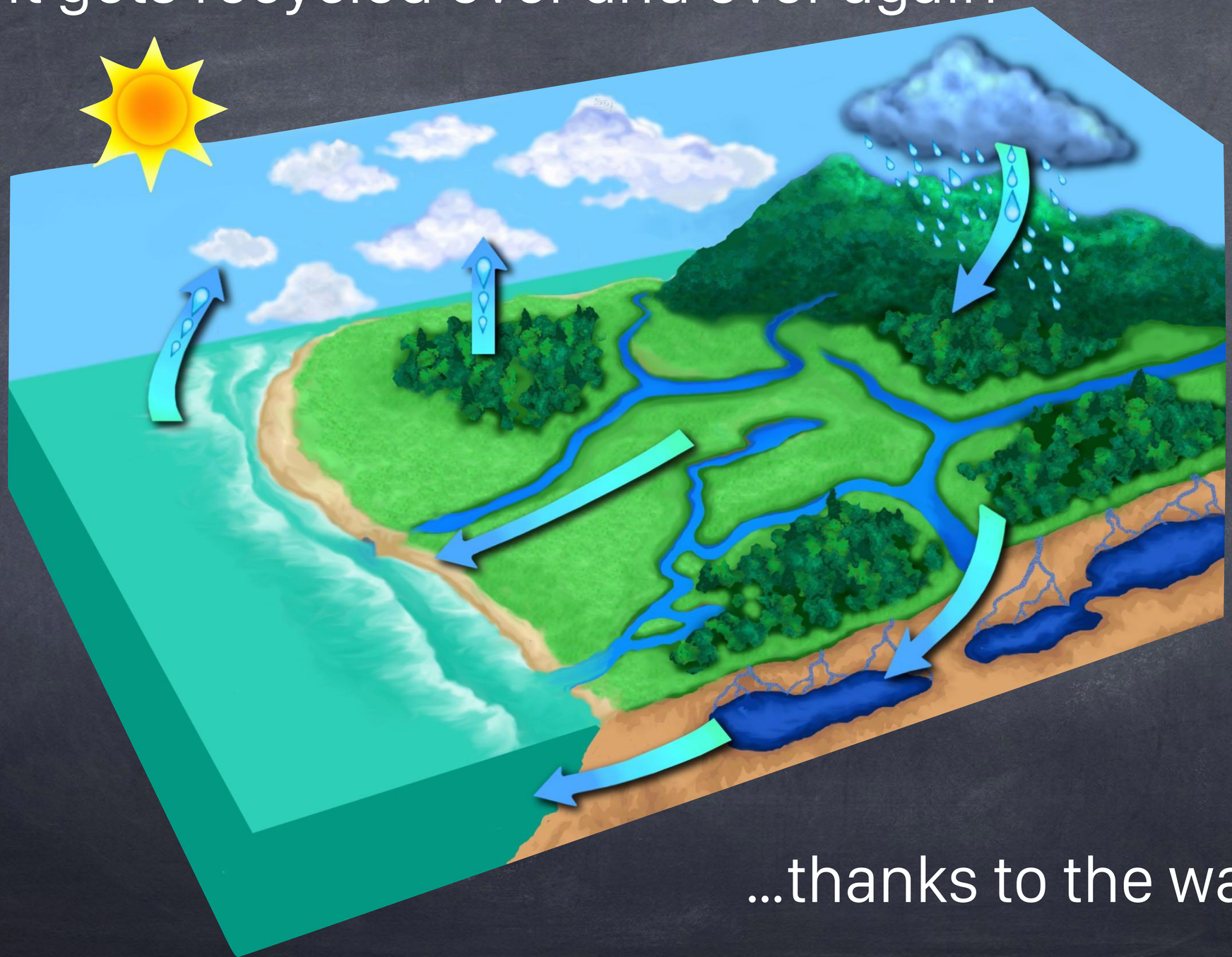
The Water Cycle

Water has been around for billions of years...
7years

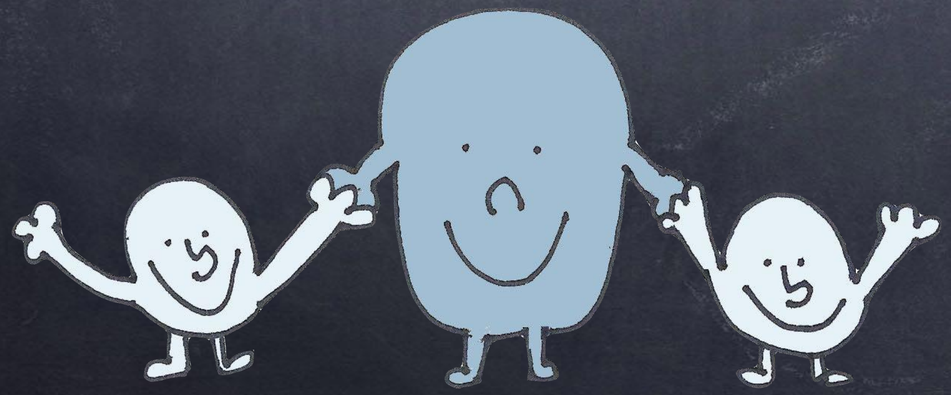
...cause it gets recycled over and over again

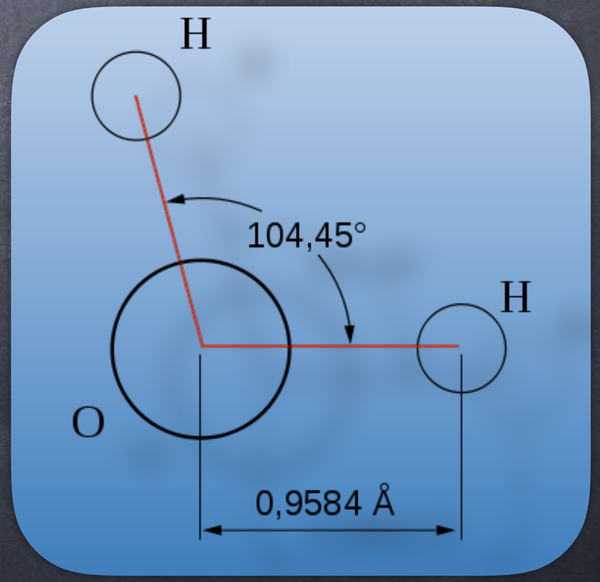


...thanks to the water cycle!

Water is a transparent fluid which forms the world's streams, lakes, oceans and rain, and is the major constituent of the fluids of organisms.

As a chemical compound, a water molecule contains one oxygen and two hydrogen atoms that are connected by covalent bonds.

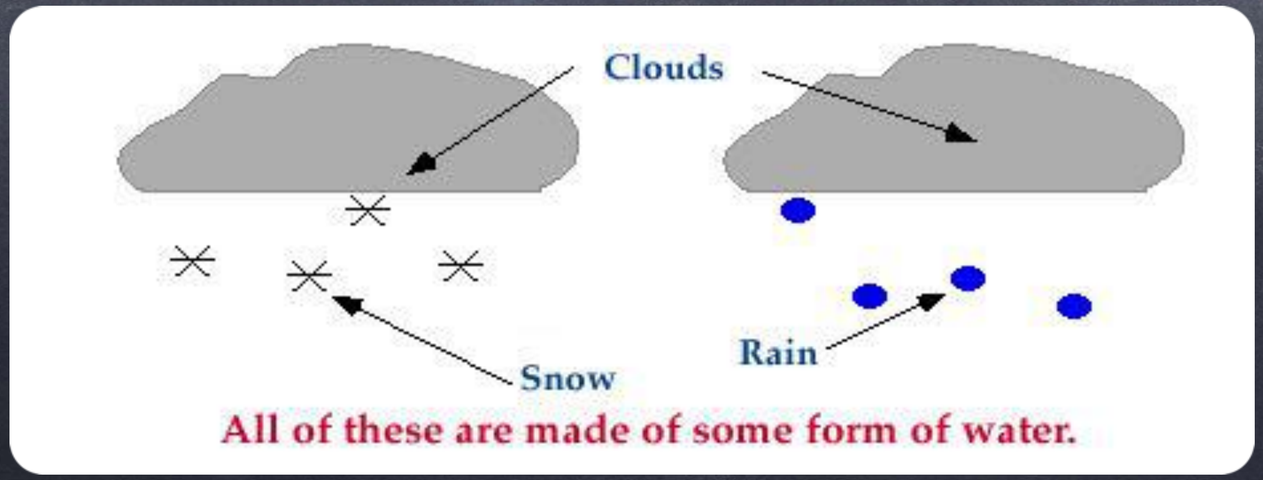




The States of Water: solid, liquid, gas

Water is known to exist in three different states; as a solid, liquid or gas.

Clouds, snow, and rain are all made of up of some form of water. A cloud is comprised of tiny water droplets and/or ice crystals, a snowflake is an aggregate of many ice crystals, and rain is just liquid water.

