Garden Lesson G6-6

Water Cycle

Communication

Students define the water cycle in their own words and discuss how it is affected by climate change. They collaborate to identify water conservation strategies in the garden and play games to reinforce their learning.

Academics

This lesson fulfills Next Generation Science Standards for water in Earth's surface processes; natural resources; human impacts on Earth systems; global climate change; patterns; cause and effect; stability and change; energy and matter; asking questions and defining problems; constructing explanations and designing solutions; obtaining, evaluating, and communicating information; developing a model to describe the cycling of water; Common Core State Standards for integrating information; collaborative discussion; interpreting information; speaking and listening; language; and acquiring words and phrases.

Sustainability

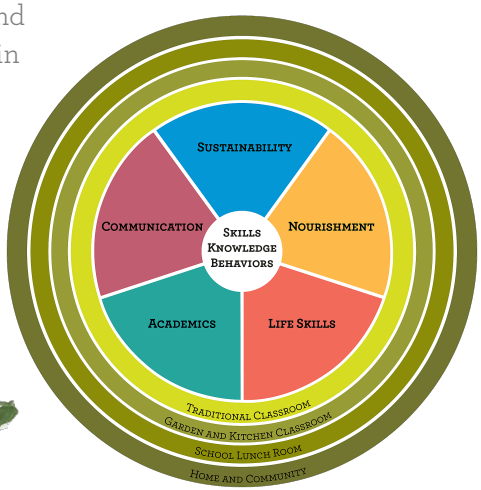
By exploring the interactions of these two planetary systems, we can better understand the extreme drought affecting Northern California.

Nourishment

Humans need water to survive and it is our job to understand it in order to protect it.

Life Skills

Students reflect on the importance of water as a precious resource, while they encourage each other and participate in class



Grade 6 Fall Rotation
Garden Lesson #6
G6-6 Fall

Water Cycle Abstract

Summary

In this 6th grade science lesson, students consider how two planetary systems – the **water cycle** and the **greenhouse effect** – interact in the context of California's current and severe **drought**. In response, they explore how the garden conserves water and fosters **drought resilience**.

Objectives

After this lesson, students will be able to:

- Describe the **water cycle**
- Discuss how **climate change** impacts the **water cycle**
- Name one strategy that the garden uses to conserve water and increase **drought resilience**
- Reflect on the importance of water as a precious resource

Assessments

- During this lesson, students will:
- Explain the **water cycle** by explaining the Water Cycle Cards in their own words
- Discuss how **climate change** impacts the **water cycle** by reading the Climate Change Cards out loud and following up with a discussion
- Explore areas of the garden that demonstrate strategies to conserve water and increase **drought resilience**
- Share their understanding of water saving techniques in a *Give One, Get One* activity

Communication is strengthened as students explain the **water cycle** in their own words, discuss how **climate change** affects it and share their findings with partners. *Sustainability* is highlighted while the interaction of two planetary systems is explored, in order to better understand **drought**. *Nourishment* is embraced by the realization that humans are the necessary stewards of water. *Life Skills* are sharpened as students reflect on the importance of water, encourage each other and participate in class routines.

Academics fulfill Next Generation Science Standards for water in Earth's surface processes; natural resources; human impacts on Earth systems; global climate change; patterns; cause and effect; stability and change; energy and matter; asking questions and defining problems; constructing explanations and designing solutions; obtaining, evaluating, and communicating information; developing a model to describe the cycling of water through Earth's systems; Common Core State Standards for integrating information; collaborative discussion; interpreting information; speaking and listening; language; and acquiring words and phrases. See **Connections to *Academic* Standards** below for details.

Edible Schoolyard curriculum emphasizes developing community and personal stewardship, along with skills that will help students navigate different situations throughout their lives; using **observation and awareness** and acknowledging **water as a precious resource**.

This lesson follows the BEETLES Project's ***Learning Cycle*** (Invitation-> Exploration -> Concept Invention -> Application -> Reflection) and uses their ***Discussion Routines*** (Think-Pair-Share, Whip-Around). All are highlighted in ***Green**** with an asterisk for easy identification. See the documents BEETLES_Discussion_Routines.pdf and BEETLES_Learning_Cycle.pdf included in **Resources** below for more information. Games and activities from other sources are also identified in ***Green***, without an asterisk.

