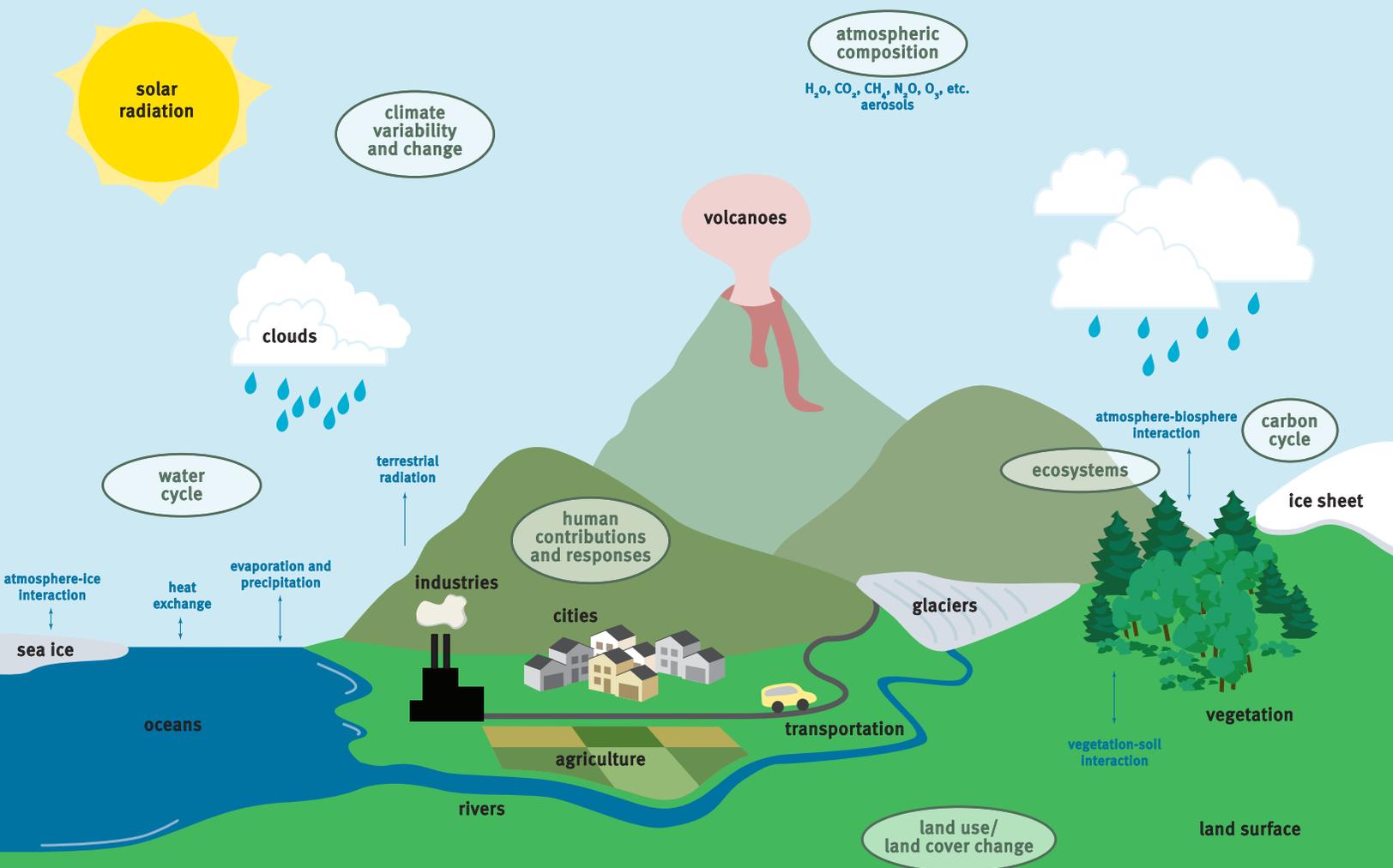


Color and Understand the Global Climate System



MRCC
Midwestern Regional Climate Center

Color and Understand the Global Climate System

Illustrations by Olivia Kellner

Overview

This activity book is meant to be a fun way to learn the basics of the global climate system, ideally for students in grades 3-5. Each part of the climate system is presented as a black and white illustration for coloring with a brief explanation of what each illustration is showing or explaining about components of Earth's climate system.