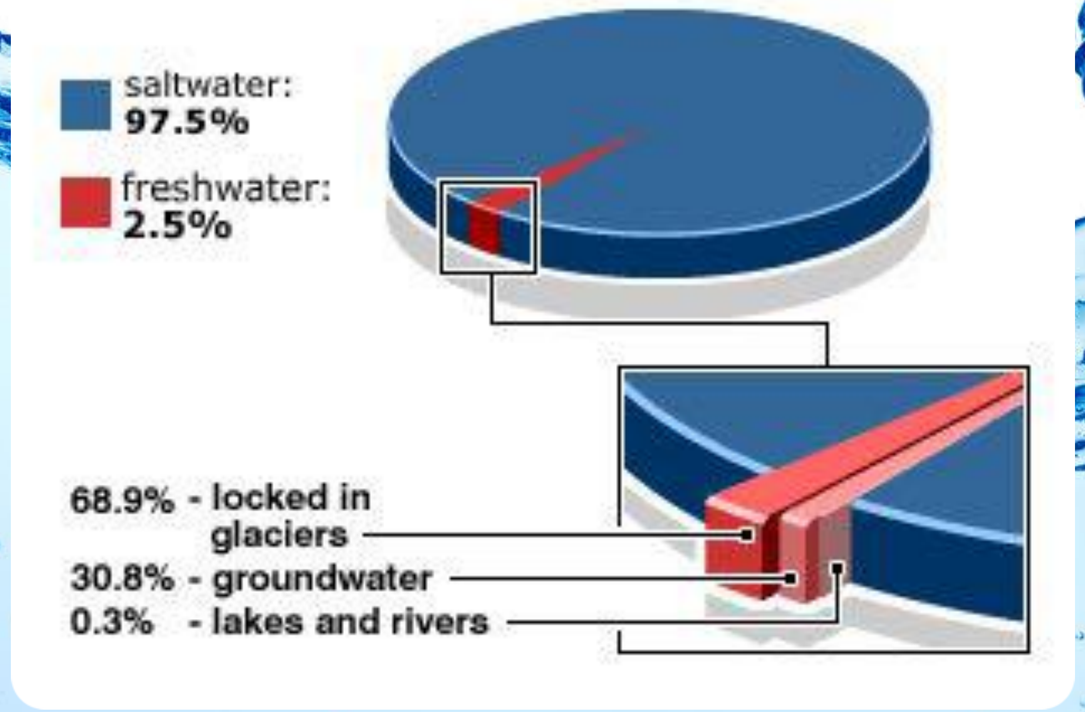


Water covers 71% of the Earth's surface and it is vital for all known forms of life.

On Earth:

- **96.5%** of the planet's crust water is found in seas and oceans;
- **1.7%** in groundwater;
- **1.7%** in glaciers and the ice caps of Antarctica and Greenland, a small fraction in other large water bodies;
- **0.001%** in the air as vapor, clouds (formed of ice and liquid water suspended in air), and precipitation.

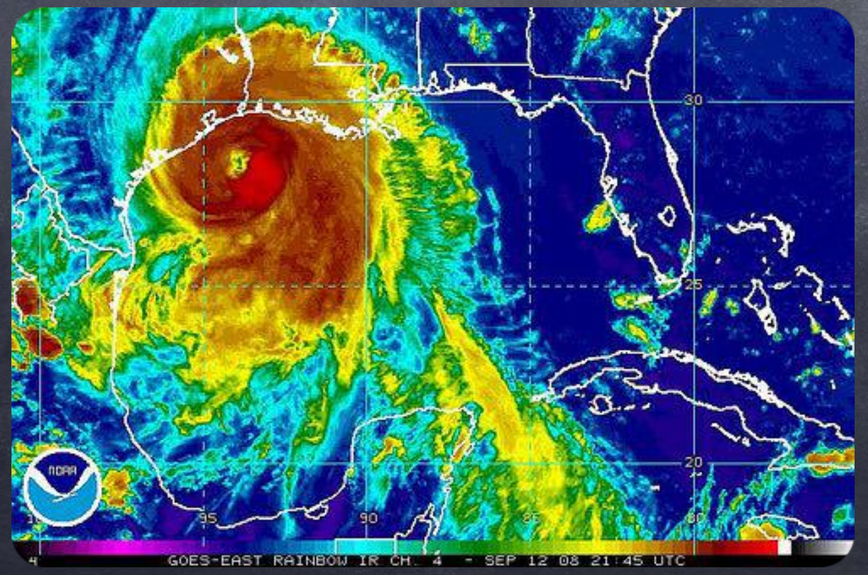
Where’s all of the earth's water?

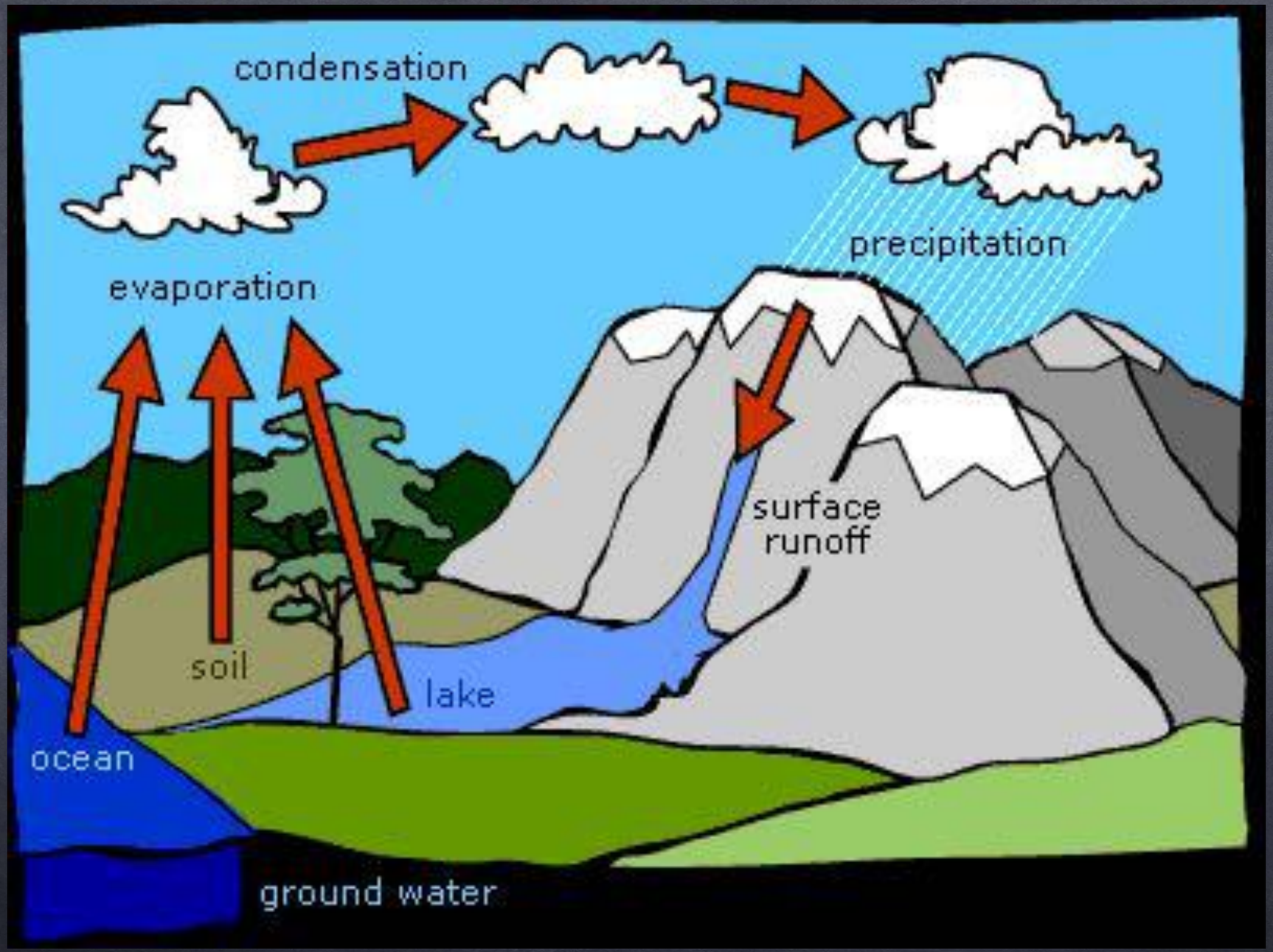


Hydrology

Hydrology is the science that studies the distribution, movement, and the biological-chemical parameters of the water masses. It consists of many fields of scientific study as hydrography, hydrogeology, the hydrogeochemistry and hydrobiology.