Connections to *Academic* Standards
Next Generation Science Standards, Middle School
Disciplinary Core Ideas:

- ESS2.C: The Roles of Water in Earth's Surface Processes
    - Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. (MS-ESS2-4)
    - The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. (MS-ESS2-5)
    - Global movements of water and its changes in form are propelled by sunlight and gravity. (MS-ESS2-4)
- ESS3.A: Natural Resources
    - Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. (MS-ESS3-1)
- ESS3.C: Human Impacts on Earth Systems
    - Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and

causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. (MS-ESS3-3)
        - Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. (MS-ESS3-3),(MS-ESS3-4)
- ESS3.D: Global Climate Change
    - Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities. (MS-ESS3-5)

Crosscutting Concepts:

- Patterns
    - Graphs, charts, and images can be used to identify patterns in data. (MS-ESS3-2)
    - Patterns can be used to identify cause-and-effect relationships. (MS-ESS1-1)
- Cause and Effect
    - Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. (MS-ESS3-3)
    - Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-ESS3-1),(MS-ESS3-4)
- Stability and Change
    - Stability might be disturbed either by sudden events or gradual changes that accumulate over time. (MS-ESS3-5)
- Energy and Matter
    - Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. (MS-ESS2-4)

Connections to Engineering, Technology, and Applications of Science:

- Influence of Science, Engineering, and Technology on Society and the Natural World
    - All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ESS3-1),(MS-ESS3-4)
    - The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. (MS-ESS3-2),(MS-ESS3-3)

Connections to Nature of Science:

- Science Addresses Questions About the Natural and Material World
    - Science knowledge can describe consequences of actions but does not necessarily prescribe the decisions that society takes. (MS-ESS3-4)

Science and Engineering Practices:

- Asking Questions and Defining Problems
    - Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables, clarify arguments and models.
    - Ask questions to identify and clarify evidence of an argument. (MS-ESS3–5)
    - Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. (MS-ETS1-1)
- Constructing Explanations and Designing Solutions
    - Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.
    - Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-ESS3-1)
- Obtaining, Evaluating, and Communicating Information
    - Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods.
    - Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (MS-LS1-8)
    - Apply scientific principles to design an object, tool, process or system. (MS-ESS3-3)

Performance Expectations:

- MS-ESS2-4: Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. [Clarification Statement: Emphasis is on the ways water changes its state as it moves through the

multiple pathways of the hydrologic cycle. Examples of models can be conceptual or physical.] [Assessment Boundary: A quantitative understanding of the latent heats of vaporization and fusion is not assessed.]

Common Core State Standards, English Language Arts and Literacy, Grade 6

- RI.6.7 Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.
- RST.6.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
- SL.6.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher- led) with diverse partners on *grade 6 topics, texts, and issues,* building on others' ideas and expressing their own clearly.
    - SL.6.1.b Follow rules for collegial discussions, set specific goals and deadlines, and define individual roles as needed.
    - SL.6.1.c Pose and respond to specific questions with elaboration and detail by making comments that contribute to the topic, text, or issue under discussion.
    - SL.6.1.d Review the key ideas expressed and demonstrate understanding of multiple perspectives through reflection and paraphrasing.
- SL.6.2 Interpret information presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how it contributes to a topic, text, or issue under study.
- SL.6.4 Present claims and findings, sequencing ideas logically and using pertinent descriptions, facts, and details to accentuate main ideas or themes; use appropriate eye contact, adequate volume, and clear pronunciation.
- SL.6.6 Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when indicated or appropriate. (See grade 6 Language standards 1 and 3 on page 53 for specific expectations.)
- L.6.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
    - L.6.1.a Ensure that pronouns are in the proper case (subjective, objective, possessive).
    - L.6.1.b Use all pronouns, including intensive pronouns (e.g., *myself, ourselves*) correctly.
    - L.6.1.c Recognize and correct inappropriate shifts in pronoun number and person.
    - L.6.1.d Recognize and correct vague pronouns (i.e., ones with unclear or ambiguous antecedents).
- L.6.3 Use knowledge of language and its conventions when writing, speaking, reading, or listening.
    - L.6.3.a Vary sentence patterns for meaning, reader/ listener interest, and style.
    - L.6.3.b Maintain consistency in style and tone.
- L.6.6 Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases; gather vocabulary knowledge when considering a word or phrase important to comprehension or expression.

Connections to *Edible Schoolyard* Standards

Edible Schoolyard 3.0

In the Edible Schoolyard Program

- 1.0 Students work with each other and teachers to develop community and personal stewardship, along with skills that will help them navigate different situations throughout their lives.
- 1.1.1 – 1.3.12 This lesson fulfills all Edible Schoolyard Program standards, numbers 1.1.1 through 1.3.12. See ***The Edible Schoolyard Berkeley Standards*** for details.

In the Garden Classroom

- Concepts 3.3.7 Use **observation and awareness** to explore, investigate and be inquisitive learners in the garden. The garden classroom provides the opportunity for students to tap into their inherent curiosity about the natural world, observe patterns and connections and understand cause and effect.
- Concepts 3.3.10 Acknowledge **water as a precious resource** that is intrinsic to all living organisms, explore methods of water conservation, and are encouraged to do the same in their own lives as well.