Objectives

- Students will be introduced to the six climate system features:
 - Energy balance and radiation
 - The biosphere
 - The atmosphere
 - The hydrosphere
 - The cryosphere
 - The lithosphere
- Students will learn how urban environments impact the climate system
- Students will be introduced to the carbon cycle
- Students will be introduced to the Greenhouse Effect

Materials

Crayons, colored pencils, or markers

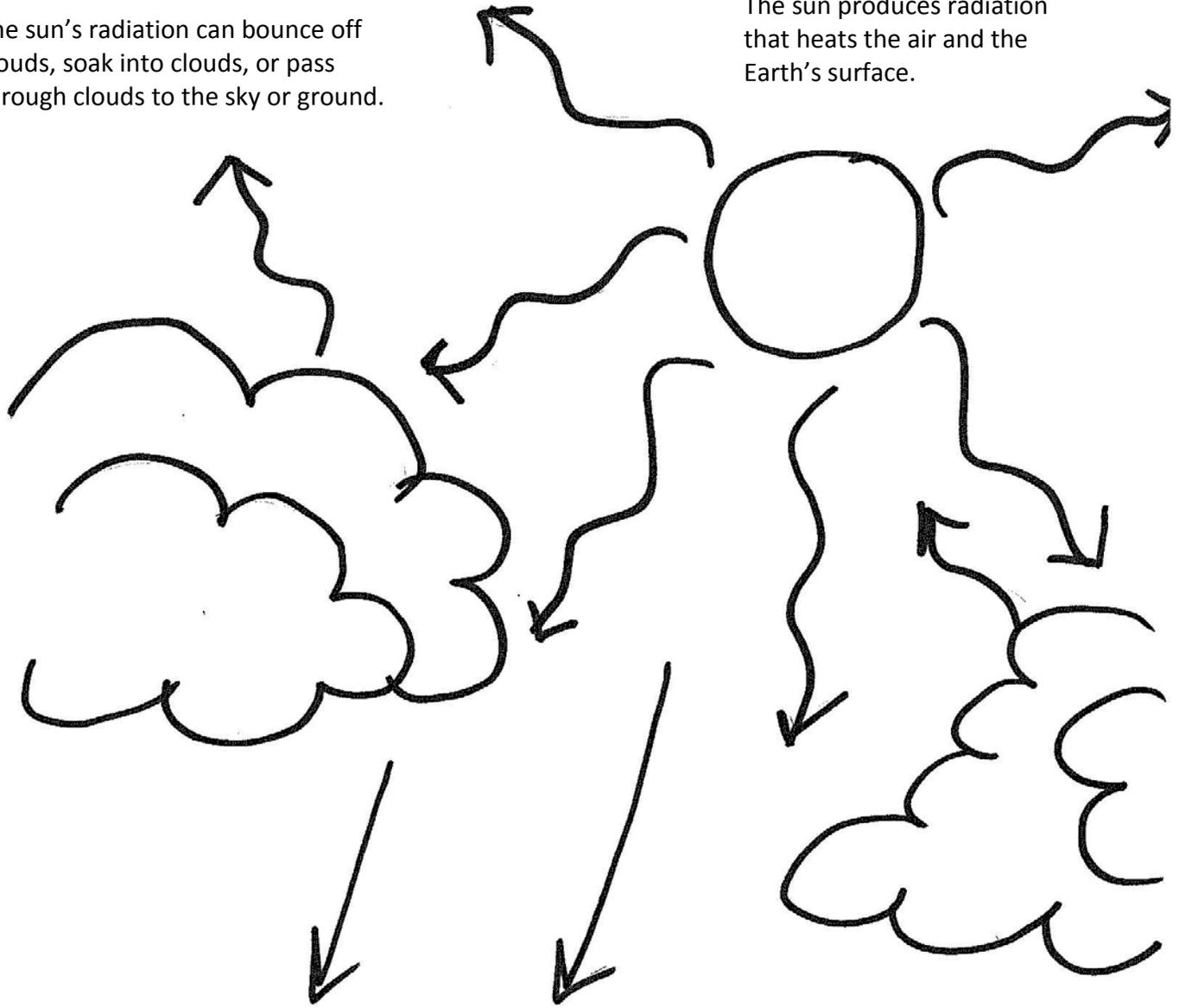
Climate System Glossary

- **Atmosphere:** the air that surrounds the earth.
- **Biosphere:** refers to all of earth's ecosystems.
- **Carbon:** an element that exists naturally on Earth. When in the form of a gas, it is called carbon dioxide, and it absorbs heat and warms the atmosphere. It is also absorbed plants, oceans, and soils.
- **CH₄:** the chemical formula for the greenhouse gas methane. Methane is a waste gas produced by microorganisms called methanogens.
- **CO₂:** the chemical formula for the greenhouse gas carbon dioxide. Volcanoes, hot springs, geysers, groundwater, rivers, lakes, icecaps, and glaciers are natural sources. Also, as part of the carbon cycle, plants use carbon dioxide during respiration. At night, plants respire and convert sugar into energy and CO₂ and during the day, plants convert CO₂ to oxygen.
- **Cryosphere:** the frozen water part of the Earth system. This would include glaciers, sea ice, lake ice, snow cover, and frozen ground. Frozen ground is included because it is the water in the soil that causes the ground to freeze.
- **Ecosystem:** a community of living plants, animals, insects, and organisms that live together with nonliving things like soil, air, and water that depend on each other to function.
- **Energy balance:** the balance between all heating and cooling sources of a system. Earth's energy balance is driven by radiation from the sun.

