WATER FOR LIFE

Module 4 The Hydrological Cycle

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WATER FOR LIFE

Module 4 The Hydrological Cycle

Water is always on the move!

In this module, we will cover the steps of the hydrological cycle and then examine the differences that may be encountered among the water cycle on different types of islands. Specifically, we will examine the following:

- Basic hydrological cycle
- Hydrological cycle on land
- Hydrological cycle on high islands
- Hydrological cycle on low islands

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4 The Hydrological Cycle

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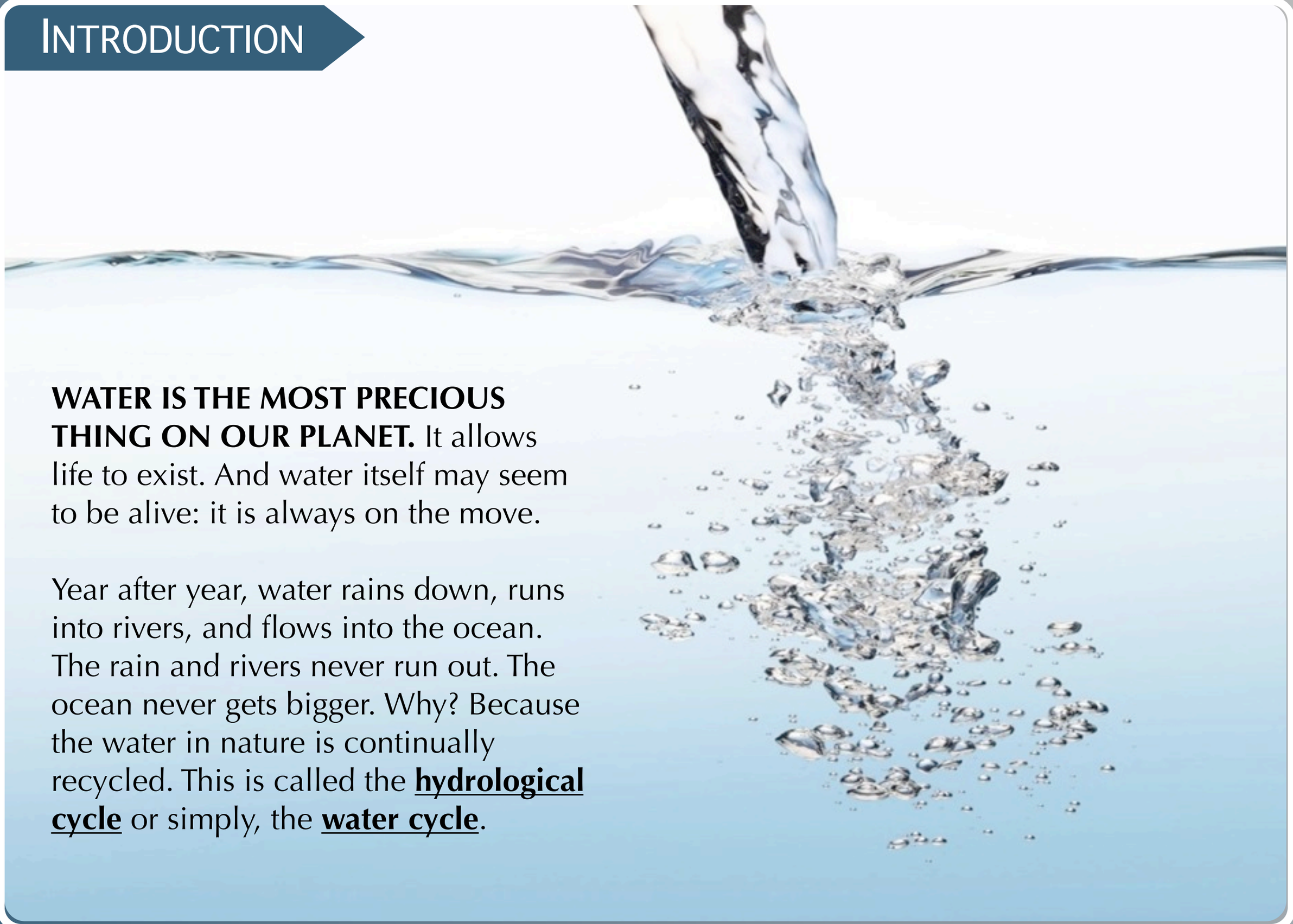
INTRODUCTION



WATER IS THE MOST PRECIOUS THING ON OUR PLANET. It allows life to exist. And water itself may seem to be alive: it is always on the move.

Year after year, water rains down, runs into rivers, and flows into the ocean. The rain and rivers never run out. The ocean never gets bigger. Why? Because the water in nature is continually recycled. This is called the **hydrological cycle** or simply, the **water cycle**.

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INTRODUCTION

As part of the hydrologic cycle, water moves from **from the ocean to the atmosphere**, **from the atmosphere back to the ocean** or **to reservoirs on land** (before returning to the ocean). The balance of water on Earth and quantity in different reservoirs remains fairly constant over time, but individual water molecules come and go, in and out of each reservoir. As they do so, they undergo various physical processes, and go through different phases: liquid, solid, and gas.

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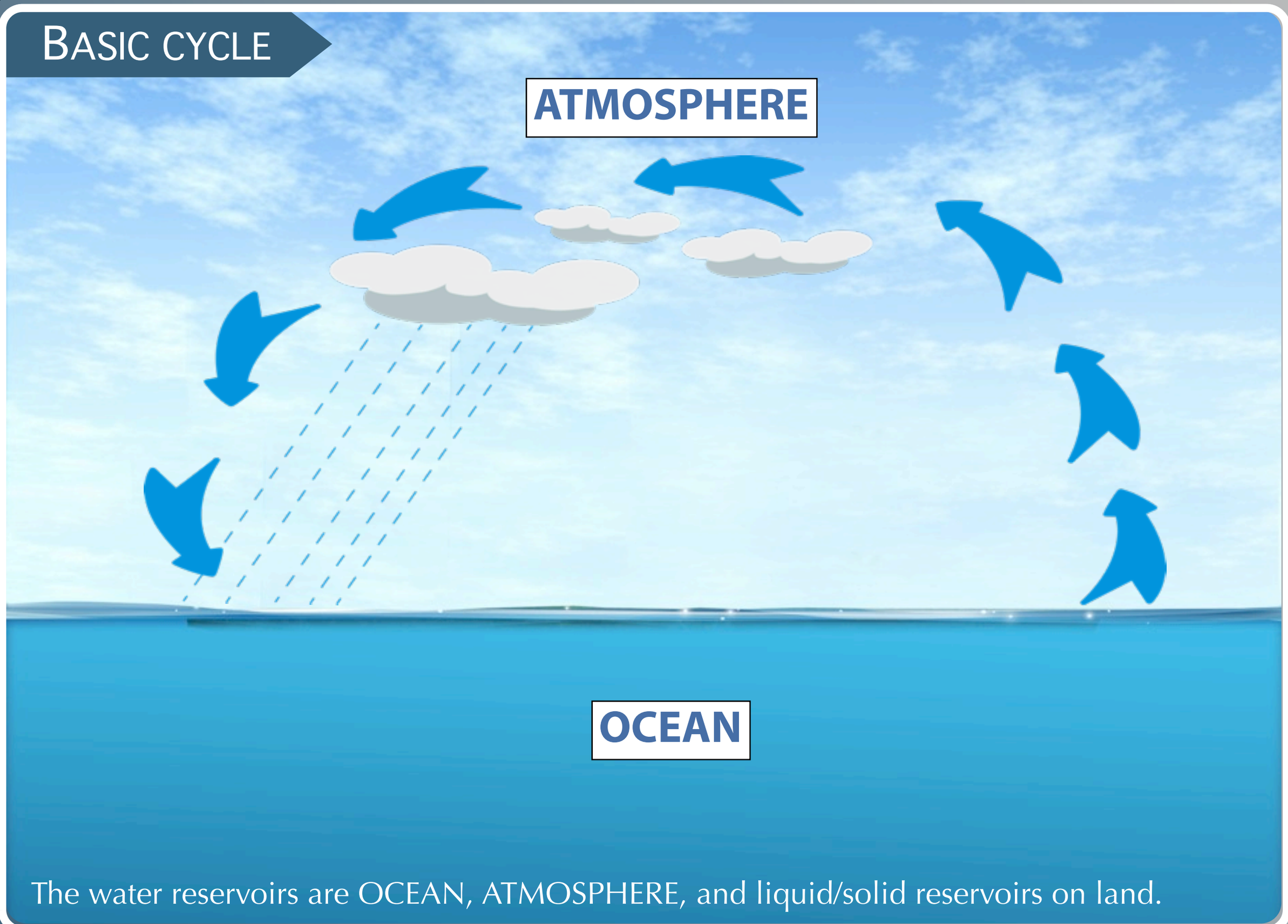
BASIC CYCLE



