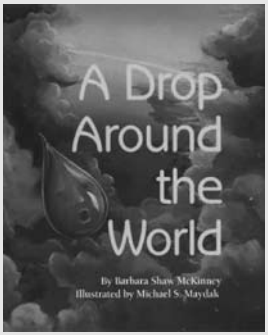
Water Here, Water There, Water Is Everywhere!

By Stephanie Standriff and Steve Mattox, Grand Valley State University

Water transcends both space and time. One water molecule might be locked in a gypsum crystal as a plate drifts slowly north for hundreds of millions of years. Another water molecule might sublimate off a Himalayan glacier and, several days later, fall as rain in our yards. The water cycle is crucial for children to understand because it is important to quality of life. Every time students go outside they witness the water cycle in action. Safe, abundant water is readily available to families in Michigan and many children take for granted where their water comes from. The books below give students innovative ways to view the dynamic life of water and it's relevance in everyday life around the world. Our activities allow students to role-play components and processes of the water cycle and to compare and contrast the water cycle in three very different climate zones.

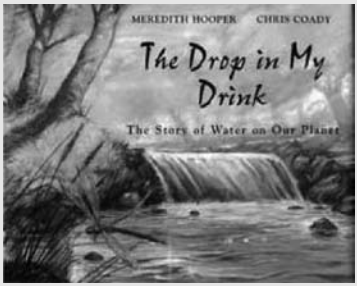
This Month's Trade Books:



A Drop Around the World

Barbara S. McKinney. Dawn Publications 1998.
32 pp. Paperback
ISBN 1883220726, $7.95. (readability 4.2)

McKinney's book is the best available on the hydrologic cycle, uses of water, and sources of water. The writing is excellent and the illustrations are exceptionally well done. Easily in the top ten Earth science trade books. The story follows a drop in and out of water reservoirs (clouds, rivers, cows, etc.) and changes in state as it travels the world. Small symbols on each page aid in interpretation and are thoroughly explained in the back of the book. Buy this book!



The Drop in My Drink

Meredith Hooper. Viking Books 1998. 32 pp.
Hardcover
ISBN 0-670-87618-6, (readability 5.6)

Hooper's books are exceptional. She weaves water through Earth's history, materials, and life, all leading towards sources. The story provides many points to jump off or link to other topics. An engaging book that will hold students' interest and can be reread to add depth of understanding.

Curricular Connections:

Water is a focus of the 2nd and 4th grade content expectations. The two featured trade books and their accompanying activities are especially well suited for upper elementary.

GLCEs: grade 2-4; "Where are you going water droplet?"

E.FE.02.11 Identify water sources (wells, springs, lakes, rivers, oceans).

E.FE.02.13 Describe the properties of water as a liquid (visible, flowing, shape of container and recognize rain, dew, and fog as water in its liquid state. *

E.FE.02.14 Describe the properties of water as a solid (hard, visible, frozen, cold) and recognize ice, snow, and hail as water in its solid state.

E.FE.02.21 Describe how rain collects on the surface of the Earth and flows downhill into bodies of water (streams,rivers, lakes, oceans) or into the ground.

E.FE.02.22 Describe the major bodies of water on the Earth's surface (lakes, ponds, oceans, rivers, streams).

S.RS.04.11 Demonstrate scientific concepts through various illustrations, performances, models, exhibits, and activities.

S.IP.04.11 Make purposeful observation of the natural world using the appropriate senses.

P.CM.04.11 Explain how matter can change from one state (liquid, solid, gas) to another by heating and cooling.

GLCEs: grade 4-6; "The Water Cycle of Diverse Regions!"

E.ES.03.43 Describe ways humans are protecting, extending, and restoring resources (recycle, reuse, reduce, renewal).

S.IP.04.11 Make purposeful observation of the natural world using the appropriate senses.

S.IP.04.12 Generate questions based on observations.

S.IA.04.11 Summarize information from charts and graphs to answer scientific questions.

S.IA.04.12 Share ideas about science through purposeful conversation in collaborative groups.

S.IA.04.13 Communicate and present findings of observations and investigations.