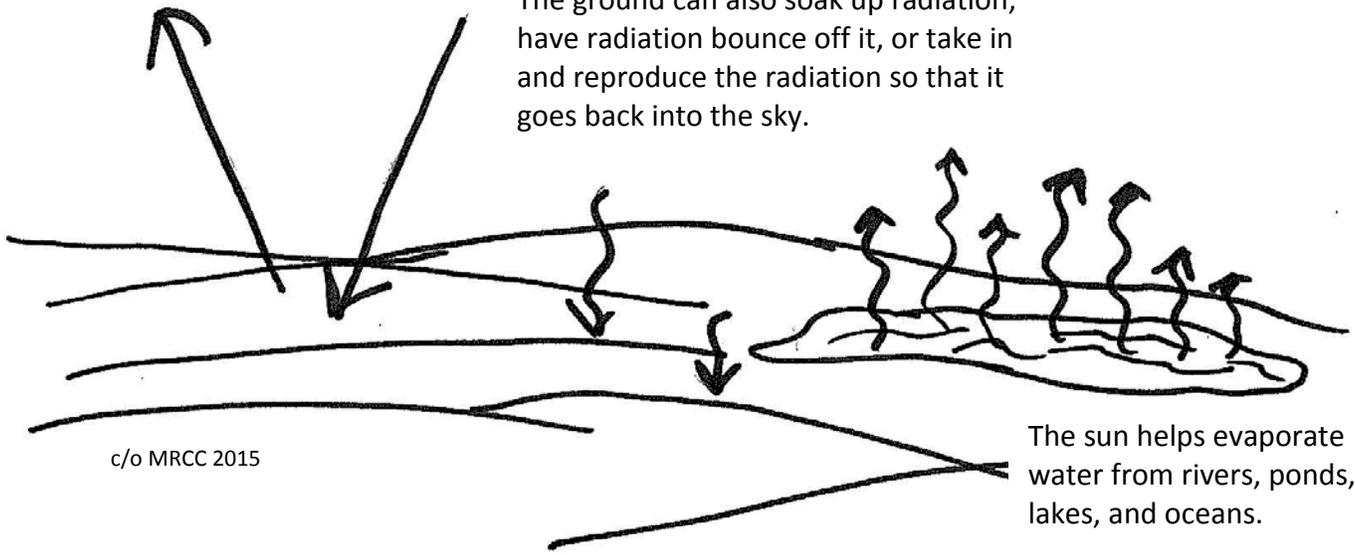
- **Evaporation:** the process of liquid turning into a gas, such as water turning into water vapor which is non-visible.
- **Fossil Fuels:** buried materials such as coal, oil, and natural gas that are formed from dead plants and animals. These materials are taken from the ground and burned for energy by humans to provide electricity and power cars and airplanes.
- **Hydrology:** the study of water in its liquid, gaseous (water vapor), and frozen forms (ice and snow), its location, quality, and movement over, into, and through the Earth.
- **Hydrosphere:** the parts of earth that have or involve water. This includes rivers, lakes, oceans, rain, snow, and ground water. 70% of earth is covered by water in its various forms.
- **Lithosphere:** the Earth's crust. This includes mountains, volcanoes and magma, rocks, and soil.
- **NO₂:** the chemical formula for nitrogen dioxide. Nitrogen dioxide is produced by car engines, and is produced by power stations that are driven by burning gas to heat water and release steam. The steam turns a machine round and round which produces electricity with N₂O as a byproduct.
- **Precipitation:** rain, hail, sleet, or snow that falls to the ground.
- **Radiation:** light and heat energy produced by the sun that reaches earth. It gives us light and warmer temperatures in the daytime. Absence of solar radiation results in darkness and cooler temperatures at night.
- **Recharge:** to refill, as in how rain refills our rivers and the ground with water.
- **Transpiration:** the release of water from a plant through tiny holes in its leaves when the plant is hot. The water quickly evaporates into water vapor which cools the plant. This is similar to the human body sweating when it gets too hot. Our body's sweat evaporates to cool our skin.
- **Vegetation:** all of the plants in an ecosystem or habitat.

