

Global Precipitation Measurement Mission

NASA-Unique Resources to Support the “Water Cycle” concepts

Precipitation is a vital component of how water moves through Earth’s water cycle, connecting the ocean, land, and atmosphere. Knowing where it rains, how much it rains and the character of the falling rain, snow or hail allows scientists to better understand precipitation’s impact on streams, rivers, surface runoff and groundwater. Frequent and detailed measurements help scientists make models of and determine changes in Earth’s water cycle.

The water cycle describes how water evaporates from the surface of the earth, rises into the atmosphere, cools and condenses into rain or snow in clouds, and falls again to the surface as precipitation. The water falling on land collects in rivers and lakes, soil, and porous layers of rock, and much of it flows back into the oceans, where it will once more evaporate. The cycling of water in and out of the atmosphere is a significant aspect of the weather patterns on Earth.

This resource guide has been developed to assist presenters in providing supplemental lesson plans, videos, data sets, hands-on activities, and other types of resources to educators or other participants who might benefit from having supplemental materials.

LESSON PLANS AND ACTIVITIES

Water Falls: Pre-Visit lesson: In this lesson, students will learn about the water cycle. The lesson is intended to be use by teachers before they take their students to view the Science On a Sphere movie, “Water Falls.” <http://pmm.nasa.gov/education/lesson-plans/water-falls-pre-visit-lesson> and related docent-led presentations.

Connecting the Spheres: Earth’s Systems: This activity was developed as an introductory experience to a series of lessons about water resources on Earth. Students will investigate Earth systems by making observations in nature and identifying systems in the natural world. Ultimately, the students will understand how the four spheres/systems on Earth (biosphere, hydrosphere, geosphere, and atmosphere) are interconnected. <http://pmm.nasa.gov/education/lesson-plans/connect-spheres-earth-systems-interactions>

Earth’s Water: This activity was developed to give participants an understanding of Earth’s water – how much we have, what forms does it take and where it is found. In this one-hour long activity, students participate in a demonstration showing the distribution and composition of water on earth. Students also create a map showing where freshwater

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is located on earth (streams, ice pack, wetlands, etc.).

<http://pmm.nasa.gov/education/lesson-plans/earths-water>

Water Cycle: This activity was developed to give participants an understanding of Earth's water cycle. In this one-hour long activity, students participate in a webquest to learn about the water cycle, and then build a mini-model of the water cycle to demonstrate how water moves through Earth's four systems.

<http://pmm.nasa.gov/education/lesson-plans/water-cycle>

Water in the Hydrosphere: This is one-hour long activity gives participants an understanding of the hydrosphere. Participants learn about the hydrosphere by making observations and taking measurements. They also go outside and use scientific equipment to investigate temperature, pH, and transparency of a body of water. They will use collected qualitative and quantitative data to understand why it is important to know about the condition of freshwater sources in many places in the natural environment and how these places are connected in the water cycle. The data collection is based on protocols from the GLOBE program. www.globe.gov

<http://pmm.nasa.gov/education/lesson-plans/water-earths-hydrosphere>

Water in the Geosphere: This one-hour long activity gives participants an understanding of the geosphere. Participants learn about the geosphere by making observations and taking measurements. They will go outside and use scientific equipment to investigate water in the soil, measuring soil moisture, temperature, color and consistence. Participants will use collected qualitative and quantitative data to understand how water is found in many places in the natural environment and how these places are connected in the water cycle. The data collection is based on protocols from the GLOBE program. www.globe.gov

<http://pmm.nasa.gov/education/lesson-plans/water-earths-geosphere>

Water in the Atmosphere: This one-hour long activity gives participants an understanding of the atmosphere. Participants learn about the atmosphere by making observations and taking measurements. They will go outside and use scientific equipment to collect atmospheric moisture data (temperature, relative humidity, precipitation, and cloud cover). Participants will use collected qualitative and quantitative data to understand how water is found in the atmosphere, how the atmosphere determines weather and climate, and how Earth's spheres are connected through the water cycle. The data collection is based on protocols from the GLOBE program.

<http://pmm.nasa.gov/education/lesson-plans/water-atmosphere>

Water in the Biosphere: This one-hour long activity gives participants an understanding of the biosphere. Participants learn about the biosphere by making observations and taking measurements. They will go outside and use scientific equipment to investigate plants and land cover as an indication of amount of water in the biosphere. Participants will use collected qualitative data to understand how water is found in many places in the natural environment and how these places are connected in the water cycle. The data



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<http://pmm.nasa.gov/education/lesson-plans/water-biosphere>

The Water Cycle: In this lesson plan, students will observe and investigate the movement of water through the different stages of the water cycle and determine what drives this cycle. They will discover how changes in heat energy occur throughout the cycle.

<http://pmm.nasa.gov/education/lesson-plans/water-cycle>

Water Cycle Webquest: This webquest was developed to teach students about Earth's water cycle as they visit and interact with several websites that help them explore various facets and processes of the water cycle.

<http://pmm.nasa.gov/education/interactive/water-cycle-webquest>

Earth System Science: This lesson plan will introduce students to many of the complex issues surrounding the Earth as a system and will help students to look at Earth in a new way—as a living system. <http://pmm.nasa.gov/education/lesson-plans/earth-system-science>

WEBSITES

Precipitation Education: The Global Precipitation Measurement (GPM) mission's education and public outreach website. The website focuses on four main categories: water cycle, weather and climate, technology, and societal applications. Each of these categories has many educational resources that include descriptions about each resource, information on intended audiences, and a lot of other useful information.