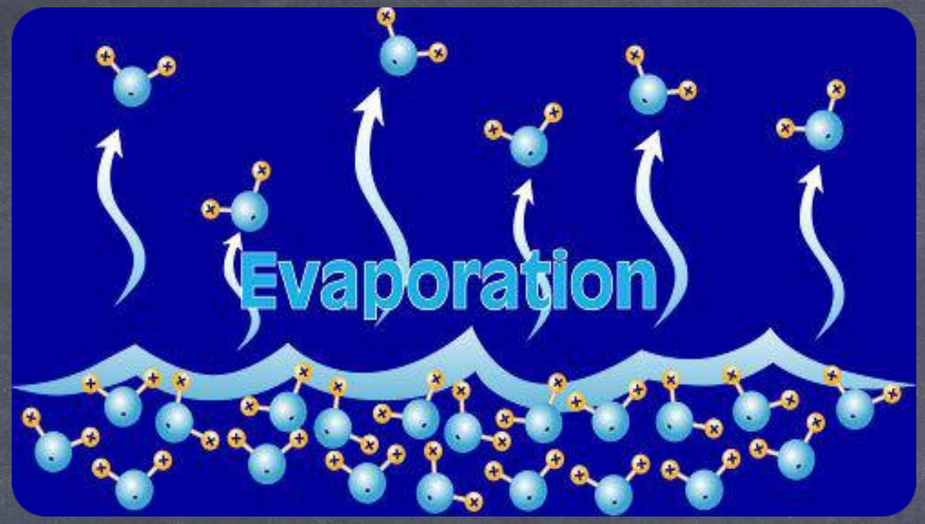
The monitoring and collection of data about the hydrological phenomena are critical steps in order to create a database the richest possible of information related to water from wells or to a particular section of river. Other than that are used to protect the catchments of specific areas or wider territories.




condensation
precipitation
evaporation
surface
runoff
soil
lake
ocean
ground water

The conversion of water from a liquid to a gas

Solar energy drives evaporation of water from the ocean.
The evaporated water changes from a liquid form into water vapor a gaseous form.



The transformation of water from liquid to gas phases as it moves from the ground or bodies of water into the overlying atmosphere.

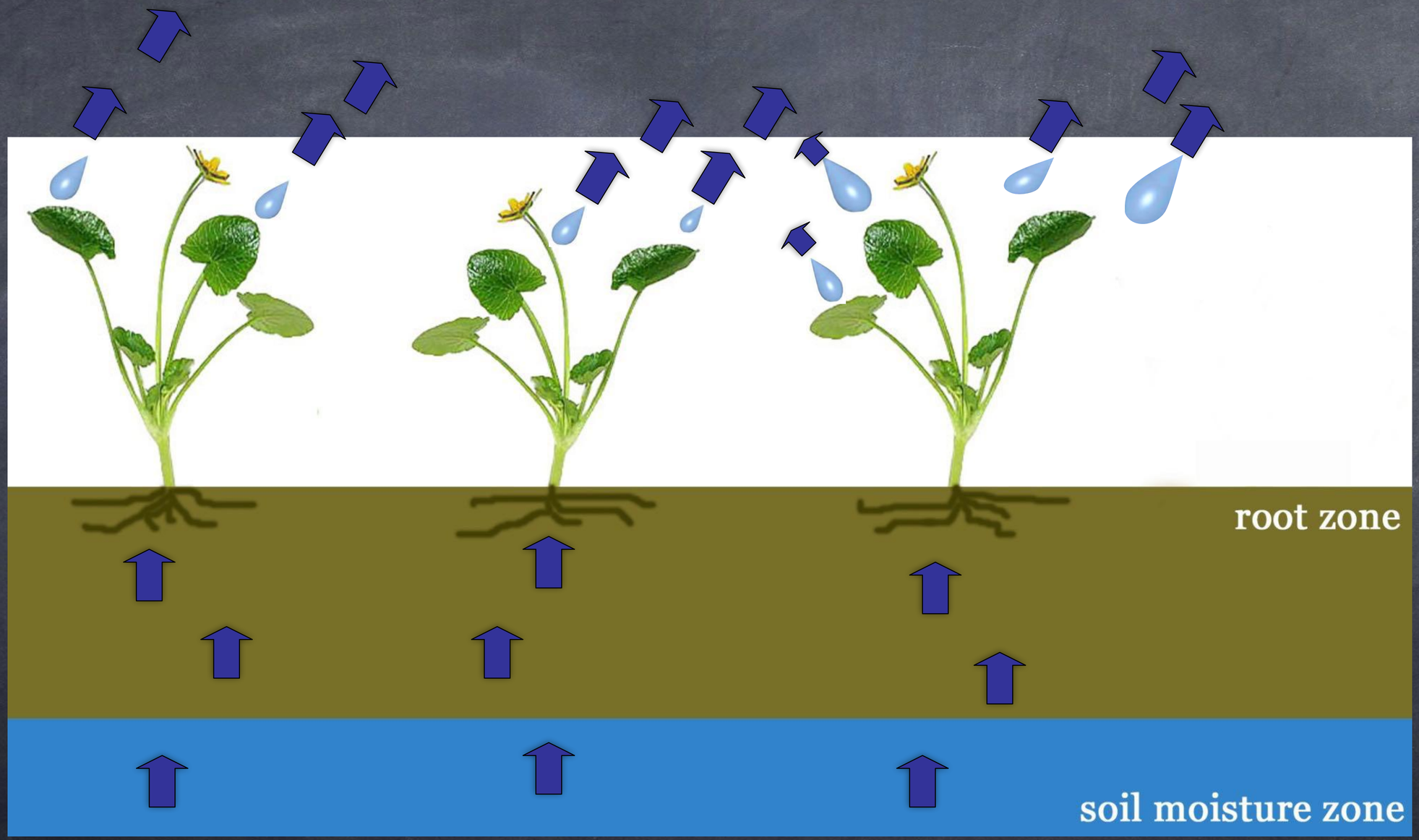
The source of energy for evaporation is primarily solar radiation. Evaporation often implicitly includes transpiration from plants, though together they are specifically referred to as evapotranspiration. Total annual evapotranspiration amounts to approximately 505,000 km^3 of water, 434,000 km^3 of which evaporates from the oceans. So 86% of global evaporation occurs over the ocean.

…do plants really sweat?

Transpiration

Plants like me release water during photosynthesis as I bring minerals up from my roots.

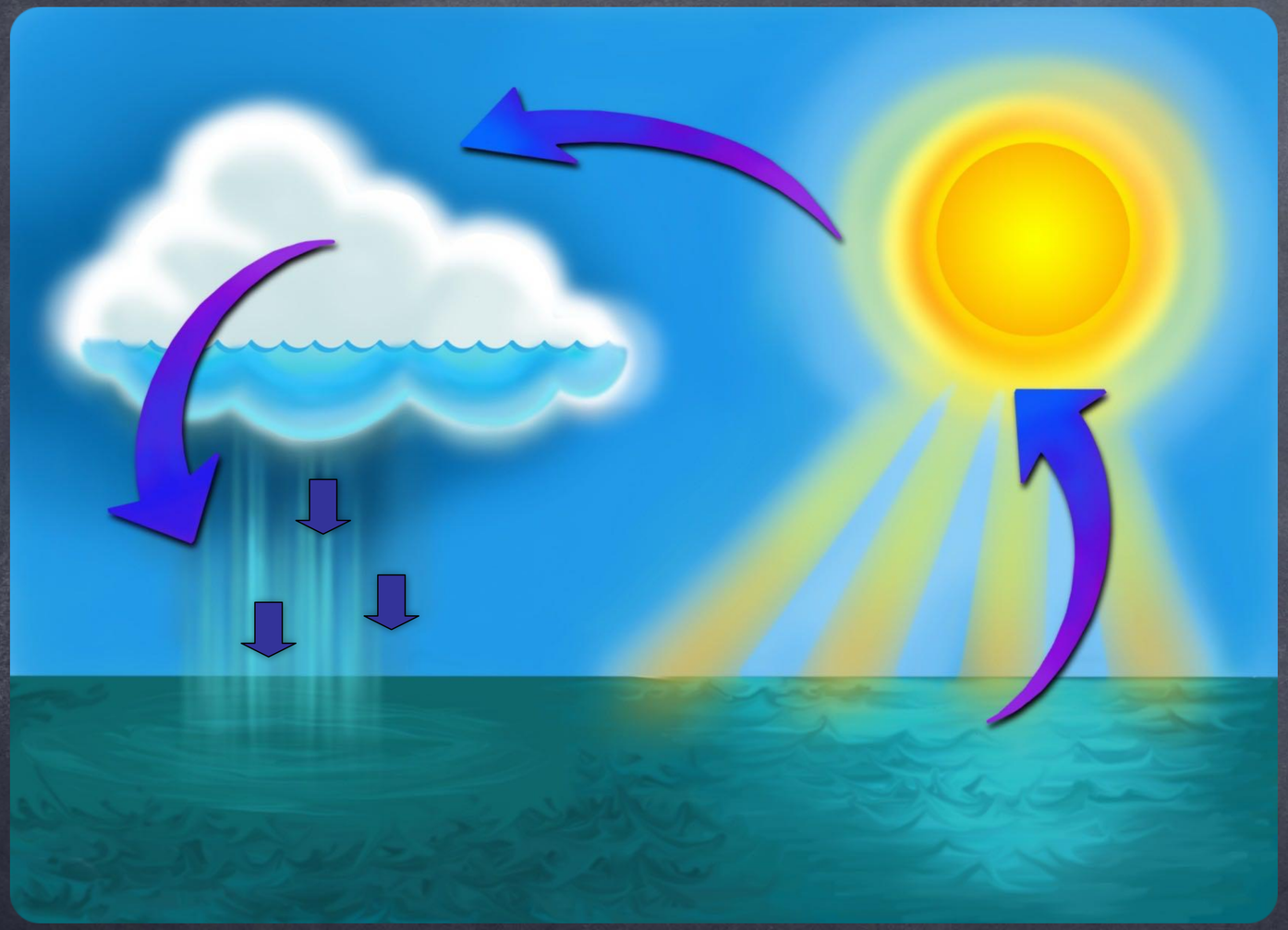
The evaporation of water from plants



The transformation of water vapor back into liquid water by cooling

Evaporated water is warmed and rises into the air where it eventually cools and condenses to form clouds.