Grade 6 Fall Rotation
Garden Lesson #6
G6-6 Fall

Water Cycle Lesson

Materials

- Job board
- G6-6 Water Cycle Cards
- G6-6 Climate Change Cards
- G6-6 *Give One Get One* sentence structures

Before You Begin

- Create the Job Board
- Copy G6-6 Water Cycle Cards for each for each adult leading a group
- Copy G6-6 Climate Change Cards for each for each adult leading a group
- Copy G6-6 *Give One Get One* sentence structures for each adult leading a group
- Identify water saving techniques that students can investigate. Some examples are:
    - Rainwater catchment system (know the details, for example at the Edible Schoolyard Berkeley: 3000 gallon capacity; 200 gallon/inch of rainfall; Berkeley average rainfall is 27 inches)
    - Mulched garden beds
    - Greywater basin
    - No/low-till garden beds
    - Drip irrigation
    - Cover crops

Timeline Overview

Total Duration: 90 minutes

1. *Invitation** (10 minutes)
2. *Exploration** (10 minutes)
3. *Concept Invention** (20 minutes)
4. *Application** (40 minutes)
5. *Reflection** (10 minutes)

Procedures

At the Opening Circle

1. *Invitation*:* (10 minutes)
   Welcome students and explain that today we'll be discussing how two planetary systems interact, the **water cycle** and the **greenhouse effect**.
   - **a.** Remind students that water is incredibly precious.
     - **i.** Scientifically, it is a nonrenewable resource (a **closed system** on planet Earth) that is critically important to sustain life.
     - **ii.** Many cultures believe that water is sacred and involve it in important spiritual practices.
     - **iii.** We need water to survive and it is our job to understand it in order to protect it.
   - **b.** Ask students to define, in their own words, the **greenhouse effect** and explain that today in our small groups we are going to explore how this is connected to or impacts the **water cycle**.
   - **c.** Explain to students that each Garden Work Rotation group will explore one strategy that we use in the garden to conserve water and that in Closing Circle students will have the opportunity to share this strategy using the *Give One, Get One* activity (refer to posted sentence frame).
   - **d.** Go over today's garden jobs, divide students into 4 working groups, one group for each job, and begin.

In the Field (70 minutes total)

2. *Exploration**: (10 minutes)
   Investigate a water saving technique in the garden.
   - **a.** Gather your small group around a water saving technique being used in the garden.
   - **b.** Explain how this device saves water.
   - **c.** Ask students to look around and identify other things that might save water in the garden.

3. *Concept Invention*:* (20 minutes)
   Discuss the **water cycle**.
   - **a.** Pass out the Water Cycle Cards to students.
     - **i.** Go around the circle and have each student describe what they think is being depicted on their illustrated card.
     - **ii.** Ask students to reflect on (even repeat) the definition of the **greenhouse effect** from Opening Circle.
     - **iii.** Now pass out the Climate Change Cards explaining how the **greenhouse effect** is impacting our **water cycle**.
       1) The cards are numbered and each should correspond to a counterpart in the **water cycle** that it

modifies.

iv. One at a time, have students read their Climate Change Card out loud to the group.

v. Prompt a discussion about the **greenhouse effect**, focusing on its impact on the **water cycle** and how this **climate change** is affecting Californians.

b. Explain that because of the **drought**, it is important to increase something called **drought resilience**.

c. Ask for a few ideas about what this means.

d. Share that **drought resilience** is the ability of food production systems, and the people dependent on food production systems, to adapt effectively to changes in the environment.

e. Revisit the water saving technique at use in the garden covered earlier and have each student use the ***Give One, Get One*** sentence structures to talk about it related to **drought resilience**.

i. One technique that we use to conserve water in the garden is _____.

ii. This increases **drought resilience** because _____.

f. Explain to students that each working group will have the opportunity to share this strategy in Closing Circle during the ***Give One, Get One*** activity, with the same sentence frame.

Garden Work Rotation

4. ***Application****: (40 minutes)

Have each group work on their garden job and discuss drought and water saving techniques that are being used or could be used in the garden.

At the Closing Circle

5. **Reflection***: (10 minutes)

Remind students that during class today they explored strategies being used here in the garden to conserve water and increase **drought resilience**.

a. Explain that students will participate in the ***Give One, Get One*** activity to learn more about these strategies and to share what they learned with their peers. Have students use the same sentence frame as in the field.

To play ***Give One, Get One****:*

i. Students get up and mingle throughout the circle. When a cue is given they stop and find a partner.

ii. Give 30 seconds for each person to share their question and observation with their partner, using the sentence structures on the white board or card.

iii. Allow students to share their sentences out loud to the group until the activity is over.