<http://pmm.nasa.gov/education/>

VIDEOS AND DATA ANIMATIONS

Our Wet Wide World (GPM Overview): As anyone who has ever been caught in a sudden and unexpected downpour knows, gaps still exist in our knowledge about the behavior and movement of precipitation, clouds and storms. The Global Precipitation Measurement (GPM) mission is an upcoming satellite mission from NASA and the Japan Aerospace Exploration Agency that aims to fill in those gaps in both coverage and scientists' understanding of precipitation.(4:06) <http://pmm.nasa.gov/education/videos/our-wet-wide-world-gpm-overview>

The Water Cycle - Featuring Molecule Man!: This video (4:56) uses a combination of cartoon characters, a scientist, and a series of different Earth-observing satellites with data animations to teach about the various parts of the water cycle and how different NASA satellites can improve understanding of the water cycle.

<http://pmm.nasa.gov/education/videos/water-cycle-featuring-molecule-man>



Global Precipitation Measurement Mission

The Thermohaline Circulation - The Great Ocean Conveyor Belt: The oceans are mostly composed of warm salty water near the surface over cold, less salty water in the ocean depths. This video shows the movement of ocean currents in the tropics and high latitudes, showing the continual movement of the ocean called the thermohaline circulation. (1:23)

http://www.youtube.com/watch?v=3niR_-Kv4SM

Global Precipitation Climatology: This animation of global precipitation from the Global Precipitation Climatology Project (GPCP) cycles through climatology data for each month of the year and then repeats the cycle twice. (00:24)

<http://pmm.nasa.gov/education/videos/nasa-scientists-research-global-precipitation>

Aquarius Ocean Circulation: Ocean circulation plays a key role in distributing solar energy and maintaining climate, by moving heat from Earth's equator to the poles. The NASA satellite called Aquarius (<http://aquarius.nasa.gov/>) collects salinity data from space, and when combined with data from other sensors it provides a clearer picture of how the ocean works. (1:58) <http://pmm.nasa.gov/education/videos/aquarius-ocean-circulation>

Components of the Water Cycle: The process by which water moves around the earth, from the ocean, to the atmosphere, to the land and back to the ocean is called the water cycle.

- **Data shown on flat maps:** These animations each portray a component of the water cycle as a series of four short data animations.
<http://pmm.nasa.gov/education/videos/components-water-cycle-flat-map>
- **Data shown on spheres:** These animations each portray a component of the water cycle in a series of 5 short data animations shown on the earth as a sphere.
<http://pmm.nasa.gov/education/videos/components-water-cycle>

Earth's Water Cycle: This animation uses Earth science data from a variety of sensors on NASA Earth Observing Satellites as well as cartoons to describe Earth's water cycle and the continuous movement of water on, above and below the surface of the Earth. (5:52)

<http://pmm.nasa.gov/education/videos/earths-water-cycle>

The Water Cycle: Following the Water: Explore how water moves across land and returns to the ocean in the final installment of the water cycle series. The visualizations illustrate the movement of water on land—from storage of precipitation in soil layers, to its transport via rivers. <http://pmm.nasa.gov/education/videos/water-cycle-following-water>

The Water Cycle: Watering the Land: Explore how water droplets form and fall from the sky in part three of the water cycle series. Watch how water vapor moves through the

Global Precipitation Measurement Mission

atmosphere and returns to Earth as rain and snow.

<http://pmm.nasa.gov/education/videos/water-cycle-watering-land>

The Water Cycle: Steaming the Air: Explore water vapor in the air in part two of the water cycle series. This second part of our series on the water cycle illustrates the way in which evaporation and winds combine to move water from the ocean to the land.

<http://pmm.nasa.gov/education/videos/water-cycle-steaming-air>

The Water Cycle: Heating the Ocean: Explore the solar heating of the ocean in part one of a series on the water cycle. The animations show multiple views of the solar heating of the oceans, a picture of this first stage of water's cyclical journey from sea to air to land, and back again. <http://pmm.nasa.gov/education/videos/water-cycle-heating-ocean>

Water Vapor Animation: Water vapor - and with it energy - is carried around the globe by weather systems. This satellite image shows the distribution of water vapor over Africa and the Atlantic Ocean. <http://pmm.nasa.gov/education/videos/water-vapor-animation>

Animated Water Cycle: This flash animation takes viewers through four aspects of the water cycle: rain, water storage, vapor, and clouds.

<http://pmm.nasa.gov/education/interactive/animated-water-cycle>

OTHER RESOURCES

Earth Observatory Water Cycle Overview: This text article with beautiful images explains that water is a vital substance that sets the Earth apart from the rest of the planets in our solar system. In particular, water is a necessary ingredient for the development and nourishment of life. <http://pmm.nasa.gov/education/articles/earth-observatory-water-cycle-overview>

GPM Water Cycle Droplet Handout: Educational handout in the shape of a raindrop. The front shows a diagram of the water cycle, and the back has information about GPM and facts about water. <http://pmm.nasa.gov/education/images/gpm-water-cycle-droplet-handout>

NASA Earth Science: Water Cycle: This article explains the basics behind the water cycle and includes many good visuals. It provides some good background information about our water cycle as well as providing students with many real-world applications. <http://pmm.nasa.gov/education/articles/nasa-earth-science-water-cycle>

NASA Earth Science: Water and Energy Cycle: This article on the Water and Energy Cycle Focus Area studies the distribution, transport and transformation of water and energy within the Earth System. <http://pmm.nasa.gov/education/websites/nasa-earth-science-water-and-energy-cycle>