The water reservoirs are OCEAN, ATMOSPHERE, and liquid/solid reservoirs on land.

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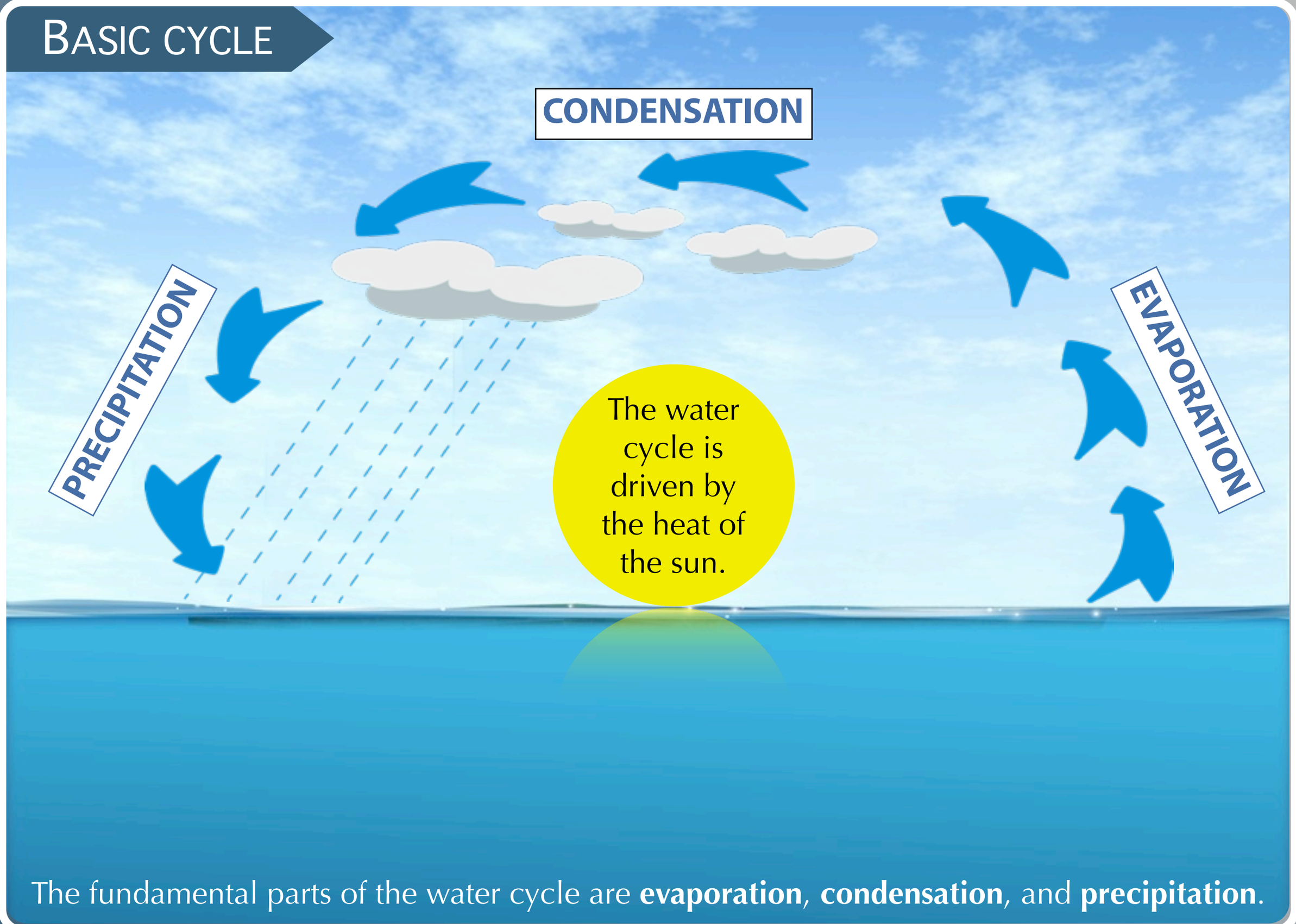
Basic cycle



The fundamental parts of the water cycle are **evaporation**, **condensation**, and **precipitation**.