The sun's radiation can bounce off clouds, soak into clouds, or pass through clouds to the sky or ground.

The sun produces radiation that heats the air and the Earth's surface.



The ground can also soak up radiation, have radiation bounce off it, or take in and reproduce the radiation so that it goes back into the sky.



The sun helps evaporate water from rivers, ponds, lakes, and oceans.

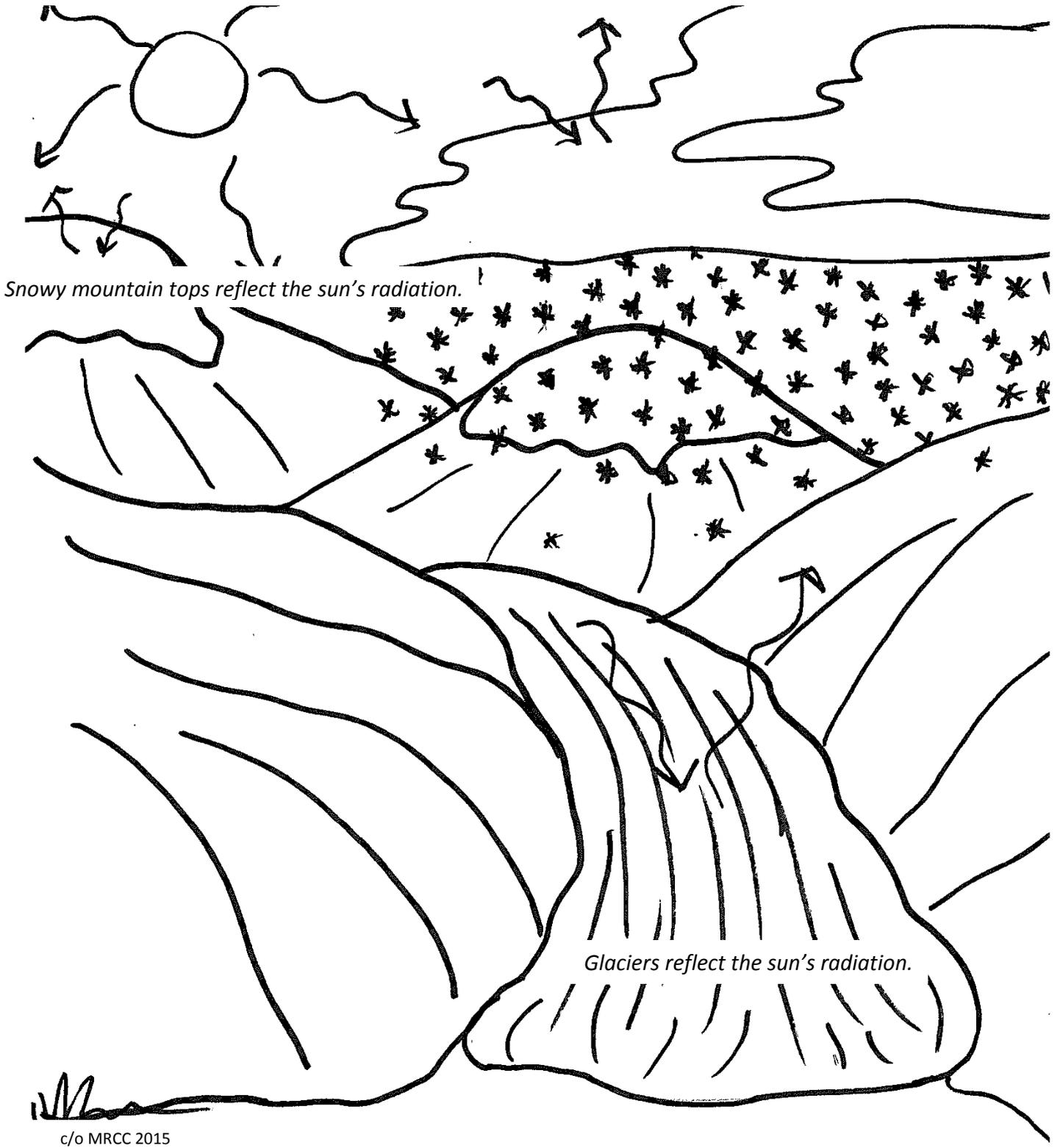
c/o MRCC 2015



Plants give water to the sky in the form of water vapor when the sun is too hot. The arrows represent this process, called transpiration. It is similar to how you sweat when you get too hot. Plants are part of the biosphere.



The layer of air over the Earth's surface is the atmosphere, and weather is the day-to-day changes in the atmosphere. Weather produces rain. Rain reaches the ground and runs off into rivers and streams, sinks into the ground and recharges groundwater, or returns to the atmosphere as evaporation. This is called the water cycle, and all of the water on and under the ground, and in the air is called the hydrosphere. The amount of rain in a region helps determine what plants and animals live there. Movement of water over land, into and through the soils, and into streams and rivers is called the science of hydrology.



Snowy mountain tops reflect the sun's radiation.

Glaciers reflect the sun's radiation.

c/o MRCC 2015

The frozen forms of precipitation and water on Earth such as snow and ice represent the cryosphere and reflect the Sun's radiation to help keep Earth at a comfortable temperature.



Earth's mountains, volcanoes, rocks, and soils are called Earth's lithosphere. Different colored rocks and soils absorb solar radiation differently making some rocks and soils hotter to the touch than others. Mountains and volcanoes develop when large pieces of Earth's crust smash together. Tall mountains influence weather patterns and volcanic ash can prevent sunlight from reaching the Earth's surface making Earth cooler.