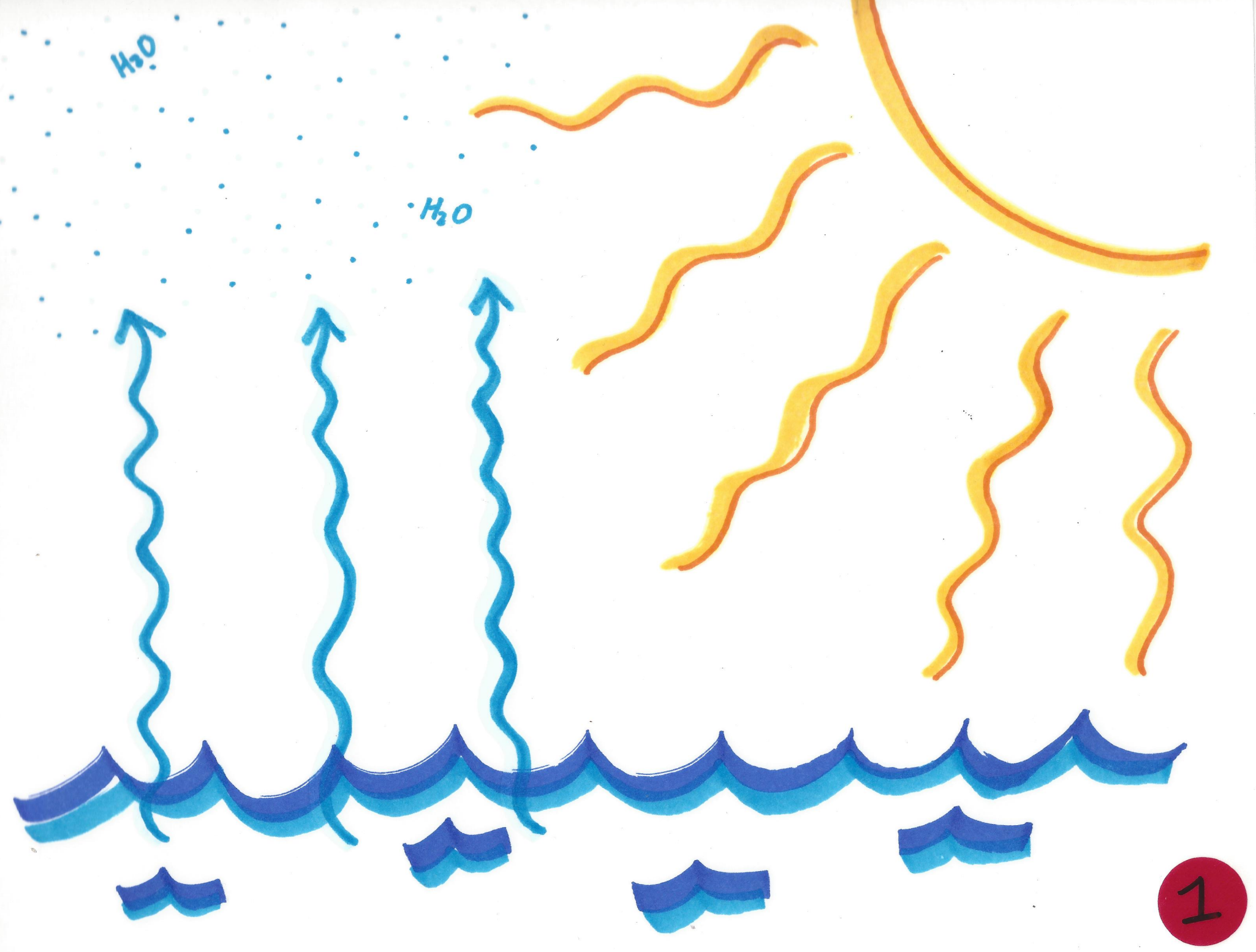
b. Share a seasonal tasting.

c. Encourage students to look for additional ways that we can help conserve water in the garden, at home and everywhere else.

Vocabulary
Water cycle
Greenhouse effect
Climate change
Closed system
Drought
Resilience

Contributors
All lessons at the Edible Schoolyard Berkeley are developed in collaboration with the teachers and staff of the Edible Schoolyard and Martin Luther King Jr. Middle School.