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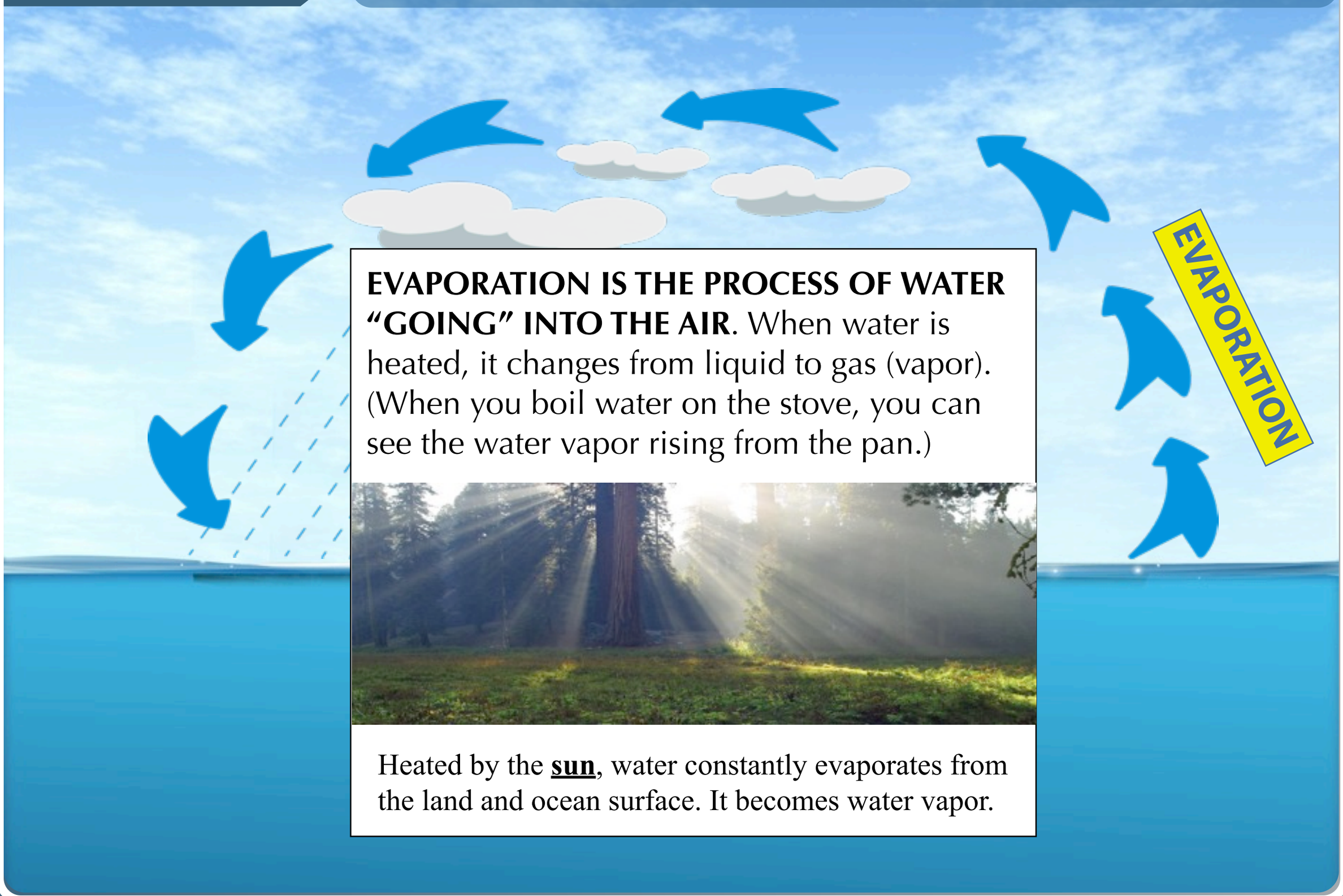
BASIC CYCLE

WHAT IS EVAPORATION?



EVAPORATION IS THE PROCESS OF WATER "GOING" INTO THE AIR. When water is heated, it changes from liquid to gas (vapor). (When you boil water on the stove, you can see the water vapor rising from the pan.)

Heated by the **sun**, water constantly evaporates from the land and ocean surface. It becomes water vapor.

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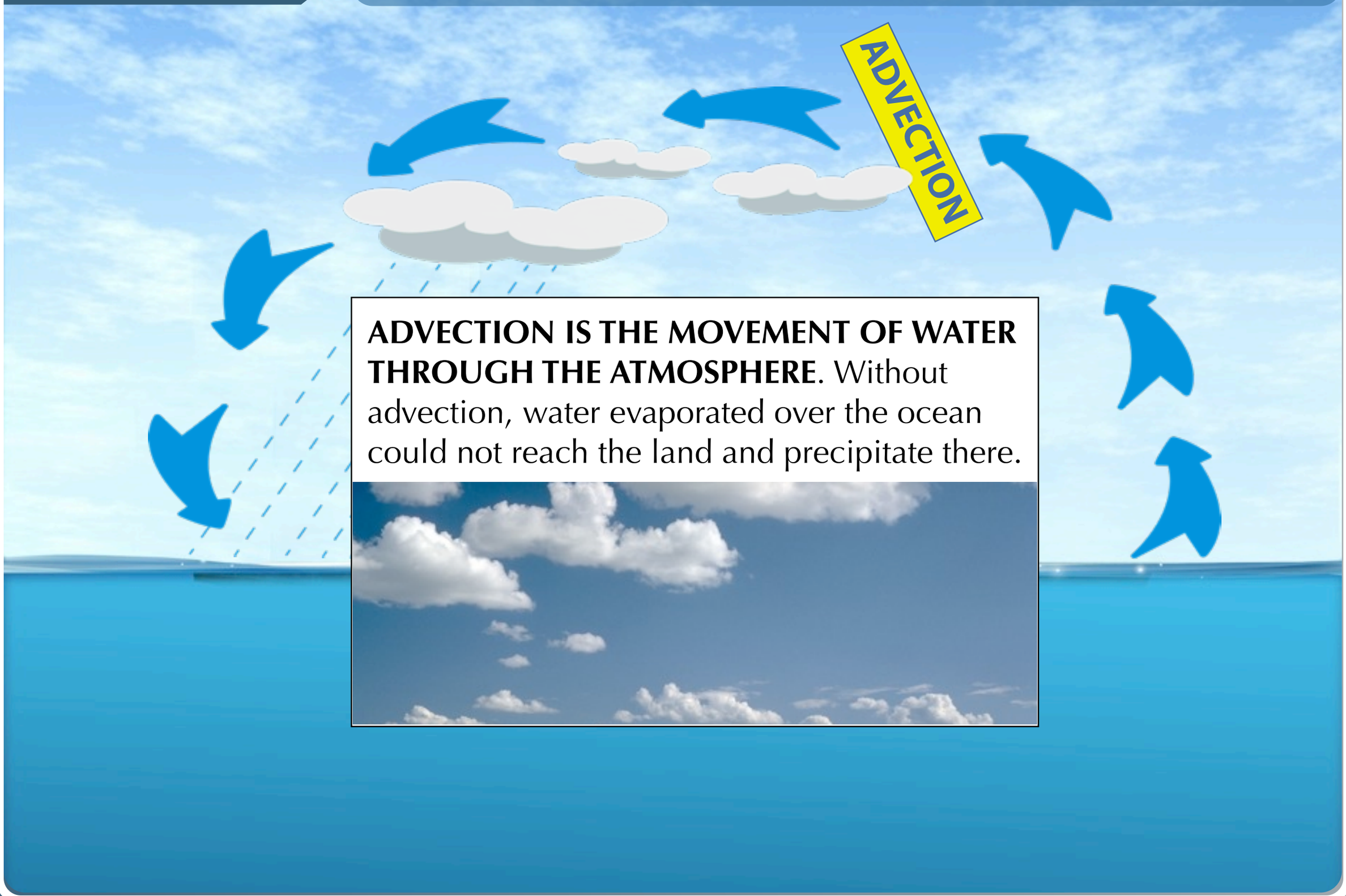
WHAT IS ADVECTION?