c/o MRCC 2015

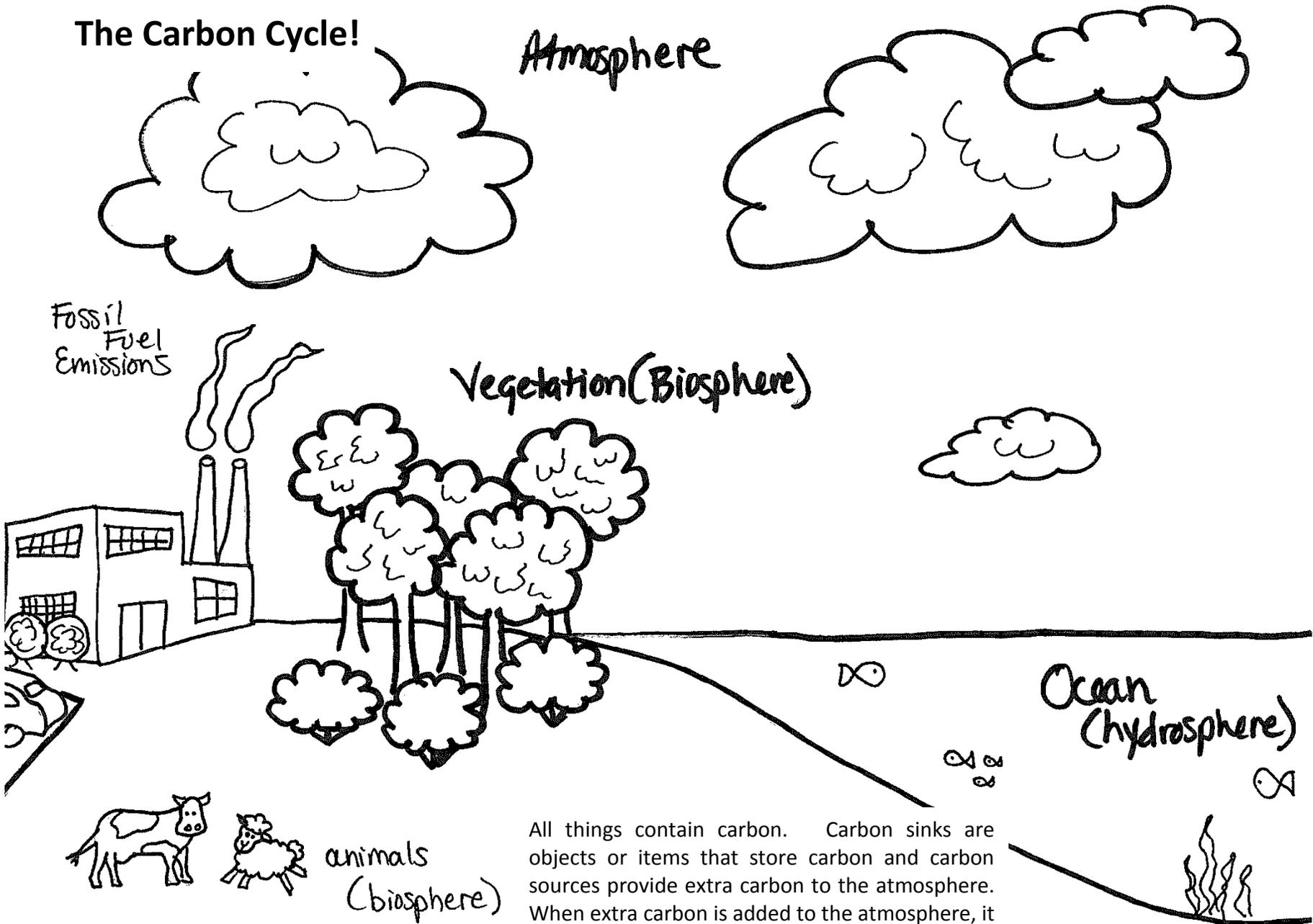


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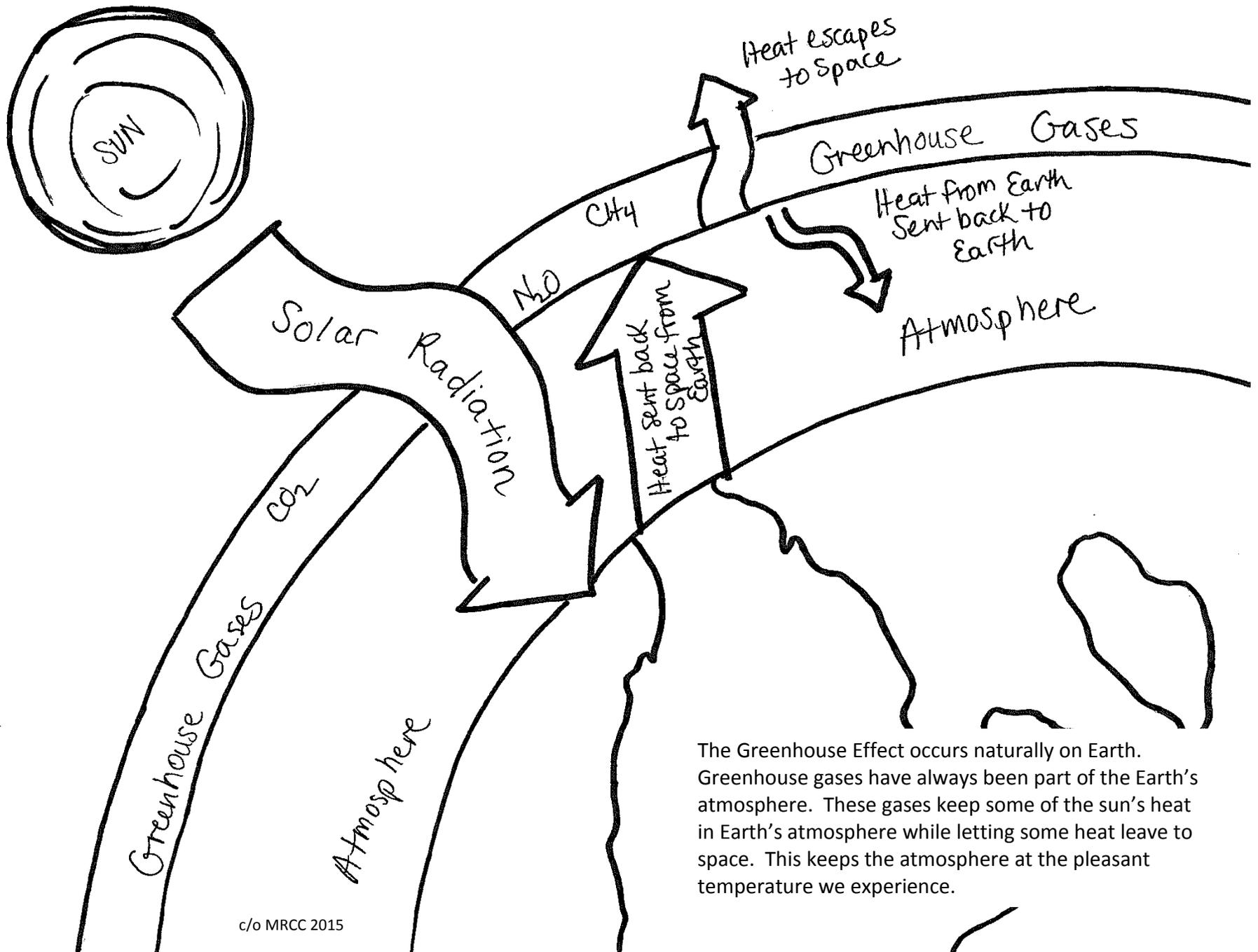
Towns and cities are examples of how humans, part of the biosphere, impact climate systems. Dark colored streets and brick buildings absorb solar radiation and increase temperatures. Hard surfaces such as concrete or asphalt do not allow rainwater to go into the ground, and instead create runoff. Tall buildings affect how air flows through the city.

The Carbon Cycle!