S.IA.04.15 Compare and contrast sets of data from multiple trials of a science investigation to explain reasons for differences.

P.CM.04.11 Explain how matter can change from one state (liquid, solid, gas) to another by heating and cooling.

S.IP.05.16 Identify patterns in data.

S.IA.05.13 Communicate and defend findings of observations and investigations using evidence.

S.IA.06.11 Analyze information from data tables and graphs to answer scientific questions.

S.IP.06.16 Identify patterns in data.

L.EC.06.41 Describe how human beings are part of the ecosystem of the Earth and that human activity can purposefully, or accidentally, alter the balance in ecosystems.

Where are you going water droplet?

Trade book - Inspired investigations for grades 3-5

Purpose:

Students analyze the Earth, identifying the different places water can be found and the forms water takes.

Materials:

"Nametags" can be made using paper or cardboard and a label with the appropriate water state. String is needed to attach to the top left and right corners of the paper or cardboard so that the students can hang it around their necks.

Procedure:

1. Everyone in the class will receive a hanging nametag that states a condition/location/form of water. The nametags should say rain, snow, hail, grapple, groundwater, runoff, atmosphere, cloud, plants, springs, glaciers, permafrost, freezing, deposition, condensation, melting, evaporation, and sublimation.
2. Ask students to stand in a circle to be able to see everyone's nametags. Just as the two trade books told a story, the teacher tells a story about the journey of the water droplet based on the hydrological cycle.
3. When the teacher describes the student's nametag, that student must step forward and hold up their nametag, identifying that they are the current condition being addressed.
4. At the end of the story, the teacher should reflect upon "A Drop Around the World" by asking the students what other places the raindrop could find itself on a journey.

Sample story:

One day a water droplet was hanging out in an ocean, trillions and trillions of other water droplets and salt surrounded the droplet. The sun beat down on the little droplet in the big ocean and the droplet got excited and all heated up. The droplet bounced right out of the ocean, going through a process called evaporation. The droplet was taken far into the sky where it met other water droplets. They all relaxed and cooled down, condensing together. When more and more water droplet friends condensed together they began to form a cloud and get heavy. The cloud was so big that it could no longer stay above in the atmosphere. Droplets fell from the cloud, making rain! The droplet fell from the sky but the wind carried it away from the ocean and towards a river where it flowed through the twists and turns, over rocks and soil. The droplet eventually went to the bottom of the river and took a dive into the ground. It found other water droplets there and they were all called groundwater. The pressure from other ground water droplets pushed the droplet over to an area with very high pressure, so much pressure that the droplet escaped through a spring. The spring spurted out on the grass where the droplet remained over night. That night was very cold and temperatures dropped below 32 degrees Fahrenheit. The little droplet froze on a piece of grass and we call that ice! In the morning the ice began melting because the sun came out and the droplet evaporated once again. This time it was carried by an intense wind all the way up to northern Canada. The droplet began to feel the temperature drop and his body started crystallizing into a snowflake!

The Water Cycle of Diverse Regions!

Trade book - Inspired investigations for grades 3-5

Purpose:

Students contrast the water cycle by visiting two very different locations (tundra and tropics) featured in the books and comparing (monthly graphs of temperature, precipitation, and humidity) them to conditions in Michigan.

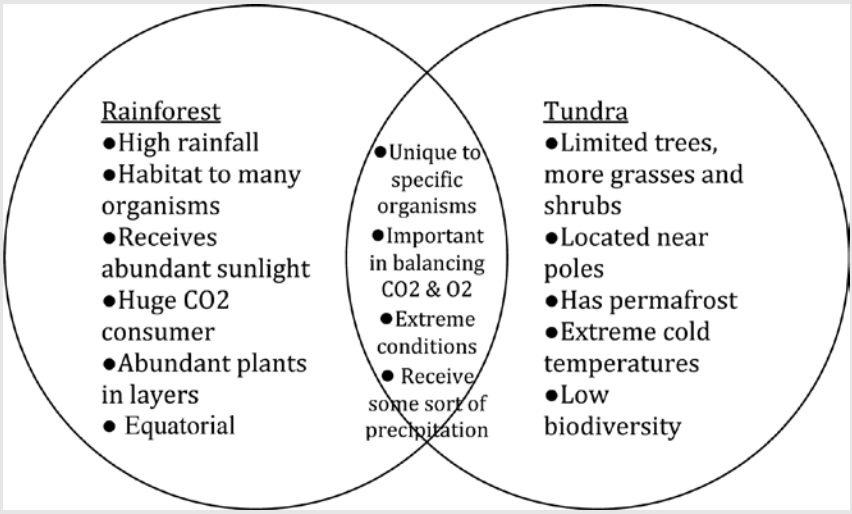
Materials:

The graphs, diagram and worksheet questions provided below.