ADVECTION IS THE MOVEMENT OF WATER THROUGH THE ATMOSPHERE. Without advection, water evaporated over the ocean could not reach the land and precipitate there.

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WHAT IS CONDENSATION?

CONDENSATION

CONDENSATION IS THE OPPOSITE OF EVAPORATION. Heating water causes it to evaporate, cooling it causes it to **condense**. As water vapor rises through the air it cools and changes from gas back into a liquid.

Clouds are masses of water vapor that condense in the cool air. Condensation also causes rainbows.

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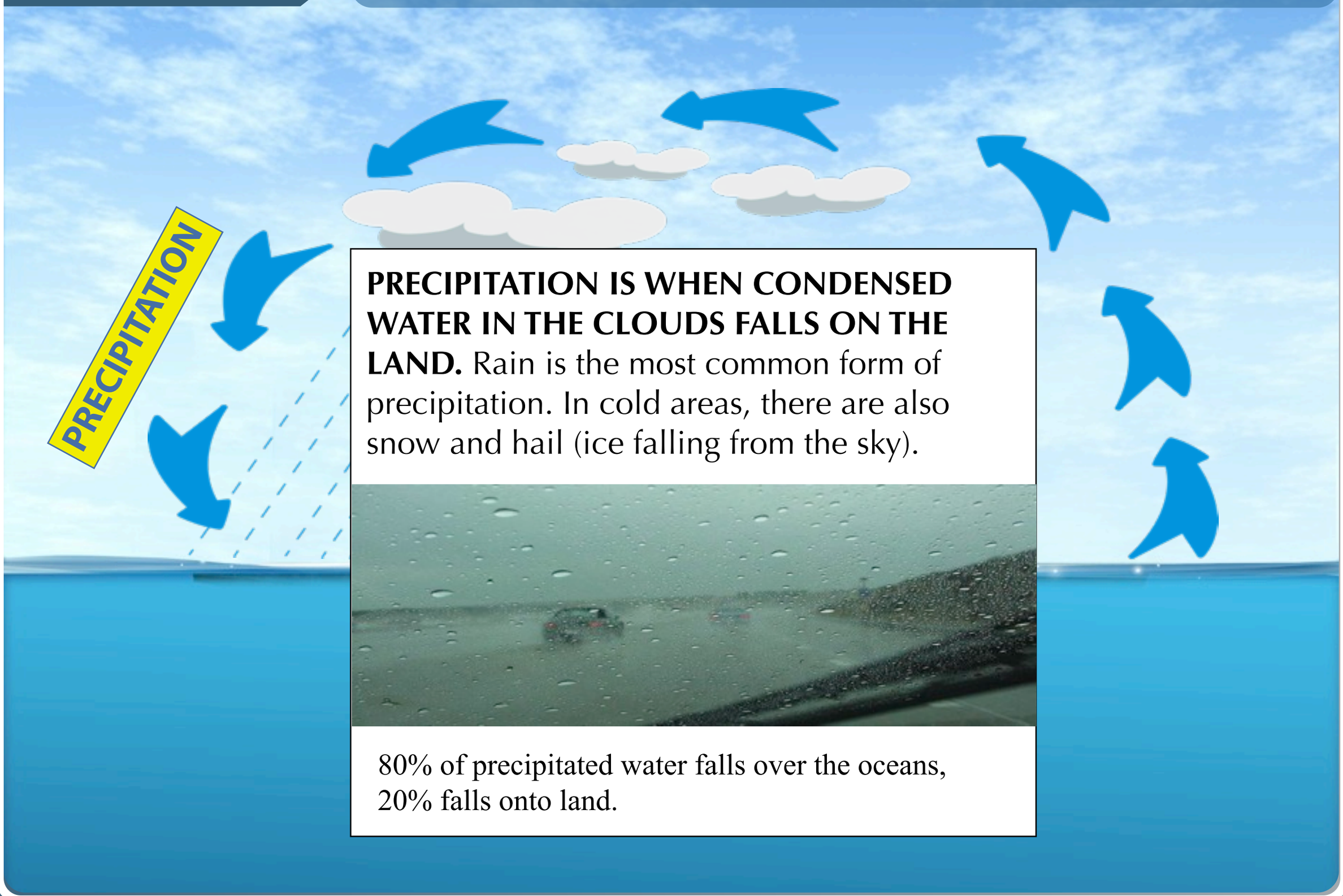
WHAT IS PRECIPITATION?



PRECIPITATION IS WHEN CONDENSED WATER IN THE CLOUDS FALLS ON THE LAND. Rain is the most common form of precipitation. In cold areas, there are also snow and hail (ice falling from the sky).

80% of precipitated water falls over the oceans, 20% falls onto land.

WHAT IS PRECIPITATION?

ACTIVITY:

Making clouds in a bottle.

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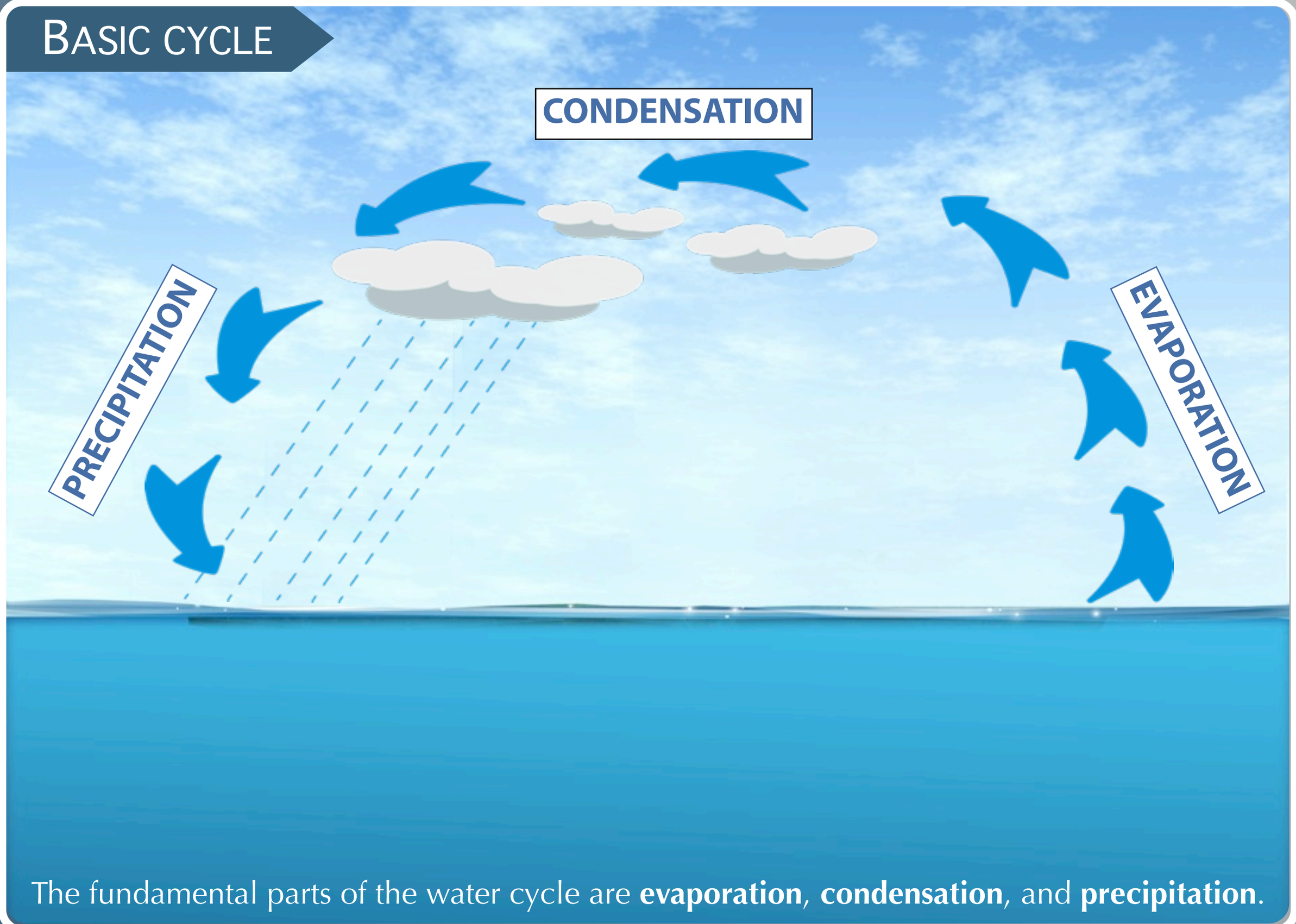
Basic cycle