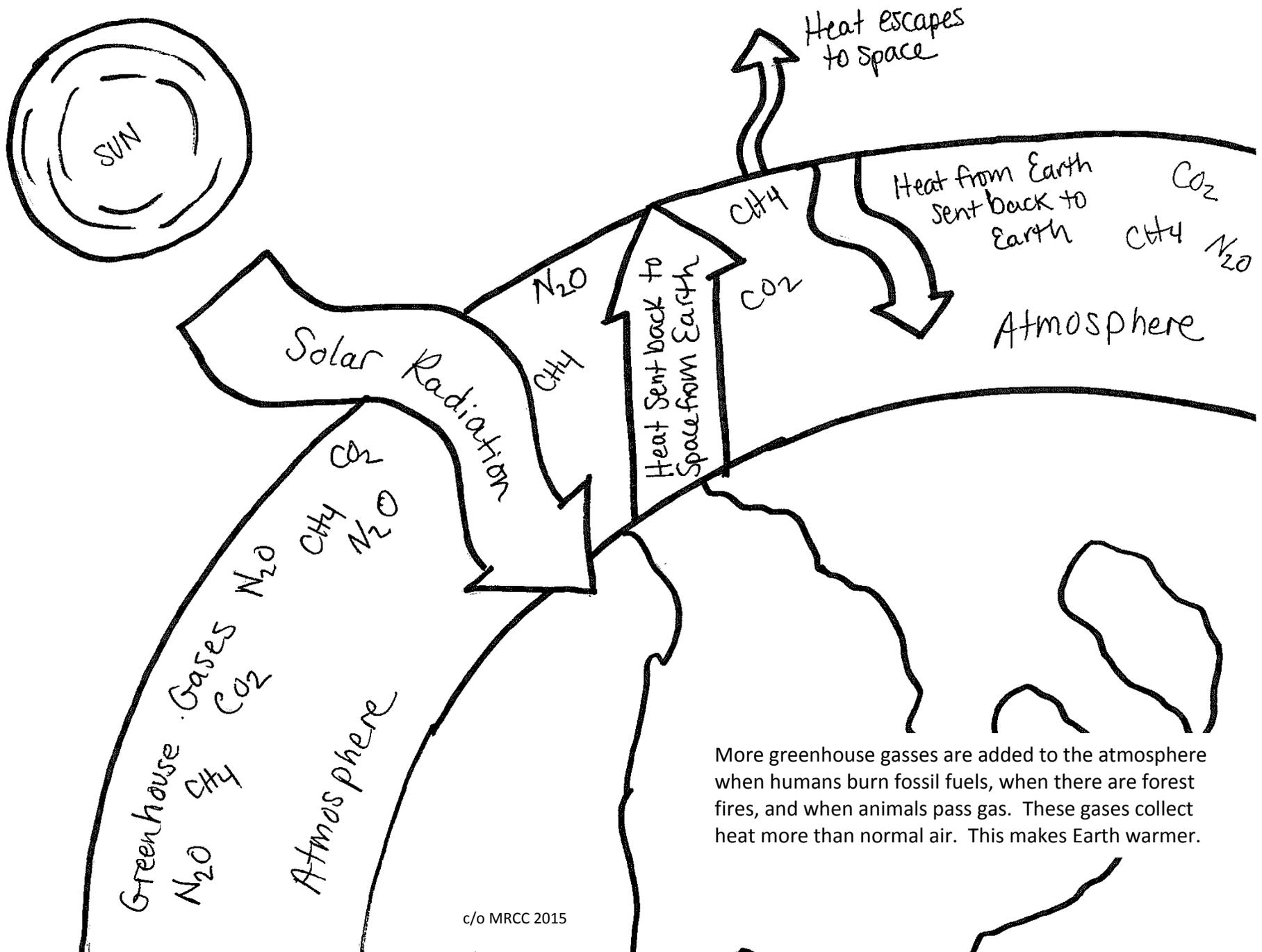
Atmosphere



All things contain carbon. Carbon sinks are objects or items that store carbon and carbon sources provide extra carbon to the atmosphere. When extra carbon is added to the atmosphere, it contributes to global warming. Label carbon sources with a big letter "C" and label carbon sinks with a big letter "S".



The Greenhouse Effect occurs naturally on Earth. Greenhouse gases have always been part of the Earth's atmosphere. These gases keep some of the sun's heat in Earth's atmosphere while letting some heat leave to space. This keeps the atmosphere at the pleasant temperature we experience.



Climate System Components

R A D I A T I O N O E L W A W G P N H E
 G H S V E C H Y D R O S P H E R E O U V
 M L U D I R E Q E K V S N A E C O I M A
 G C A T U L E H J E R E H P S O M T A P
 Z R I C C O P H G P E E N D A M R A N O