Resources
G6-6_Water_Cycle_Cards.pdf
G6-6_Climate_Change_Cards.pdf
G6-6_Give_One_Get_One.pdf
BEETLES_Learning_Cycle.pdf (See lesson G6-0)
BEETLES_Discussion_Routines.pdf (See lesson G6-1)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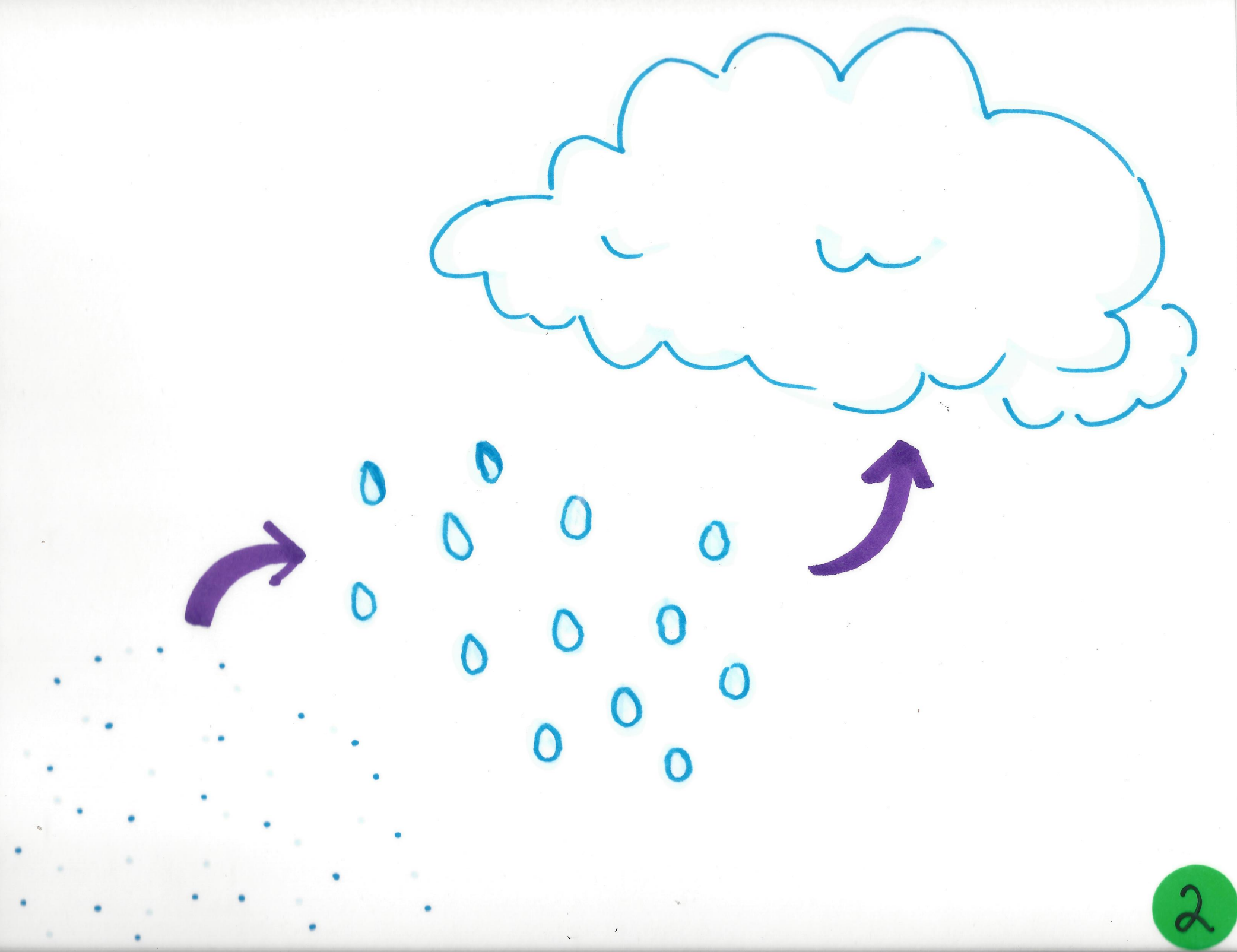