The fundamental parts of the water cycle are **evaporation**, **condensation**, and **precipitation**.

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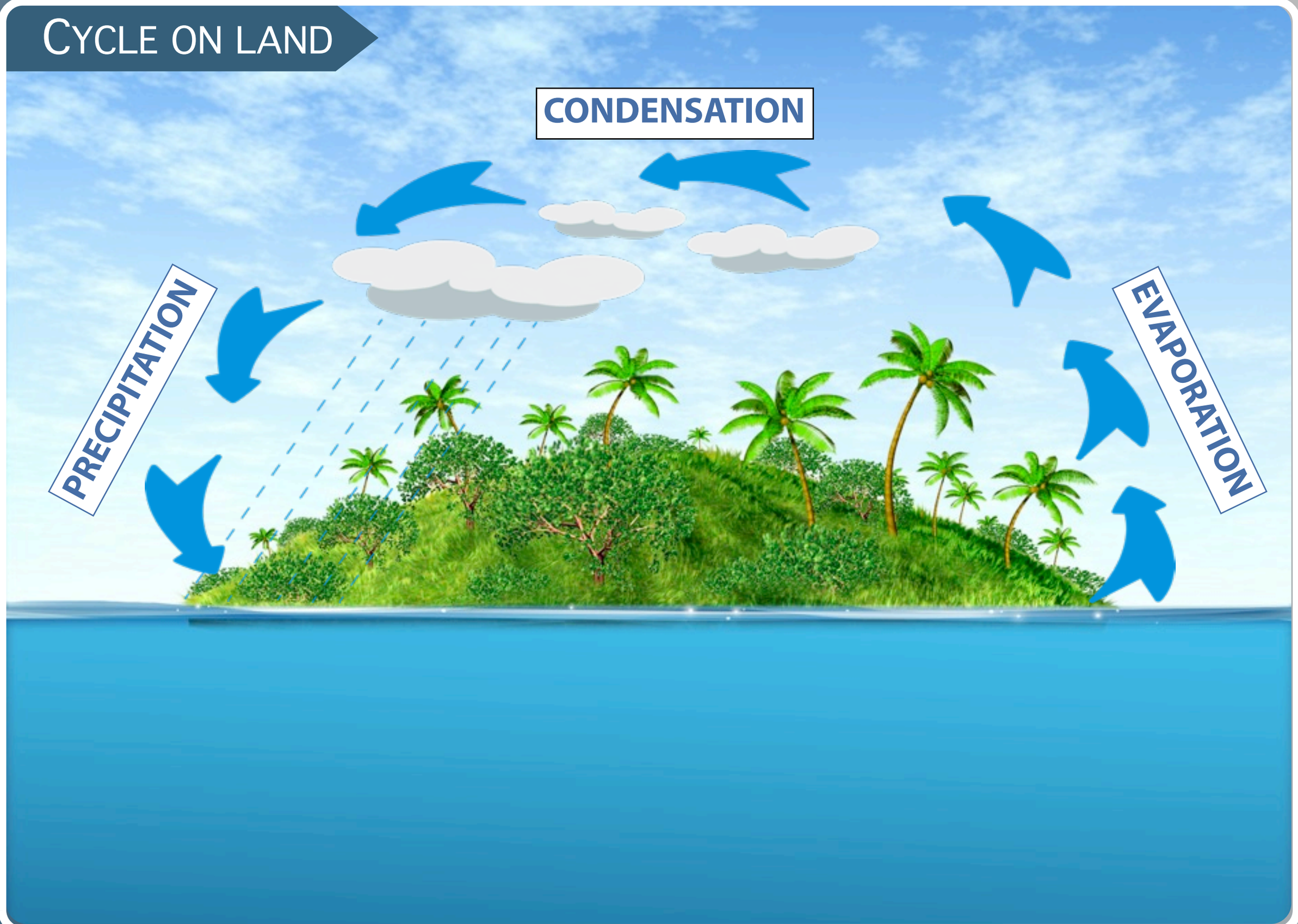
Cycle on land