 J E O Y I S L E P S S N L U E T E R S R
 S L C U O E T C N S N O Z Z R R T I M A
 O J S H N A R I U T O L A K E S A P E T
 M O T O T D A S K S W Y T H H U W S C I
 E I O I I T W M J S E J R A P S K N A O
 L J O B N L J A U I B J U C S N Q A S N
 X N B U N P S N T I W N L N O P D R D M
 T U O F L U K N M E B L V K I F S T G U
 D M A M U F R B V Z R S A U B T T X E S
 X E C I U V C X R T U R F D B W N Q Q C
 H D V V J I F B D B F W P K H L K K E J
 I X G W W L L S B X H B U S A Q B Z E J
 Q M K U Y V N H I H O D G M M Z Z M X P
 R E C T F R G M W M X N T E Z Z U C K I
 W Q T Q E G N Y X L Y Y D C C D X F B U

ATMOSPHERE
 CLOUDS
 EVAPORATION
 HUMANS
 LAKES
 OCEANS
 SOIL
 VEGETATION

BIOSPHERE
 CRYOSPHERE
 GLACIERS
 HYDROSPHERE
 LITHOSPHERE
 RADIATION
 SUN
 WATER

CITIES
 CYCLE
 GROUNDWATER
 ICE
 MOUNTAINS
 SNOW
 TRANSPIRATION



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