Procedure:

1. Have students look at picture of a tropical rainforest biome and use their prior knowledge to analyze the pictures and point out the dynamic water processes occurring. Flickr has a great rainforest picture of the Olympic Natural Park with abundant plant growth (see http://www.flickr.com/photos/simplelogic/165389751/). It's a great demonstration of the immense photosynthesis occurring.
2. Have students do the same with a picture of tundra (see http://www.alaska-in-pictures.com/data/media/19/fall-tundra-with-mountains_4433.jpg). This photo demonstrates how tundra supports a specific plant life. It also shows how the biome varies in geological features and climate conditions.
3. Have students work individually to complete a Venn diagram by writing the characteristics of the rainforest and the important hydrologic events that go on in rainforests on one side of the diagram. The other side should be filled out the same for tundra. The middle is reserved for occurrences that take place in both biomes. See Figure 1 for an example of one way to complete the diagram.

Figure 1. Venn diagram for rainforest and tundra.



4. Next, introduce climate graphs to students (See Figure 2). Temperature and precipitation are the two most important parameters in defining climate. Ask the students to apply what they know about these climates zones and biomes and what they can interpret from the data by answering the following questions on a worksheet. The teacher can also allow the students to explore the website WeatherOnline to compare conditions at different locations of interest (see http://www.weatheronline.co.uk/weather/maps/forecastmaps?LANG=en&CONT=namk&REGION=0014&LAND=MI&LEVEL=4&R=160).

We provide a useful set of questions to guide students towards key observations. Some answers may vary but likely responses are included.

T: How do Homer, Alaska and Iquitos, Peru compare in precipitation? Add up each month's rainfall.
S: Homer, Alaska averages about 64 cm annually while Peru receives about 290 cm annually. Also, Homer receives the most precipitation in fall and winter months while Iquitos peaks in the spring.

T: How do they compare in temperature?
S: Homer has below freezing winters and reaches only 16 degrees Celsius in the summer. Iquitos has very stable temperatures staying between about 21-31 degrees Celsius.

T: How do these data compare to where you live or a different place that you have been?
S: Michigan receives about 81.9 cm annually. Jamaica receives about 198 cm annually. Michigan experiences a wide range of temperatures of all four seasons while Jamaica has stable temperatures yearlong (See Figure 2).

T: What could account for these differences and why?
S: Latitude location on Earth, because generally the equator is moist and warm while the poles are cool and dry.

T: Looking at the graphs again, how could they be misleading to someone at first glance?
S: The y-axis is spaced differently for each graph so one must take into account that the stretching or shrinking of numbers on the graph could affect visual comparisons.

T: Considering what you know about biomes and the data given, what is your ideal biome to live in and why?
S: Temperate deciduous forest because it has moderate climates.

T: Referring to the Michigan data, do the temperatures and rainfall match up with what you experience day to day in Michigan? Why or why not?
S: Overall, yes because we have noticeable differences in temperature for each season and the graph shows cold winters that can get below freezing and hot summers that can reach 27 degrees Celsius.

T: What do you think accounts for the type of hydrologic processes that occur frequently in Michigan?
S: Sublimation of snow. Cold fronts moving across warm Lake Michigan resulting in a lot of snow (the lake-effect) in the winter or thunderstorms in the spring/summer. Flooding caused by melting snow and heavy rainfall. Warm temperatures leading to higher evaporation in the summer.