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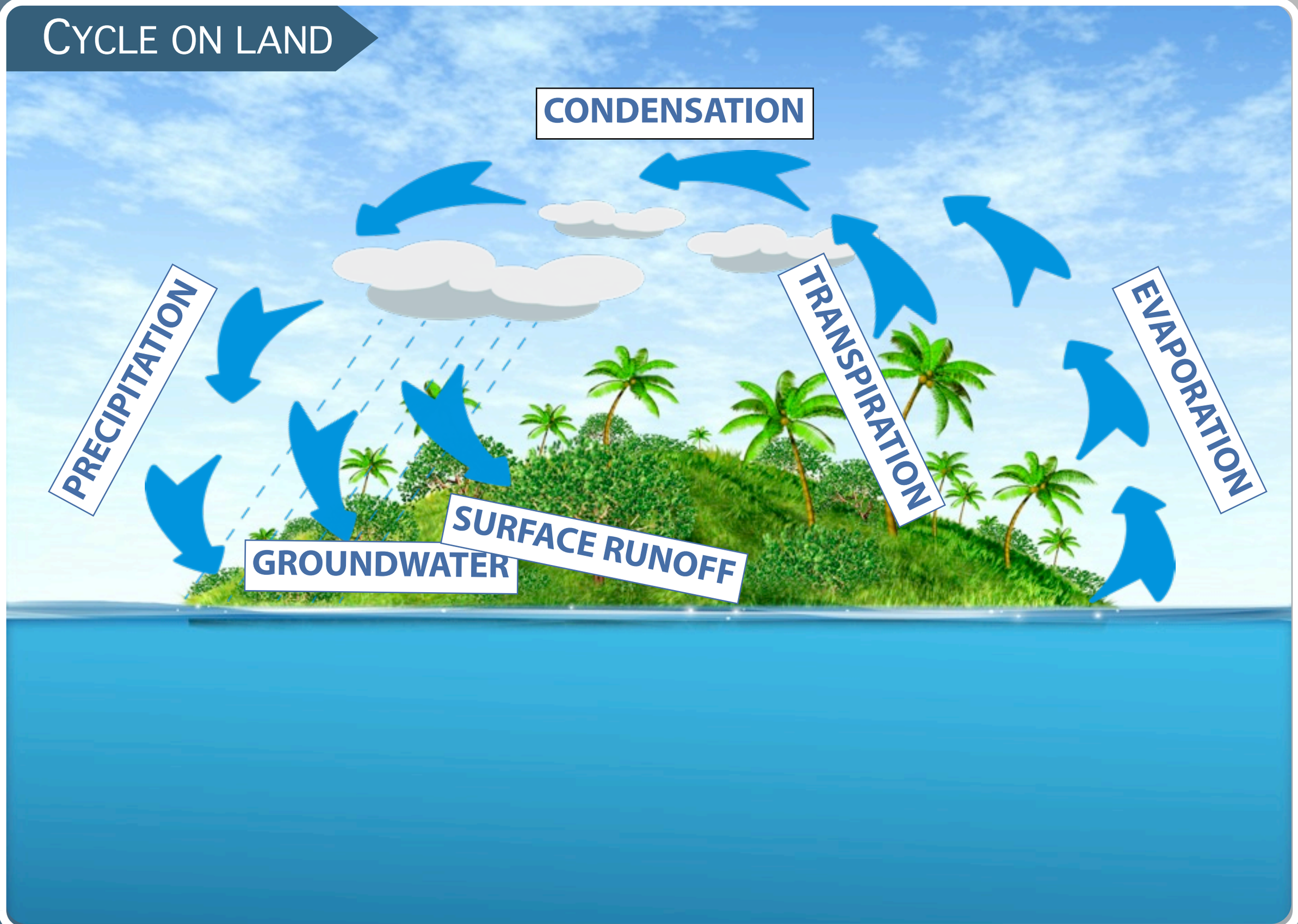
Cycle on Land



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CYCLE ON LAND

WHAT IS TRANSPIRATION?

TRANSPIRATION IS THE WAY PLANTS "BREATHE." Plants use their roots to get water from soil. Water rises from their leaves as vapor. Transpiration is just like evaporation, except that the water passes through plants*.

Water vapor given off by plants merges with other vapor in the air and makes clouds.

*For this reason, evaporation and transpiration are usually considered together and termed "Evapotranspiration".

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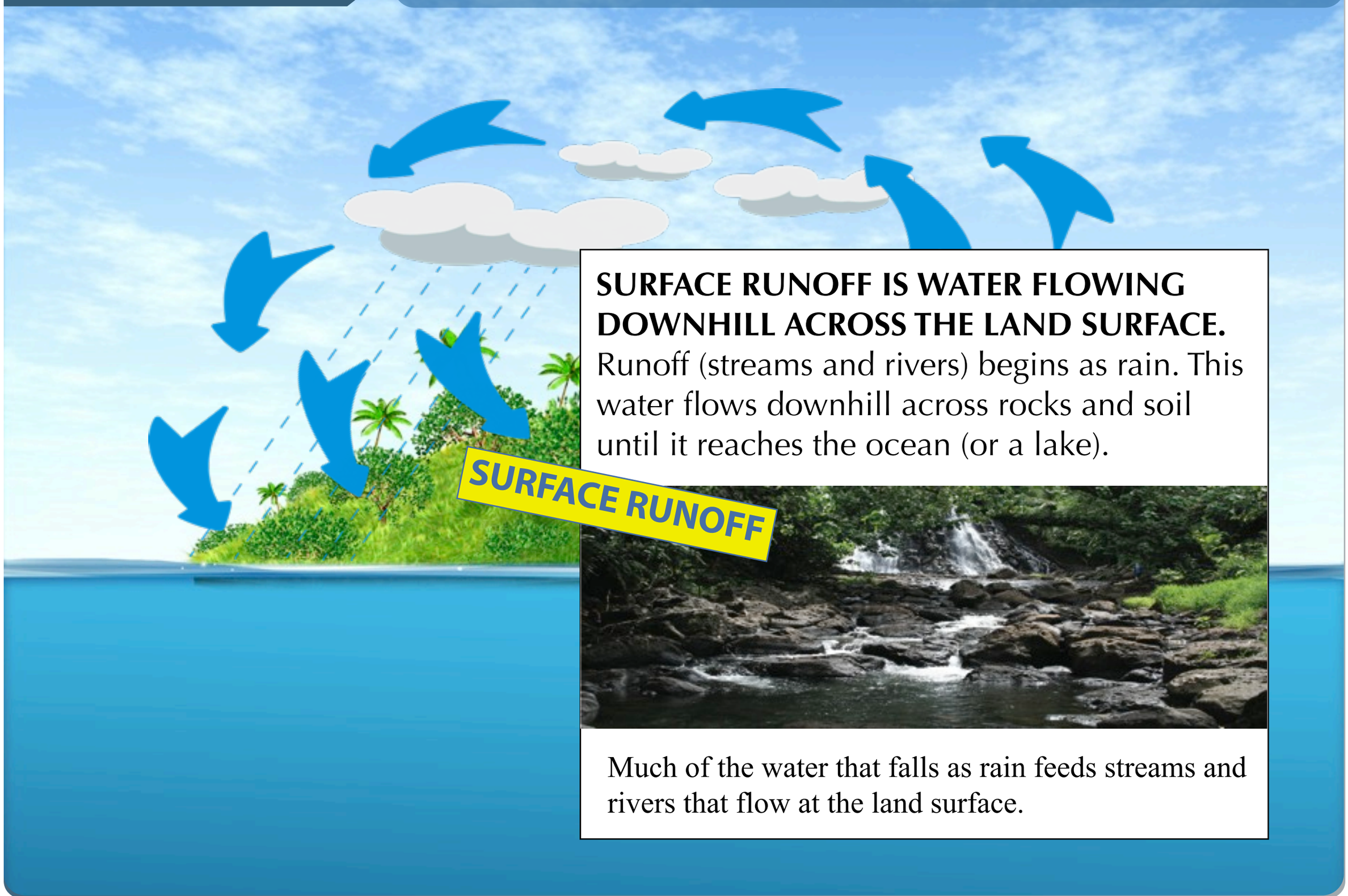
CYCLE ON LAND

WHAT IS SURFACE RUNOFF?



SURFACE RUNOFF IS WATER FLOWING DOWNHILL ACROSS THE LAND SURFACE.
Runoff (streams and rivers) begins as rain. This water flows downhill across rocks and soil until it reaches the ocean (or a lake).

