U.S. storm: Hurricane Andrew, August 22–27, 1992; $30 billion in damage; energy equivalent to a hydrogen bomb: 145-mph winds, 17-foot storm surge
- Deadliest in U.S.: Galveston, July, 1900; more than 6,000 deaths (most by flooding)
- Strongest in U.S.: Labor Day storm in Florida Keys, 1935; wind speeds to 165 mph
- Largest in U.S.: Hurricane Hugo, Charleston, S.C. in September, 1989; cost: $8.5 billion

Source: USA TODAY Weather Almanac

Lightning

- There are up to 10 million strikes per day in the Earth's atmosphere (= 100/s). About 90 percent of these are cloud-to-cloud flashes that never reach the ground
- The average stroke is incredibly powerful—up to 30 million volts at 100,000 amperes flow in 1/10 of a second
- To calculate the miles away the strike is from you, count the seconds between the flash and the thunder and divide by five
- More than 1000 people are killed by lightning worldwide every year (about 200 in the U.S.)
- From 1940 to 1981, lightning killed more people (7,761) than tornadoes (5,268), floods (4,481) or hurricanes (1,923)
- On July 17, 1940, lightning started 335 fires in "Lightning Alley," which stretches across northern central Florida (including Tampa Bay)