With enough condensed water, you get rain!

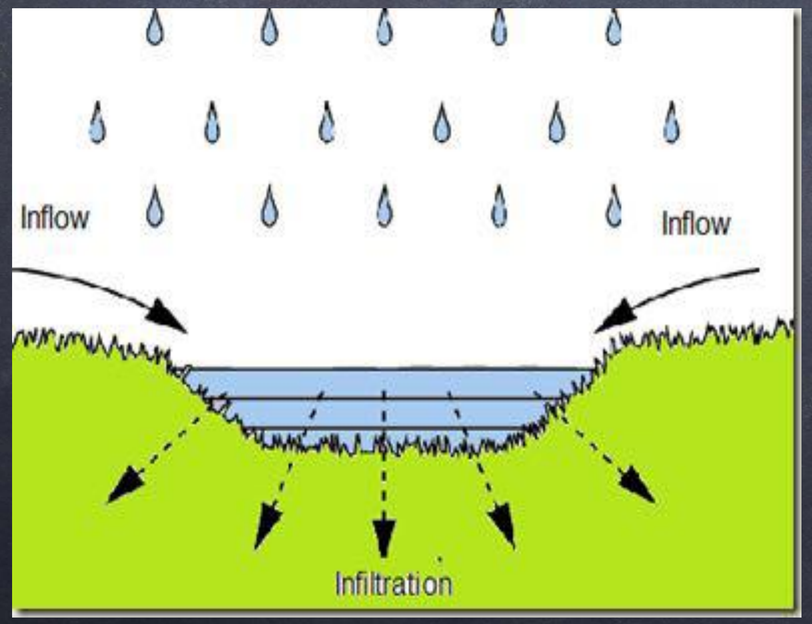


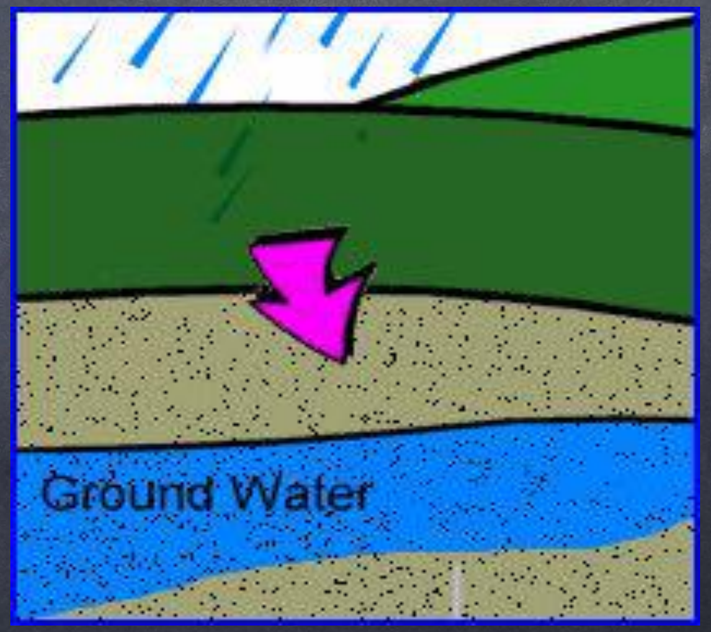
When clouds become very heavy with condensed water, the water is released in the form of rain, hail, or snow.

Infiltration

The flow of water from the ground surface into the ground. Once infiltrated, the water becomes soil moisture or groundwater.

A recent global study using water stable isotopes, however, shows that not all soil moisture is equally available for groundwater recharge or for plant transpiration.





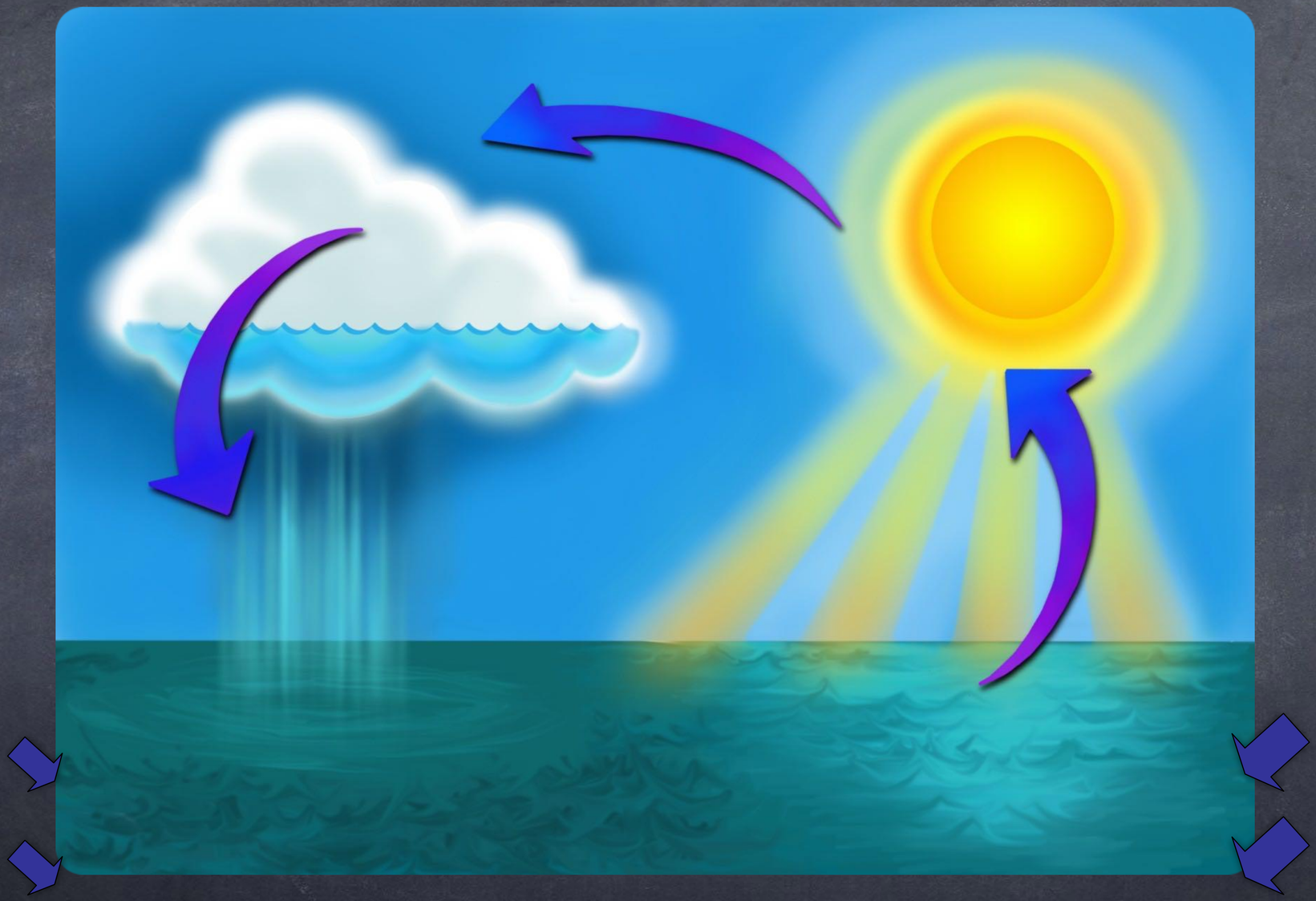
Infiltration

In hydrology, infiltration is the physical phenomenon in which the water present on the surface of the soil penetrates inside. This movement takes place under the thrust of both the gravitational force by capillarity.

The water that infiltrates into the ground, after having crossed the unsaturated zone, in turn goes in part to feed the underlying aquifers and in part is retained by the soil and thus remains at the disposal of plant and animal organisms possibly present in the soil.

