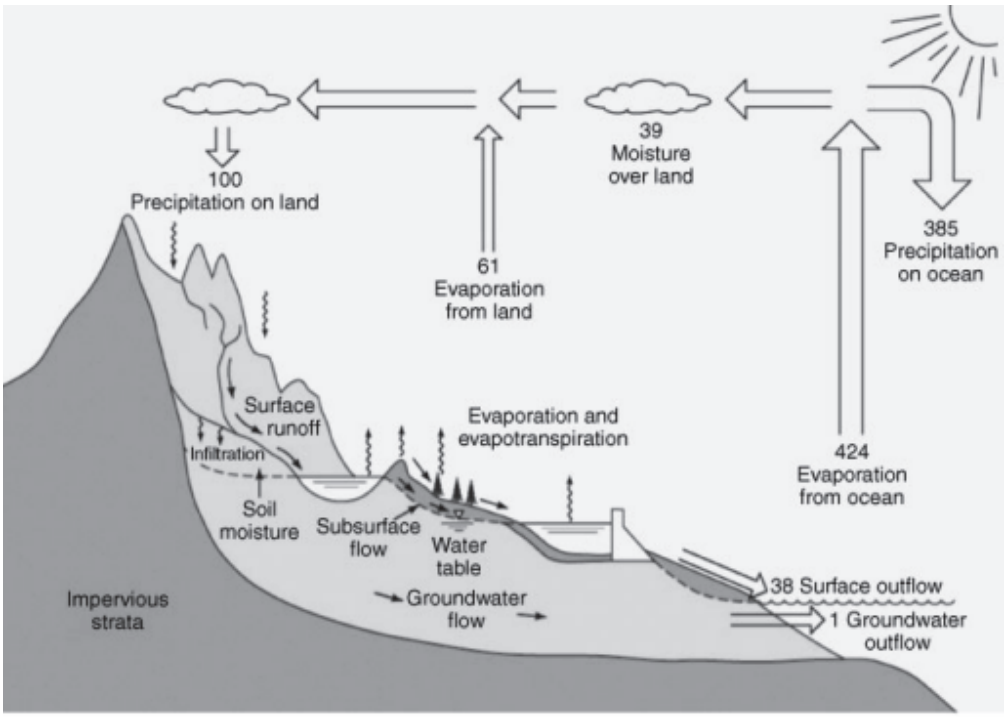
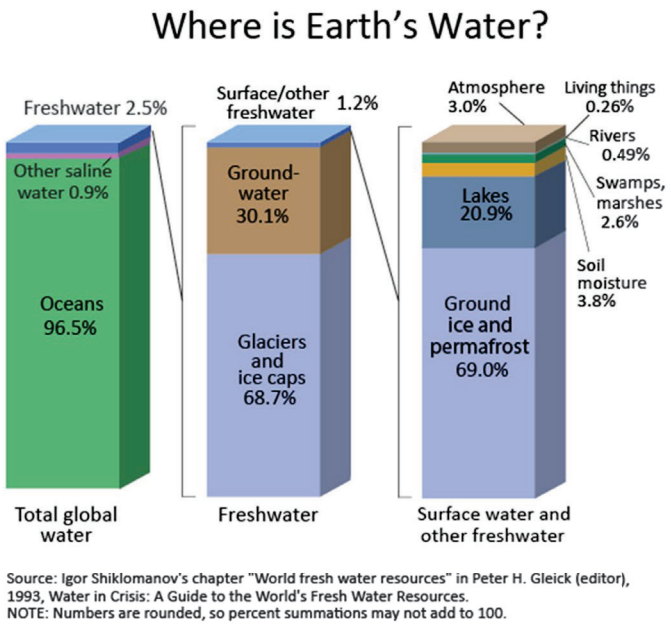



Global Water Cycle (Scientific American) (units = thousand cubic kilometers/year))




**What determines water availability?**

Humans and other organisms rely on water for life. The amount of water that is available depends on how much water there is in each water storage (water quantity). Water availability also depends on when and how fast water moves (water timing) through the water cycle. Finally, water availability depends on how clean the water is (water quality). By understanding human impacts on the water cycle, we can work toward using water sustainably. (From USGS, 2026)

**The main changes in the global water cycle with climate change** are its **acceleration and intensification**. As global temperatures rise, the atmosphere acts like a larger water storage due to its increasing water holding capacity, driving extreme shifts that result in both **severe droughts and disastrous floods.**

## Key Indicators of the Change in Global Water Cycle (UCAR Center for Science Education, USA)

- **Increased Evaporation:** Warmer temperatures cause water from oceans, lakes, and soils to evaporate at significantly higher rates.
- **Higher Atmospheric Moisture Capacity:** For every 1$^{o}$C of warming, the atmosphere can hold approximately 7% more water vapor.
- **Intense Downpours and Flooding:** When the moisture-heavy atmosphere releases its water, it often falls in intense storms, leading to flash floods.
- **More Severe and Longer Droughts and Aridity:** Meanwhile, high evaporation rates extract more moisture from the soil. During dry periods, this mechanism may lead to longer, more severe, and more widespread droughts.
- **Stronger tropical cyclones/hurricanes**: warmer ocean surface waters can lead to more intense tropical cyclones which, when they fall on land, may produce more intense storms.
- **More intense heat waves**: increasing atmospheric temperatures will lead to more intense heat waves.
- **Warming and acidifying ocean waters**: leading to much more adverse conditions for ocean life.
- **Melting glaciers and sea ice**: leading to rising ocean levels.
- **Change in the Earth's Water Stores**: rising sea levels, melting glaciers, changes in evaporation and precipitation regimes and rates render significant change in the Earth's water stores in time and space.