Much of the water that falls as rain feeds streams and rivers that flow at the land surface.

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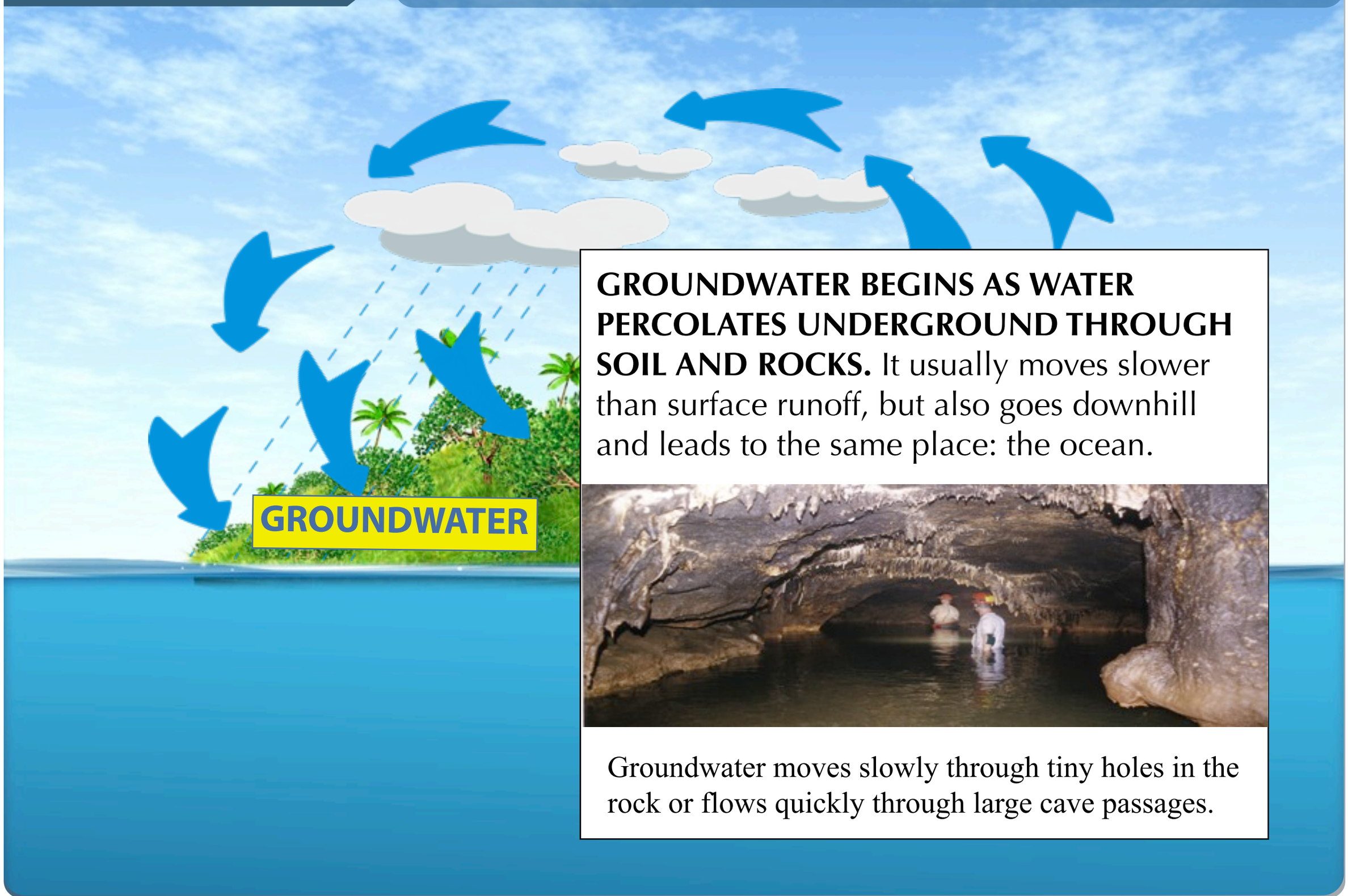
Cycle on Land

What is surface runoff?



GROUNDWATER BEGINS AS WATER PERCOLATES UNDERGROUND THROUGH SOIL AND ROCKS. It usually moves slower than surface runoff, but also goes downhill and leads to the same place: the ocean.

Groundwater moves slowly through tiny holes in the rock or flows quickly through large cave passages.

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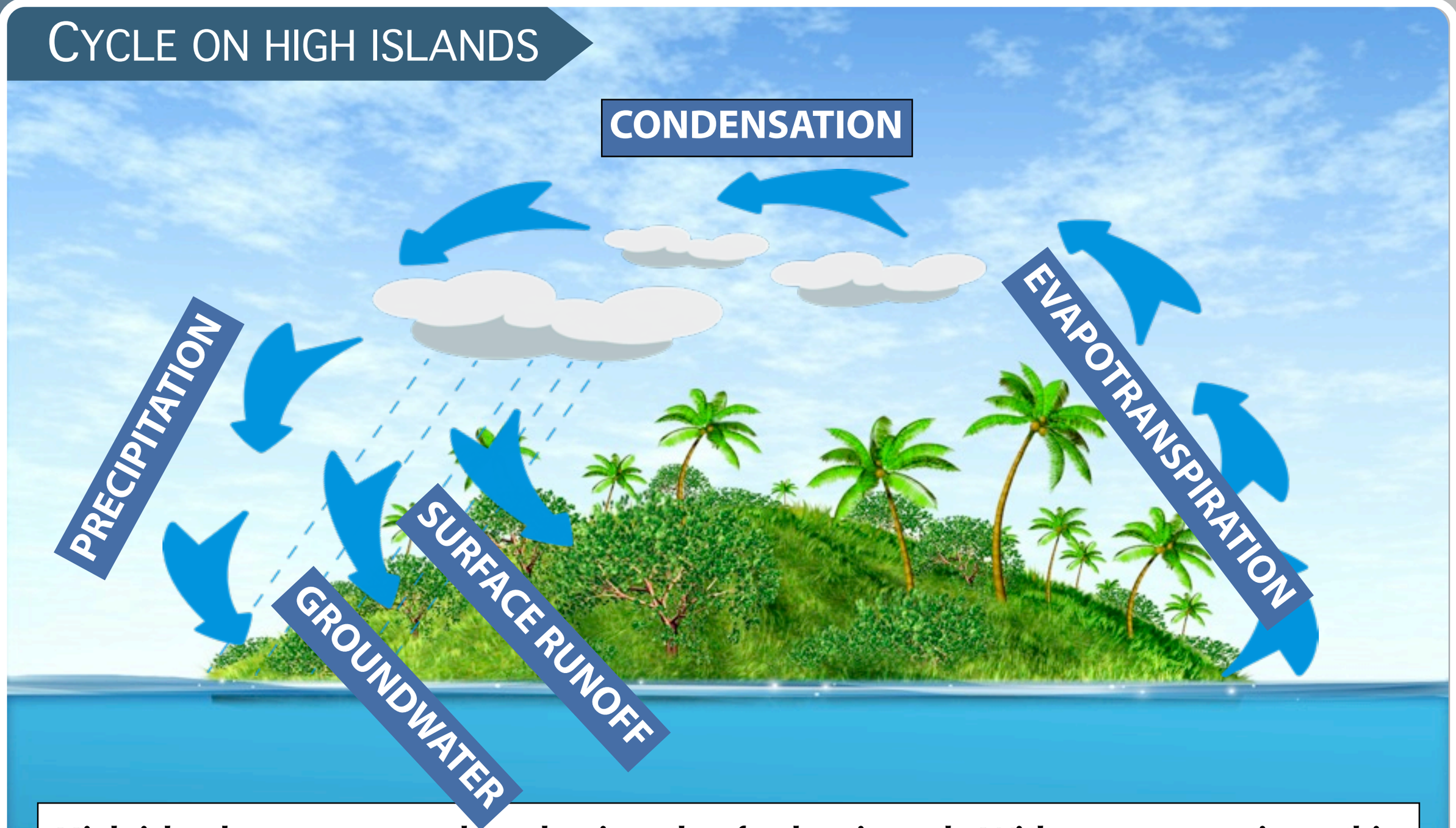
Cycle on high islands