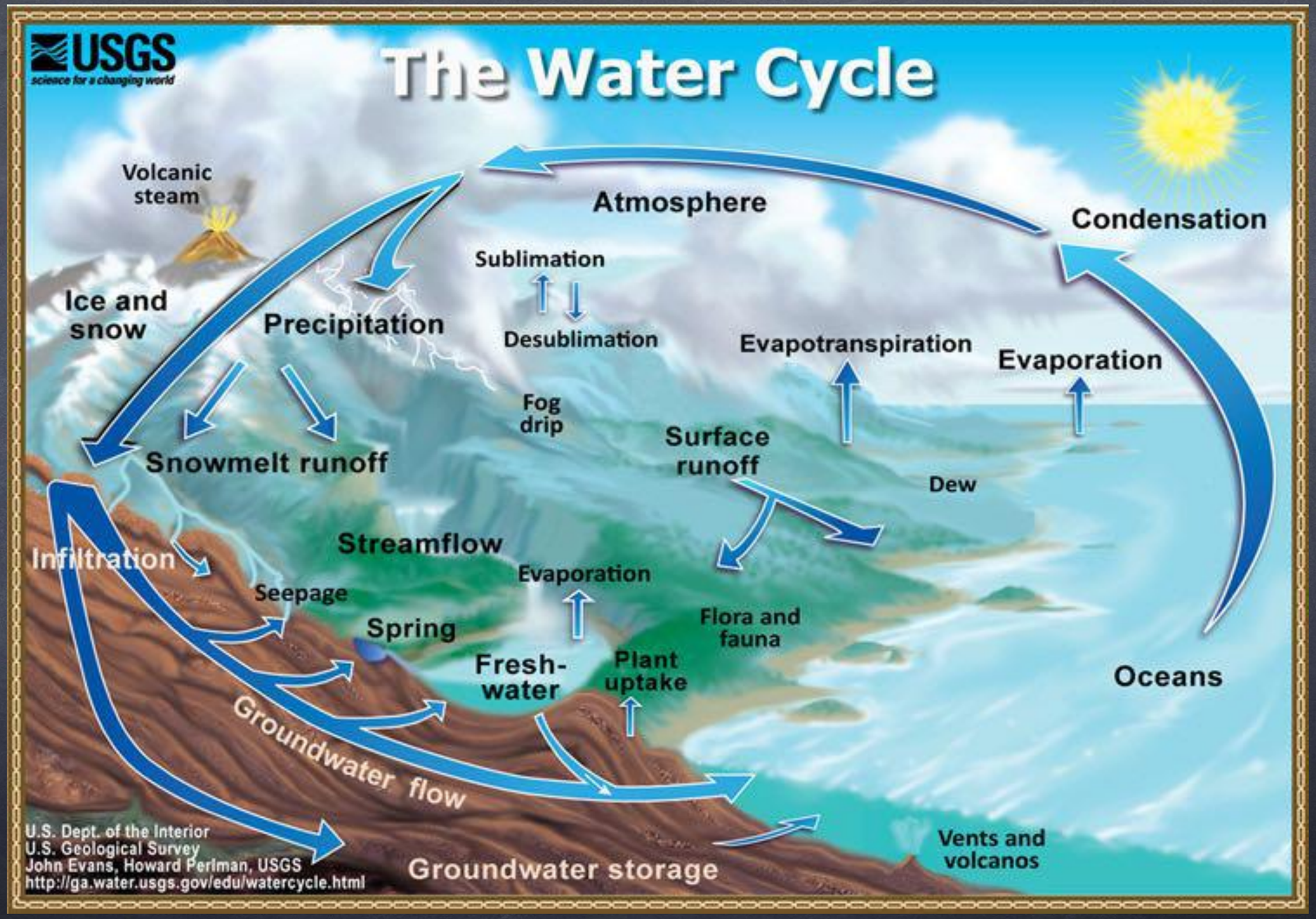
On a yearly scale infiltration can be expressed as the volume of water that in the course of a year through a certain portion of soil (m^3/year) or as infiltration height, that is, as the height in mm of water column (mm/year) that infiltrates into the soil net of losses to runoff and evapotranspiration. The amount of water that infiltrates into the ground, and therefore the permeability of the same, is measured with appropriate instruments such infiltrometers.

The collection of precipitation into rivers, lakes, and oceans.



This completes the water cycle!

- Evaporation
- Transpiration
- Condensation
- Precipitation
- Infiltration
- Accumulation

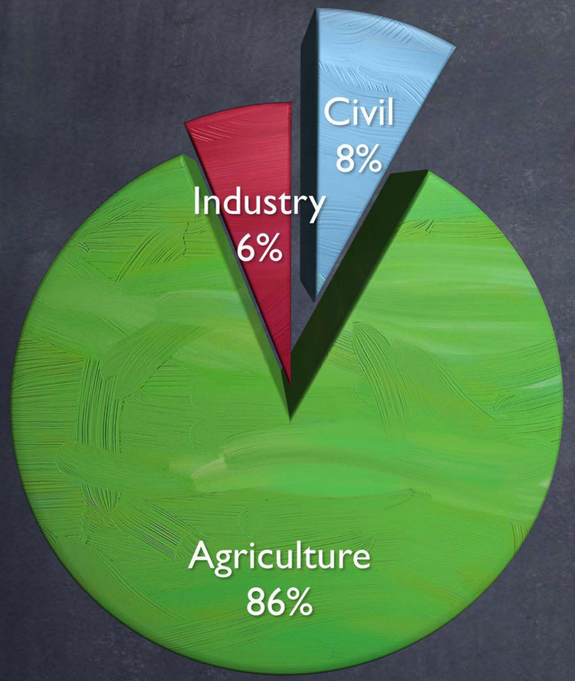


Water usage

Water is an essential resource for all aspects of life: **food**, **energy**, **transportation**, **nature**, **leisure** and for all products of daily use. Now that population growth and economic development cause a stronger demand for all goods, the importance of water becomes more and more clear to everyone. Environmental and development issues such as limited access to safe drinking water as well as the deterioration of water quality in Europe and in other parts of the world have come up as global problems. Around 30-40% of fresh water is lost due to illegal connections to the distribution network and losses on the net while the complete purification treatments cover little more than 55% of the population.

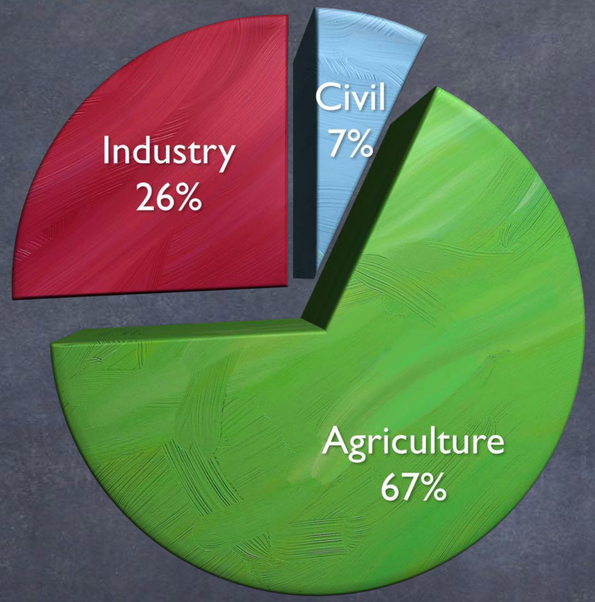
Where the water is used and how much of it...