T: What could account for the differences seen in the Michigan graphs between Grand Rapids (southwestern MI) and Houghton Lake (north central MI)?
S: Grand Rapids is closer to the water source, Lake Michigan, so each month receives slightly more precipitation. Grand Rapids is also closer to the Gulf of Mexico, another source of our precipitation.

T: Going back to the books we read, why do we need to conserve water (particularly our Great Lakes?)
S: Conservation is needed for humans today and future generations to use as a clean abundant water resource and to preserve biodiversity in the lakes.

T: In the trade book, it talks about how a droplet can travel very far. Describe how a droplet would make its way from the tundra to the rainforest and what types of circumstances would need to take place.
S: Some ice that formed during the winter in the active layer of permafrost could go through sublimation and evaporate as a gas, cooling, condensing and becoming part of a cloud. The droplet may get carried away to the equator by strong winds. Then, more water vapor added to the cloud would make it become heavy enough to precipitate above a tropical rainforest.

Elaborate:

Water conservation is discussed in the trade book "The Drop in My Drink" used for this activity. The teacher can embellish on this by asking students about available fresh water sources such as the Great Lakes. The students can participate in "partner share" in which they discuss the importance of fresh water and ideas for conserving these water resources we have. The teacher will ask the students to make an individual goal that they can start to do everyday that will save water (such as turning off the faucet when brushing teeth or taking shorter showers).

Misconceptions:

Understanding the process evaporation is one of the keys to mastering the fundamental properties of the water cycle. Some students have misconceptions about evaporation (such as it carries particles with it or that water disappears). This misconception can be clarified with a demonstration by Larry Fegel. The system should be contained in some sort of clear container with dyed blue water at the bottom and an empty clear glass in the middle of the water. There should be a heat source that allows for the water to evaporate. The teacher will ask the students what color the water will be when it condenses and falls into the cup. Some students may think the water will be blue. By using this demonstration, the teacher can show how water accumulates at the top of ▶

the system (condenses and doesn't disappear) and then falls or "rains" into the cup. The blue dye may be attached to the water at the bottom but it does not follow the water in the evaporation process.

Figure 2. Climate data for Homer, Alaska; Iquitos, Peru; Grand Rapids; and Houghton Lake, Michigan. Solid bars represent precipitation. Lines represent temperatures. Modified from Weather Online.