**Understanding the Global Water Cycle helps the Human Society to Protect and Sustain its Environment and Livelihood:**

Engineers and Scientists use their knowledge of the water cycle to forecast severe storms, ocean surges, regional water balance and water supply etc. They also use such knowledge to estimate atmospheric/hydrologic extremes, such as floods and droughts, in time and space in order to develop policies for managing them.

Such forecasts and estimates are performed by means of various atmospheric and hydrologic numerical models at various scales, starting from the global scale downward toward the watershed/city scale, while utilizing historical and current atmospheric and hydrologic observations from various international, national and state agencies.

## Main Educational Concepts in understanding the Change in Global Water Cycle (UCAR, USA)

To understand how the water cycle changes as global temperatures rise, educational curricula focus on several fundamental shifts:

- **Intensification:** Warmer global temperatures accelerate evaporation rates globally.
- **Increased Moisture Capacity:** For every 1°C of warming, the atmosphere can hold approximately 7% more water vapor. When the moisture-heavy atmosphere releases its water, it often falls in intense storms, leading to severe floods.
- **Intensifying dry conditions:** High evaporation rates extract more moisture from the soil. During dry periods, this mechanism may lead to longer, more severe, and more widespread droughts.

## Key Learning Objectives (UCAR, USA)

Educators use the above interconnected concepts to help students understand broader climate impacts:

- **The Interconnected System:** Understanding how water links the ocean, atmosphere, land, vegetation, and snowpack together into a single climate system.
- **Phase Changes:** Recognizing how heat drives phase changes (solid, liquid, gas) in water to dictate weather and climate.
- **Regional Disparities:** Learning that water cycle changes are not evenly distributed; some regions face excess water, while others may suffer aridification.

### Recommended Teaching Resources & Curricula (UCAR, USA)

Several authoritative organizations offer free, inquiry-based educational materials and activities for various grade levels:

- UCAR Center for Science Education**:** Provides accessible breakdowns of how higher evaporation and precipitation rates affect global weather patterns.
- NOAA Education Resources**:** Features searchable databases with visual resources and lesson plans on global to local-scale water cycle forecasting.
- Office for Climate Education (OCE)**:** Offers "The Water Cycle in a Changing Climate," an inquiry-based educational guide designed to help students investigate reservoirs, physical processes, and extreme weather links.
- USGS Water Science School: Provides wealth of information on the water cycle.

# UNESCO'S OFFICE FOR CLIMATE EDUCATION

## CLASS ACTIVITY

### The Water Cycle in a Changing Climate

The Office for Climate Education offers an inquiry-based activity designed for teachers who want students to understand **how the water cycle works and how climate change is modifying it**. *The Water Cycle in a Changing Climate* helps students explore the movement of water among various stores, the physical processes involved, and the links between water cycle changes and extreme weather events.

### What is this activity about?

This activity is part of *The Climate in Our Hands – Extreme Weather Events* handbook and focuses on the **structure and functioning of the water cycle**. Students discover how water circulates between different stores (oceans, atmosphere, glaciers, rivers, groundwater) through fluxes such as evaporation, precipitation, runoff, and infiltration.

By working with scaled representations and IPCC-based data, students learn that while the **total amount of water on Earth remains constant**, climate change profoundly alters the **distribution of water among Earth's various stores** and the **intensity of fluxes**. These changes play a key role in the increasing frequency and intensity of extreme weather events such as floods, droughts, and heavy precipitation.

### Key Information

**Subjects:** Physics, Mathematics, Chemistry, Natural Sciences, Geography
**Duration:** 1 hour 30 minutes (including 10 minutes of preparation)
**Teaching method:** Document analysis
**Key learning outcomes:**

- **Water stores:** Identify the main water stores on Earth and estimate their relative sizes.
- **Fluxes and states of water:** Differentiate between stores and fluxes, and understand water changes between solid, liquid, and gaseous states.
- **Conservation of water:** Calculate and explain why the total amount of water on Earth remains constant.
- **Climate change impacts:** Explain how climate change affects water stores and fluxes (e.g. melting ice, increased evaporation, intensified precipitation).
- **Extreme events:** Understand how changes in the water cycle contribute to the frequency and intensity of extreme weather events.
- **Systems thinking:** Develop a systemic understanding of interactions between the water cycle, climate change, and extreme events.

### How does it work?

1. **Introduction (15 min):**
   Students identify extreme weather events involving water and explore the different states of water using simple demonstrations. They begin to discuss where water is stored on Earth and how it moves between different stores of the Earth.
2. **Document analysis and calculations (1 h):**
   Students work with worksheets and IPCC-based data to represent the distribution of water among Earth's stores and quantify major water fluxes. They calculate evaporation and precipitation rates and verify that gains and losses balance at the global scale.
3. **Wrap-up discussion (15 min):**
   The class structures key concepts and discusses how climate change intensifies the water cycle, modifies regional precipitation patterns, and increases the risks of floods and droughts. The notion of uncertainty in scientific results is also introduced.

## Why use this activity in your classroom?

- Builds strong foundations for understanding the water cycle
- Uses real scientific data from IPCC reports
- Links physical processes to climate change and extreme events
- Strengthens systems thinking and scientific literacy.