India



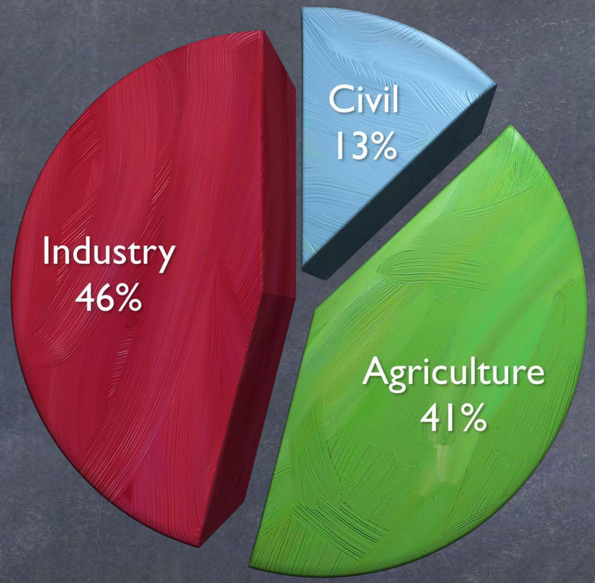
645,84 Km^3/year

China



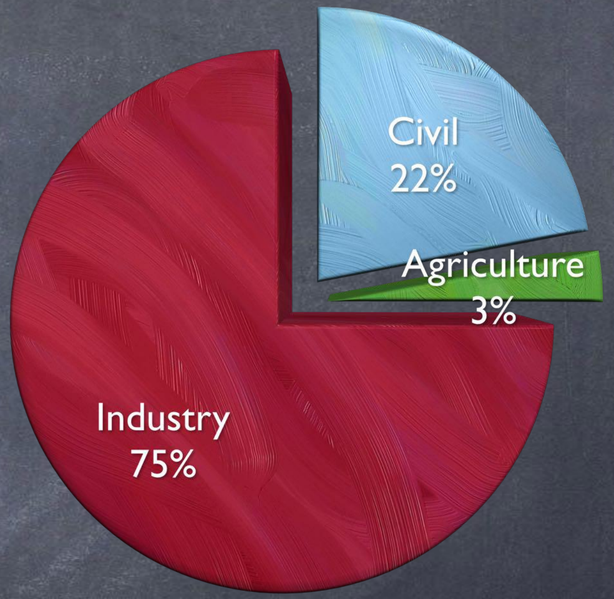
549, 76 Km^3/year

USA



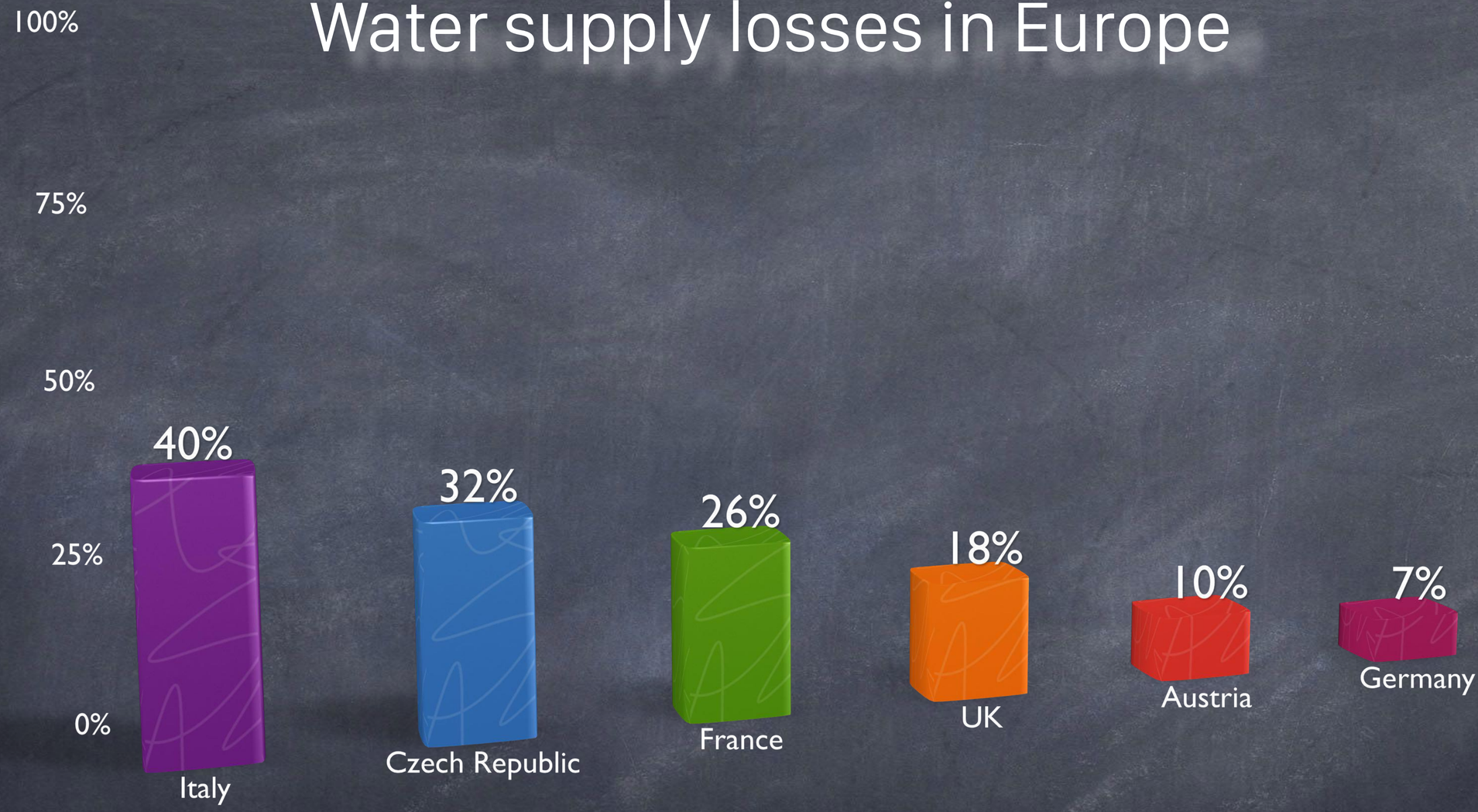
477 Km^3/year

UK



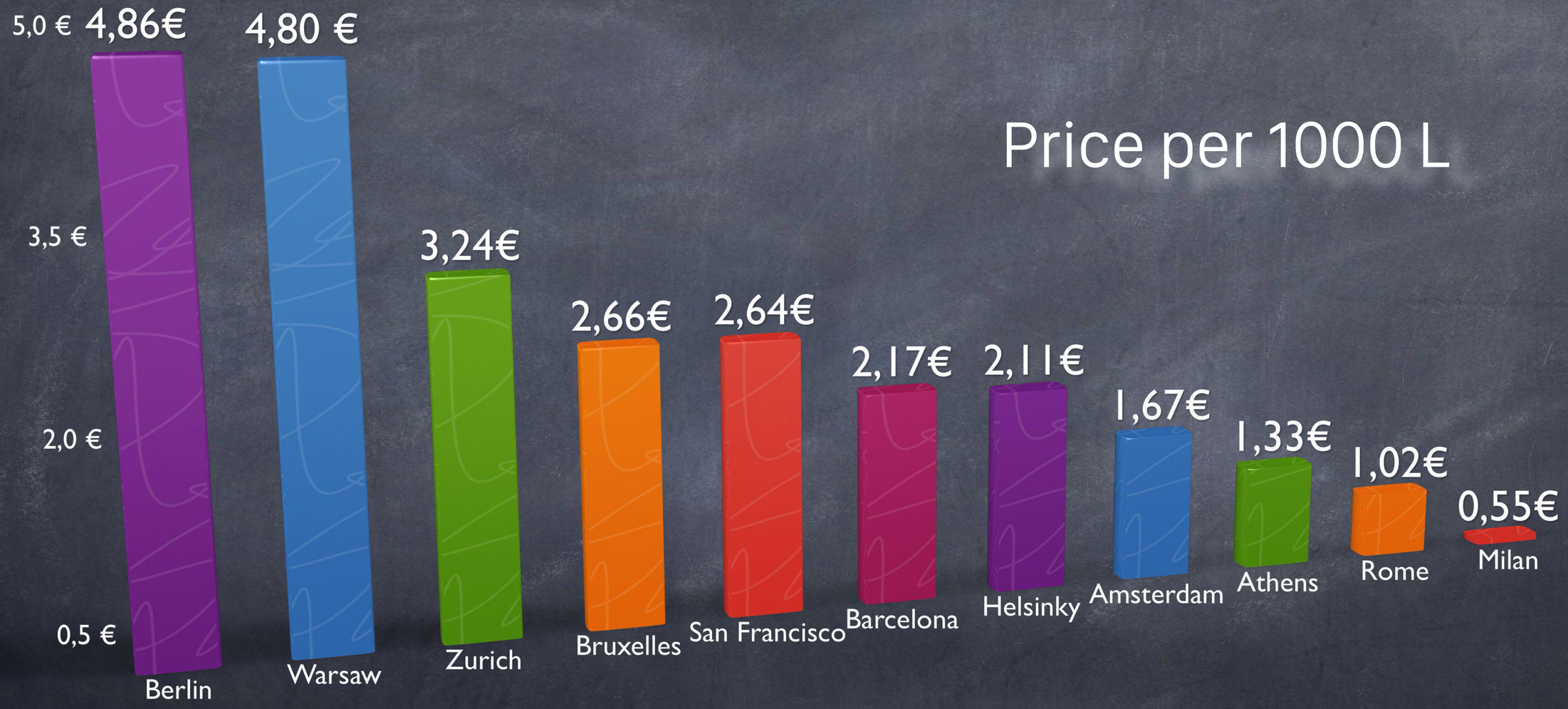
11,75 Km^3/year

Water supply losses in Europe



In Italy an investment on the aqueducts of 18.5 billion € would save 42.3 billion €, which would lead to a net saving of € 23.9 billion.