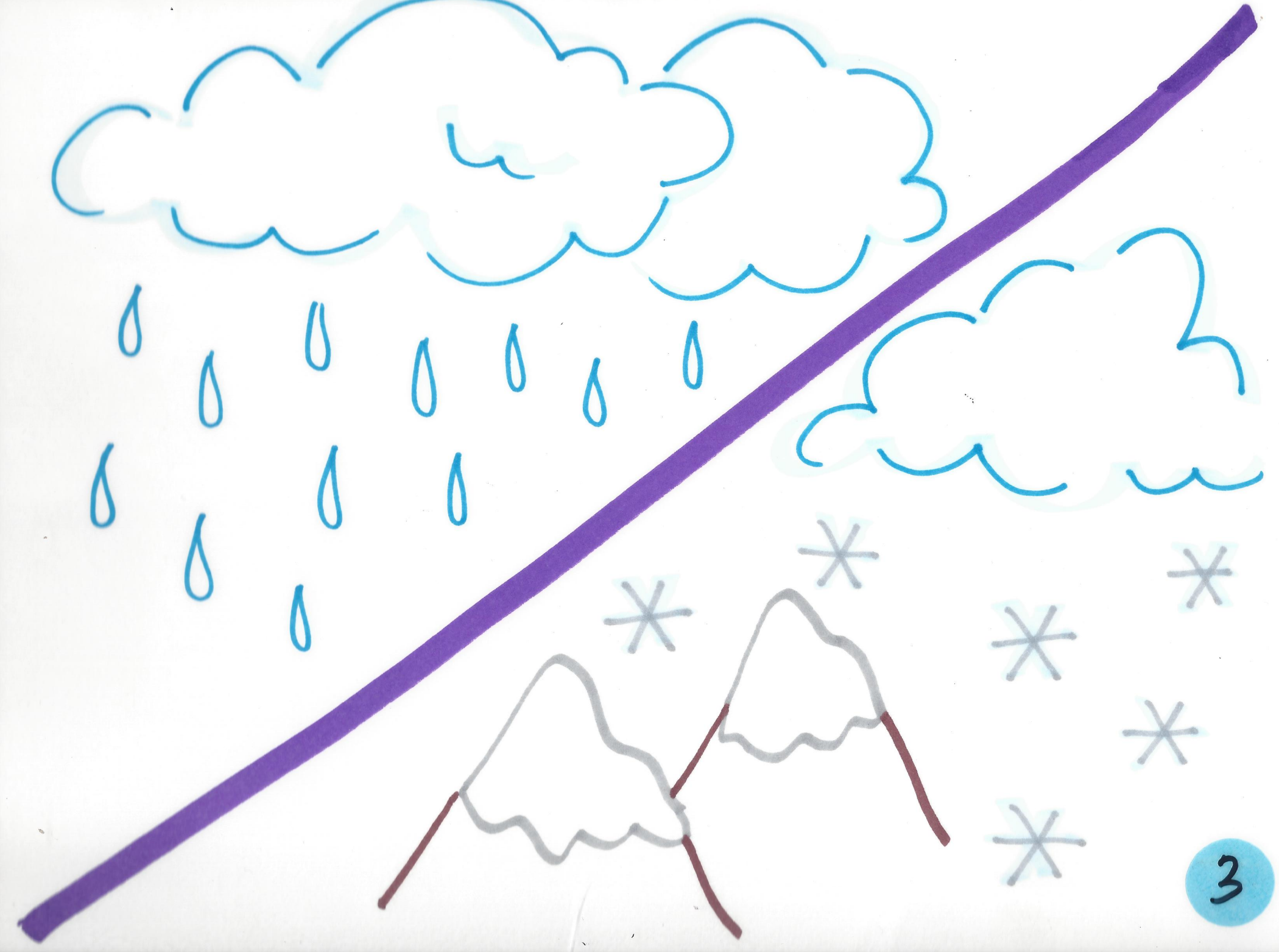

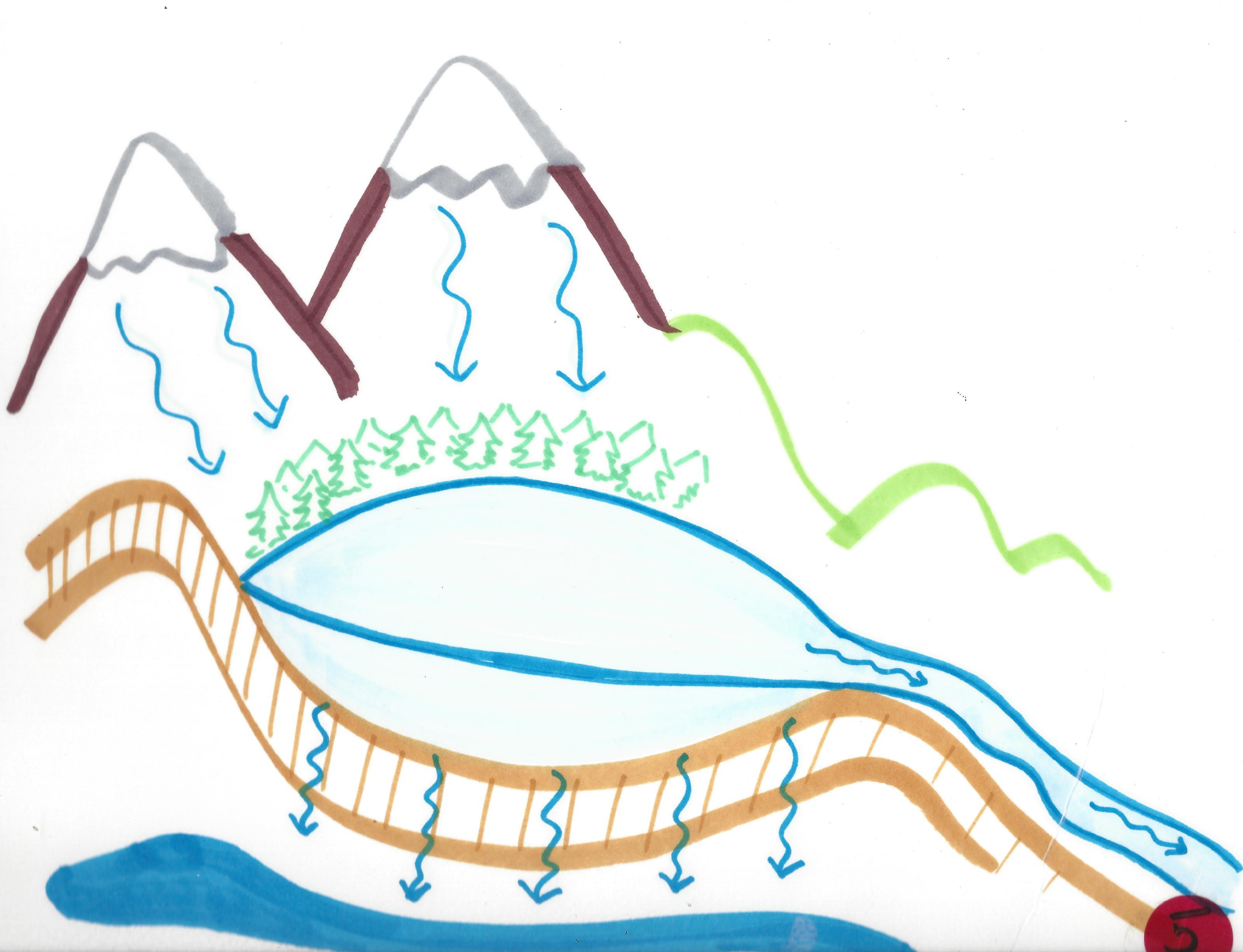

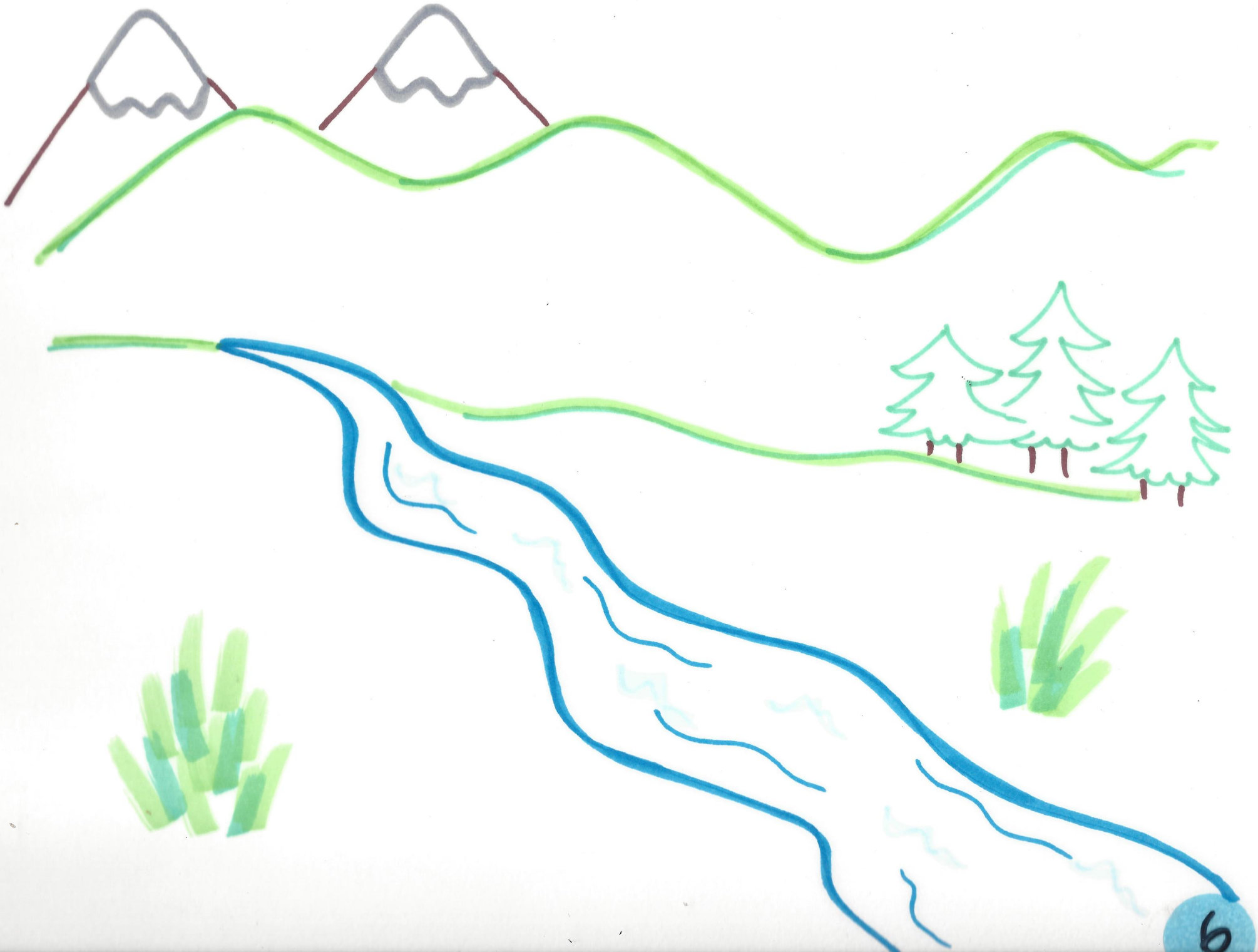

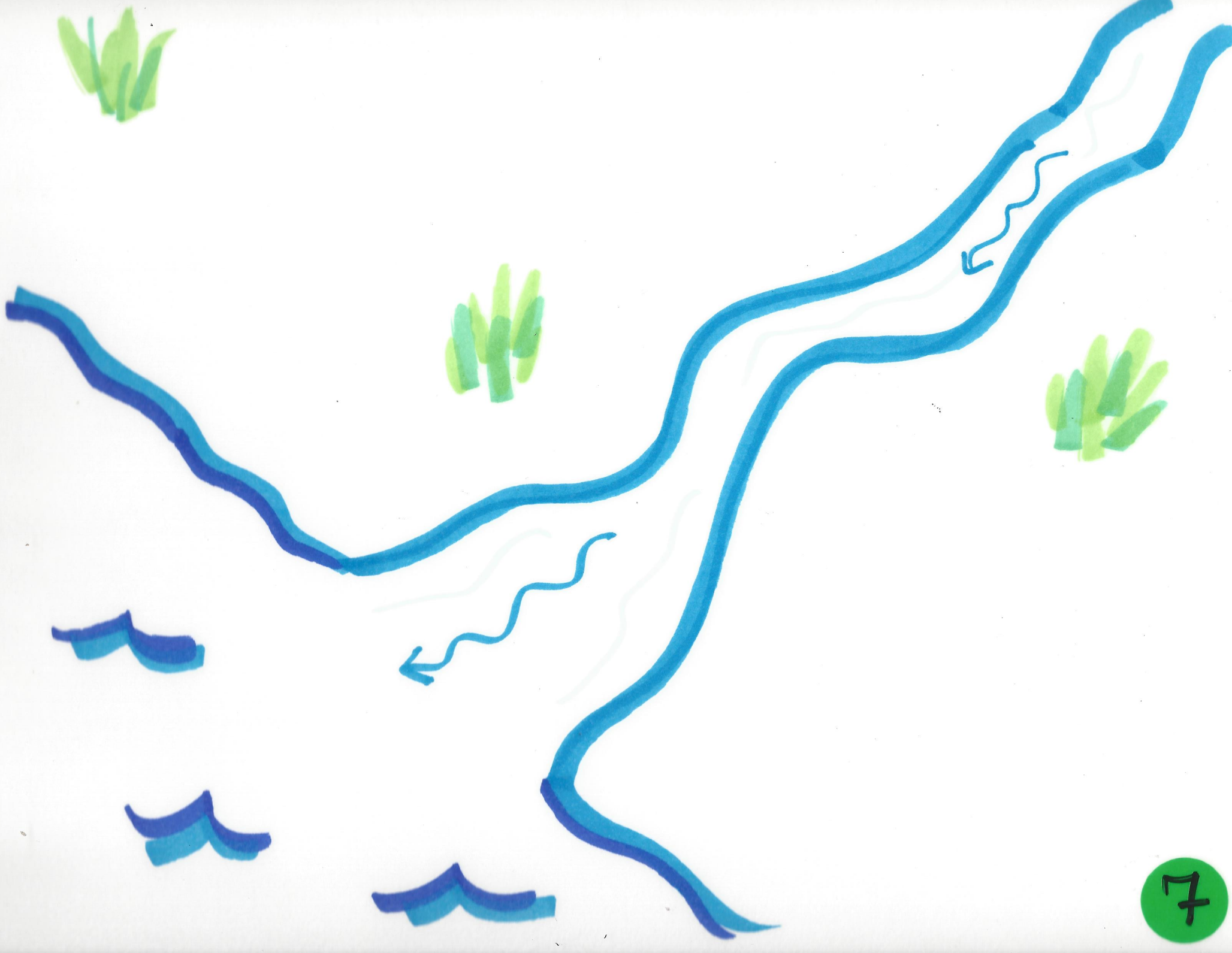

As the lower atmosphere becomes warmer, rates of evaporation increase.

As air gets warmer, it can hold and store more water vapor. This can lead to more intense storms and flooding.

As air gets warmer, more precipitation falls as rain rather than snow. Less water is stored in a seasonal "snowpack."

Changing patterns in snowmelt reduce the availability of fresh water during summer and fall months.

With less fresh water available in lakes, rivers and reservoirs, humans increasingly depend on groundwater in underground aquifers. These aquifers take much longer to replenish than surface water.

With less surface water and increased temperatures, the soil on the surface of the land dries out. This increases drought.

Freshwater resources along the coast face risks because as the ocean levels rise, saltwater moves into freshwater areas.

One strategy that we use to conserve water in the garden is _____.

This increases drought resilience because _____.