High islands are composed predominantly of volcanic rock. With some exceptions, this type of bedrock is not too pervious. As a result, rains on high islands produce trickles, streams, and rivers that flow overland, downhill, and discharge into the ocean. For that reason, surface runoff is an important feature of high island water cycle.

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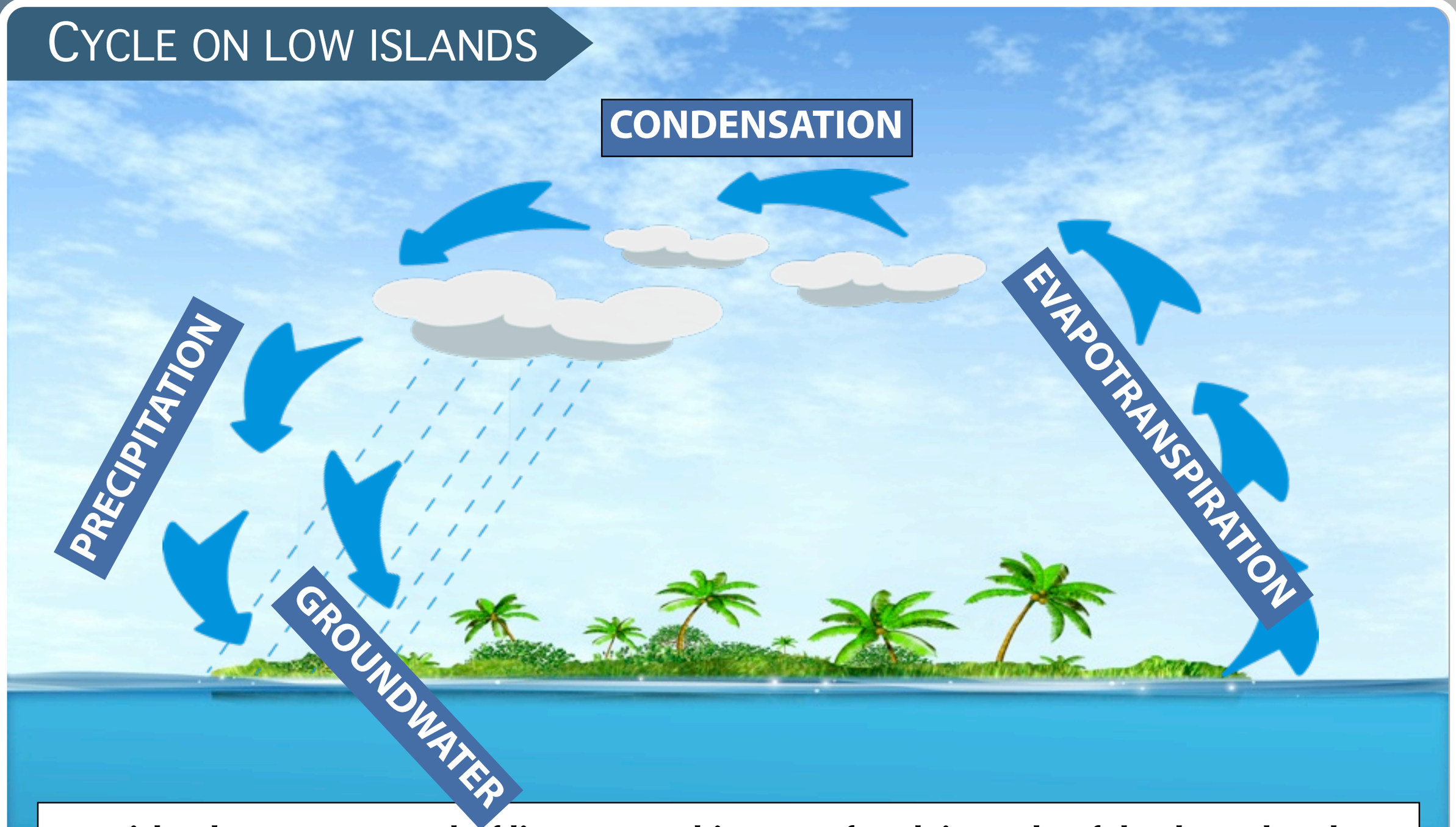
Cycle on Low Islands



Low islands are composed of limestone. This type of rock is made of dead coral and shells of marine organisms. It is soluble and can be quite pervious. As a result, rainwater on low islands quickly seeps into the ground and becomes groundwater. Groundwater slowly moves outward through the island and discharges into the ocean.

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Residence times

Reservoir	Average residence time for a water molecule
Oceans	3,200 years
Atmosphere	9 days
Ice sheets (Antarctica/Greenland)	20,000 years
Glaciers	20-100 years
Seasonal snow cover	2-6 months
Soil moisture	1-2 months
Groundwater (shallow)	100-200 years
Groundwater (deep)	10,000 years
Lakes	50-100 years
Rivers	2-6 months

Changes over time

Individual water molecules are always moving through the water cycles, but at any given time, the vast majority of time a given molecule is "stored" in a particular reservoir. The largest reservoir by far is the ocean.

In general, the amount of water in each reservoir does not change, but over longer periods of time, climates change and this affects the balance of water in the reservoirs. For example, during cold climatic periods, ice caps and glaciers form. This locks in water in solid state and removes if from the ocean. Sea level falls. The opposite happens during warm climatic periods.

During the last global warm spell (125,000 years ago), sea level was 5.5 m (18 ft) higher than today.

During the last glacial maximum (20,000 years ago), sea level was 120 m (400 ft) lower than today.

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EFFECTS

As water goes through the hydrologic cycle,

- **energy is exchanged, which leads to temperature changes and greatly affects climate**
- **water is purified, because water molecules are transferred without contaminants**
- **movement of water/ice reshapes earth's landforms through erosion and sedimentation**
- **water cycle greatly influences life and helps maintain countless ecosystems**