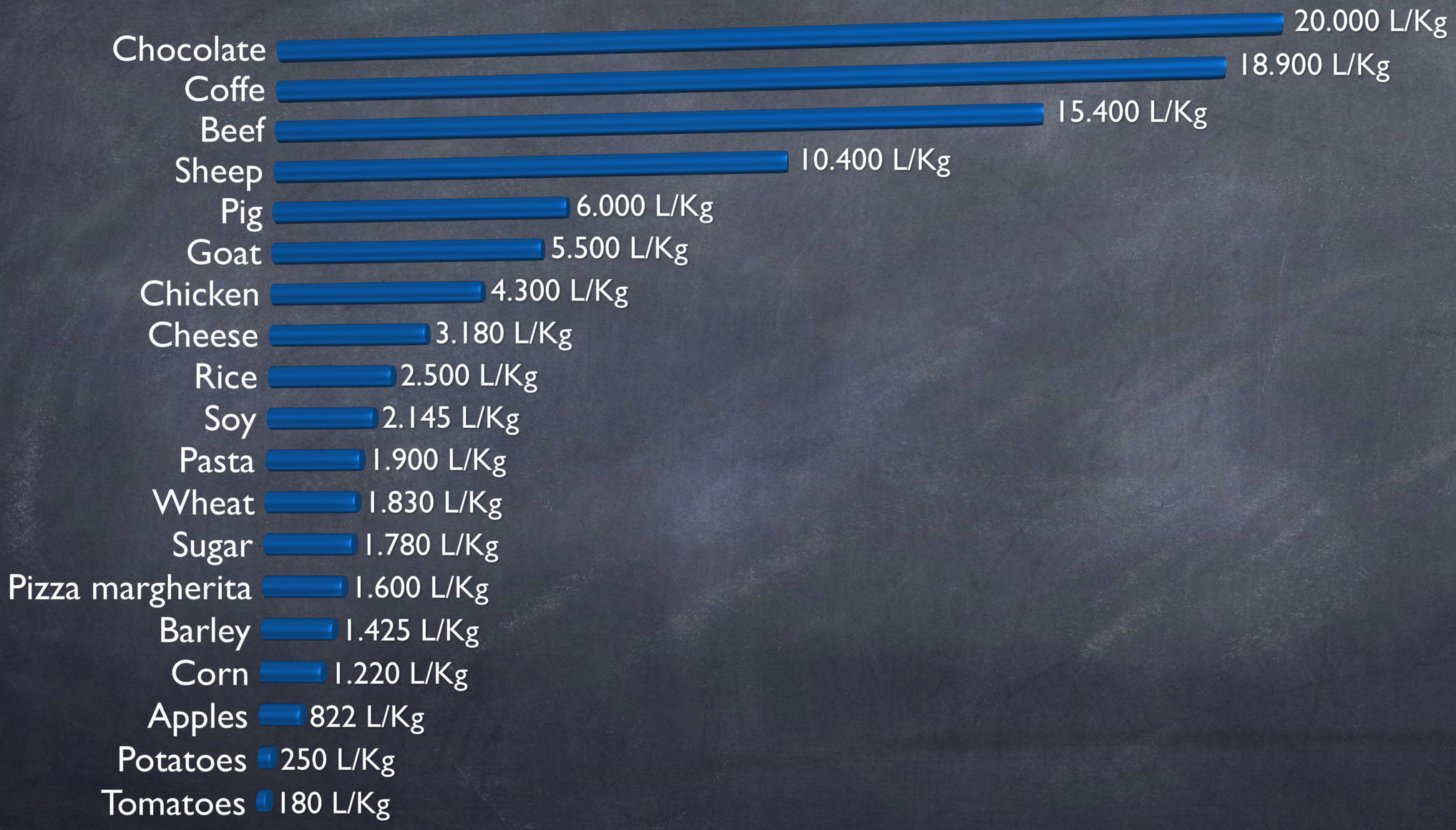
Average price of fresh water in the world



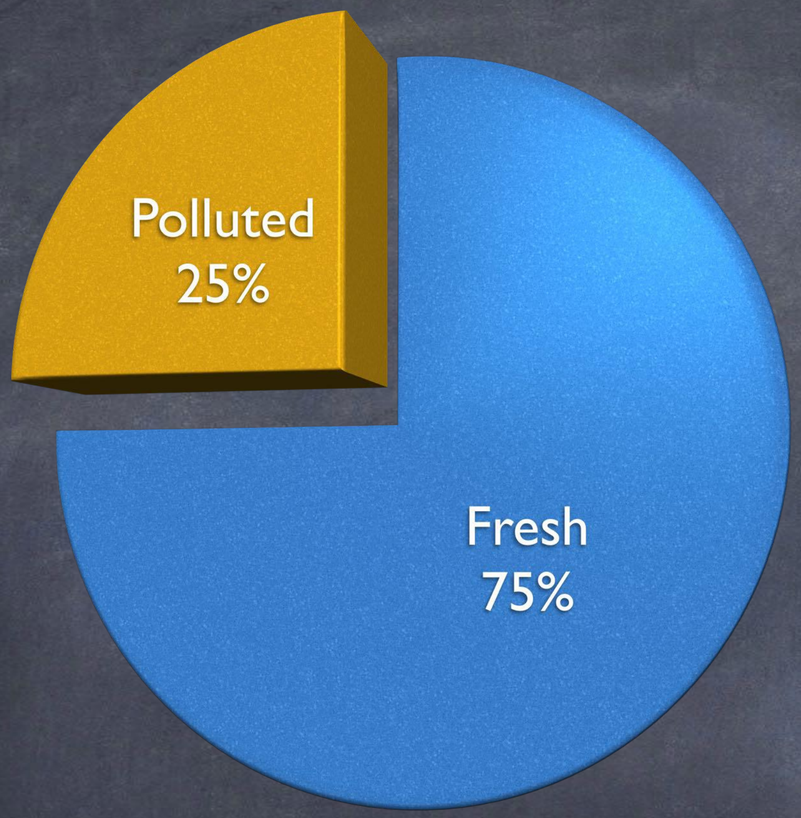
Price per 1000 L

The chart reflects the value of investments in the field of water supply "quality, quantity"

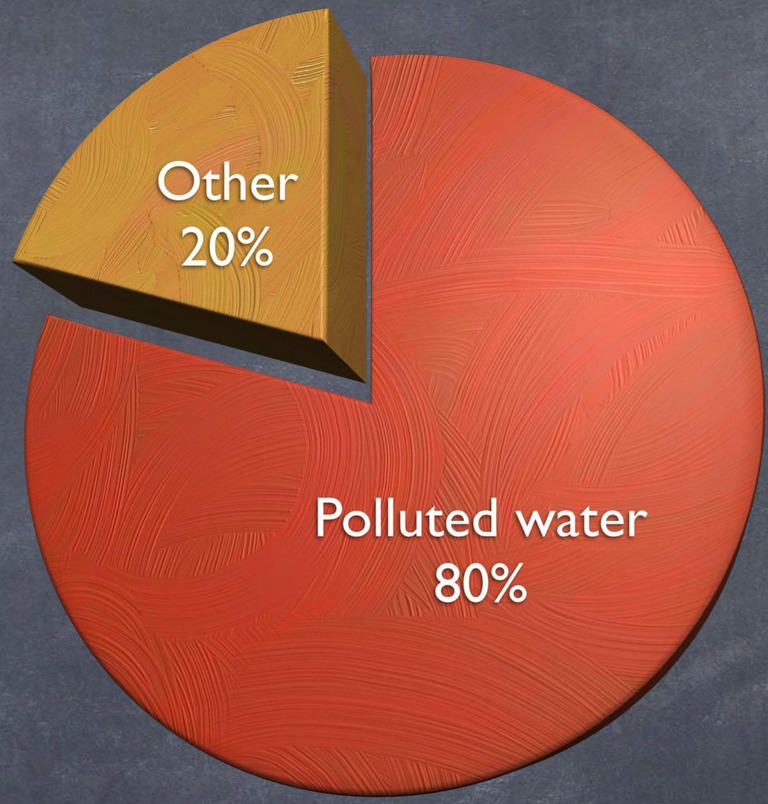
How much water is needed to produce food