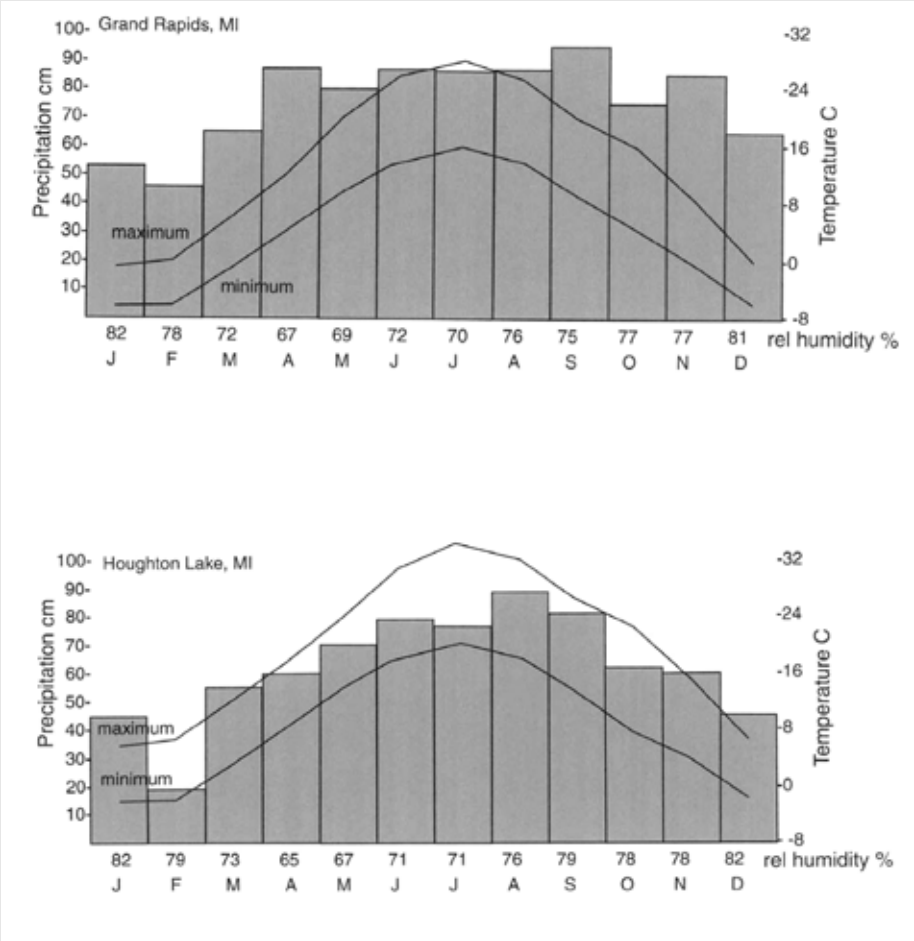
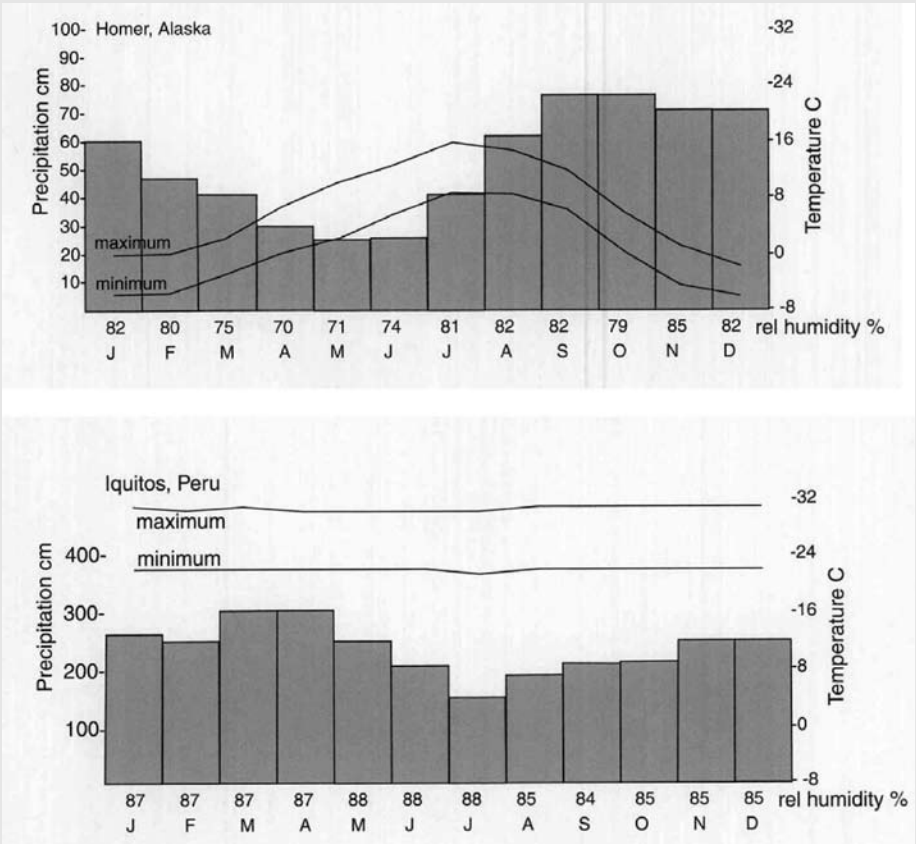


Figure 2. *continued*



Resources

Graphs for the locations used in this article as well as many other locations around the world: "Temperatures And Precipitation Climate Diagrams For More Than 5000 Stations Worldwide" Weather Online 7 Mar. 2010 http://www.weatheronline.co.uk/weather/maps/forecastmaps?LANG=en&CONT=namk&REGION=0014&LAND=MI&LEVEL=4&R=160

About the Author

- **Stephanie Standriff** (stephaniestandriff@yahoo.com)is a preservice teacher at Grand Valley State University in Allendale, Michigan. Steve Mattox(mattoxs@gvsu.edu) is an Associate Professor of Geology at Grand Valley State University.