Fresh water shortage in the world and consequences



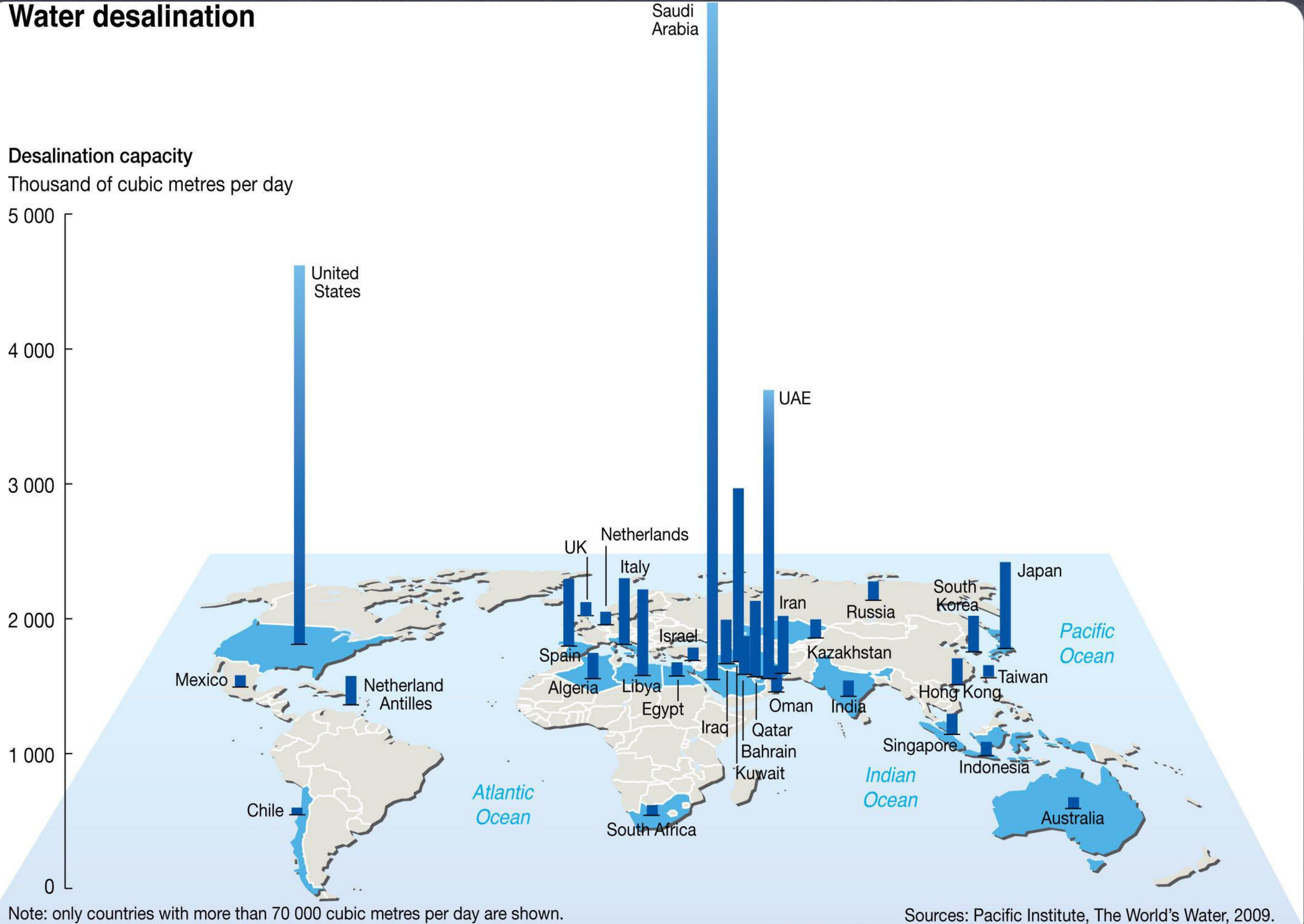
Access to fresh water around the globe



Causes of illness in the world

1 € spent on water saves 9 € between health and productivity expenses.

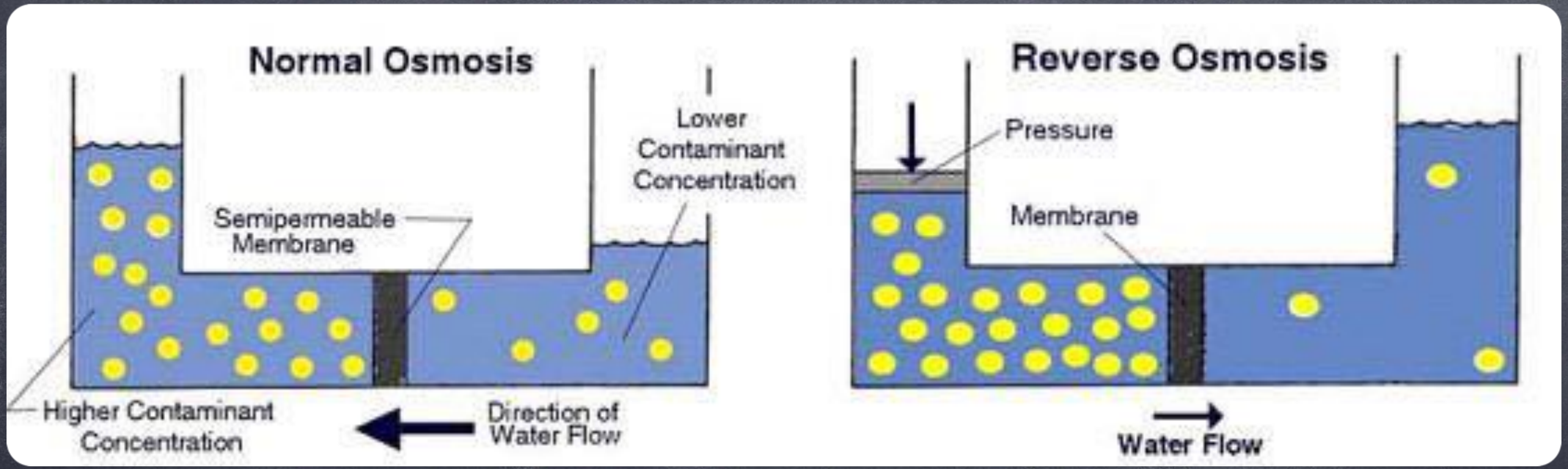
Water desalination



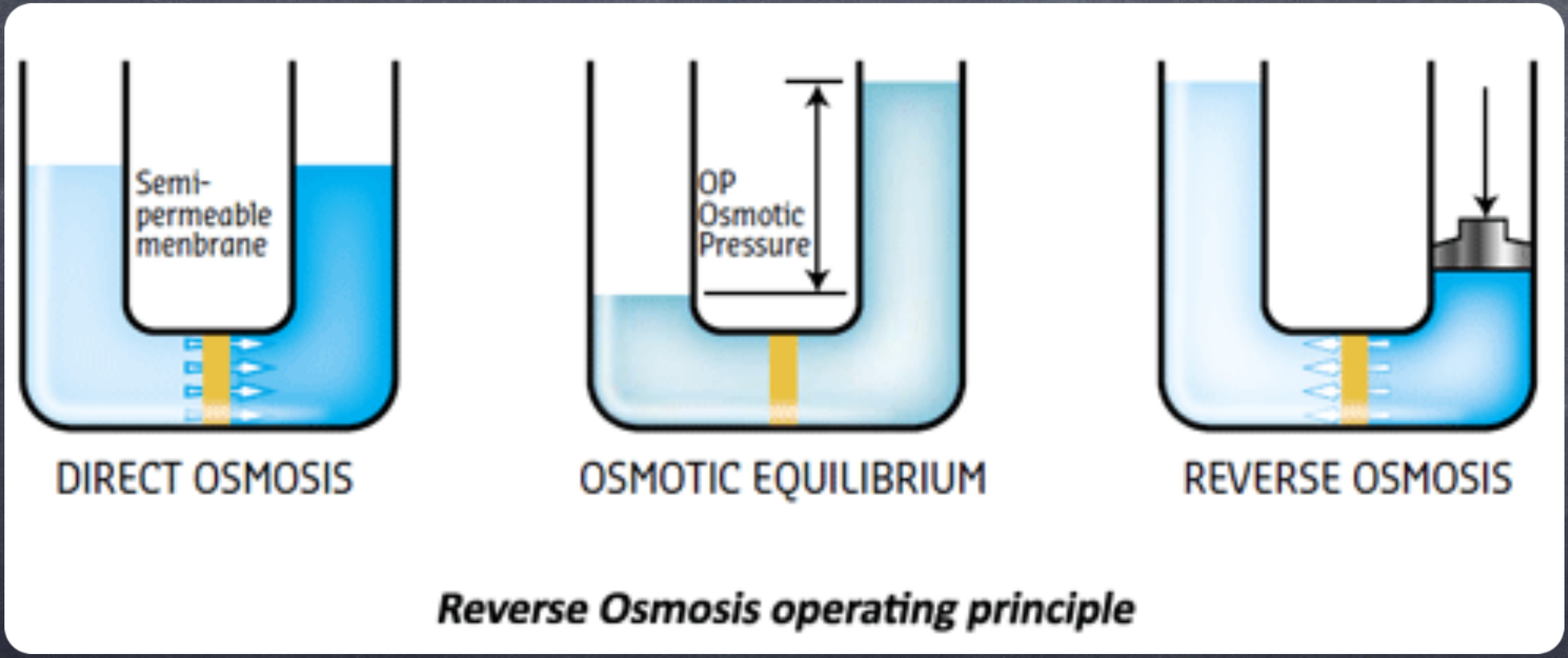
Note: only countries with more than 70 000 cubic metres per day are shown.

Sources: Pacific Institute, The World's Water, 2009.

Osmosis vs Reverse Osmosis



Osmosis vs Reverse Osmosis



Reverse Osmosis operating principle

https://www.youtube.com/watch?v=knePgp9UPAM