

The Incredible Journey

Become a water molecule and take a journey through the water cycle.



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Chapter 3 • Lesson 1

Please note: Academic Standards are updated regularly and our alignments will be updated on the DNR Academic Standards Website at: www.mndnr.gov/education/teachers/edstandards_intro.html

The Incredible Journey

Minnesota Academic Standards

- ☉ Lesson *introduces* this Benchmark.
- ☪ Lesson *partially* addresses this Benchmark.
- ☑ Lesson *fully* addresses this Benchmark.

Language Arts

Grades 3, 4, 5

I. Reading and Literature

B. Vocabulary Expansion:

Benchmark 1—The student will read unfamiliar complex and multi-syllabic words using advanced phonetic and structural analysis. ☪

II. Writing

A. Types of Writing:

Benchmark 1—The student will write in a variety of modes to express meaning ☪, including:

- a. descriptive
- b. narrative
- c. informative
- d. friendly letter
- e. poetic

III. Speaking, Listening, and Writing

A. Speaking and Listening:

Benchmark 2—The student will demonstrate active listening and comprehension. ☑

History and Social Studies

Grades K-3

IV. Historical Skills

A. Concepts of Time:

Benchmark 1—Students will define and use terms for concepts of historical time. Time in terms of processes of the water cycle.) ☪

Science

Grade 3

III. Earth and Space Science

C. The Universe:

Benchmark 3—The student will observe that the sun supplies heat and light to the Earth. ☑

Grade 4

II. Physical Science

A. Structure of Matter:

Benchmark 1—The student will observe that heating and cooling can cause changes in state. ☪

Benchmark 2—The student will describe the changes in the properties of a substance when it is cooled or heated. ☪

III. Earth and Space Science

B. The Water Cycle, Weather and Climate:

Benchmark 1—The student will describe the water cycle involving the processes of evaporation, condensation, precipitation and collection. ☪

Benchmark 2—The student will identify where water exists on earth. ☑

Environmental Literacy Scope and Sequence

Benchmarks

- Social and natural systems are made of parts. (PreK-2)
- Social and natural systems may not continue to function if some of their parts are missing. (PreK-2)
- When the parts of social and natural systems are put together, they can do things they couldn't do by themselves. (PreK-2)
- In social and natural systems that consist of many parts, the parts usually influence one another. (3-5)
- Social and natural systems may not function as well if parts are missing, damaged, mismatched or misconnected. (3-5)

For the full Environmental Literacy Scope and Sequence, see:

www.seek.state.mn.us/eemn_c.cfm

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Chapter 3 • Lesson 1

The Incredible Journey

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Grade Level: 3-5

Activity Duration: two 50-minute periods

Group Size: 9 to 30 students

Subject Areas: Language Arts, Expressive Arts, Science

Academic Skills: analysis, description, interpretation, organization

Setting: large indoor or outdoor open area

Vocabulary: condensation, evaporation, precipitation, respiration, transpiration, water cycle

Internet Search Words: evaporation, precipitation, water cycle

Instructor's Background Information

Water is always in motion. It travels through things like lakes, rivers, oceans, atmosphere, groundwater, icebergs, plants, and animals, and its path is known as the **water cycle**. Water changes form, or state, as it moves through the water cycle. These states are solid (ice), liquid, and gas (water vapor). As water circulates or passes from one form or state to another, its paths vary.

Heat energy directly influences the rate of water's motion. As the motion of water molecules increases with the amount of heat energy, water changes state from solid to liquid to gas. The sun is the energy source that evaporates water from the earth's surface and causes it to rise as water vapor. With each change in state, physical movement usually follows. For example, glacial melt runs to pools, which overflow into streams, where the water **evaporates**, or changes its form from liquid to a gas, and moves into the atmosphere.

Gravity further influences the water's travels under and above the earth's surface. As a solid, liquid, or gas, water has mass, and is subject to gravitational force—snow on mountaintops melts and descends through watersheds to the oceans of the world.

Liquid is the most visible state in which water moves. It is visible flowing in streams and rivers, or tumbling in ocean waves. Liquid water is found underground as well as on the earth's surface. Water travels slowly underground, seeping and filtering through particles of soil and pores within rocks.

Summary

By rolling some special dice, students are directed to travel from place to place as they simulate the movement of water within the water cycle.

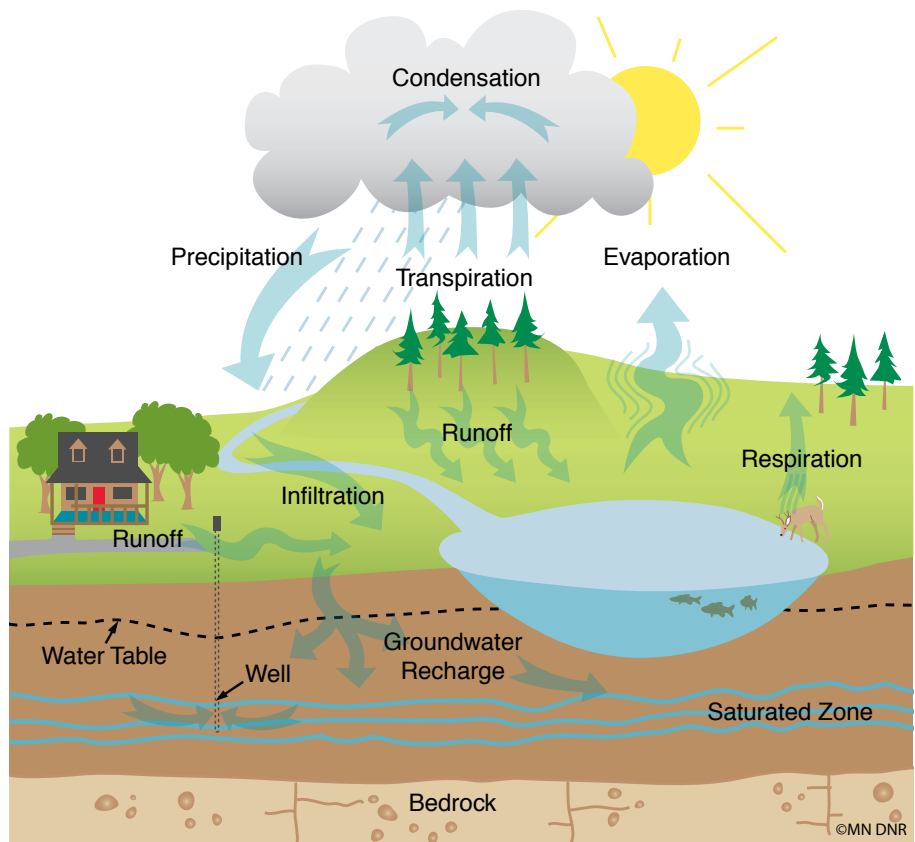
Student Objectives

The student will:

- 1 Identify the sun as the source of energy that evaporates water from the earth's surface.
- 2 Identify gravity as another force that moves water through the water cycle.
- 3 Describe the process of evaporation, condensation, and precipitation of water as it moves through the water cycle.
- 4 Identify the states of water (solid, liquid, and gas) as it moves through the water cycle.
- 5 Identify places that hold water as it moves through the water cycle, such as soil, plants, animals, lakes, rivers, clouds, glaciers, and oceans.

Materials

- **Water Cycle Table**
- One copy of each **Incredible Journey Station Sign**
- 8.5" x 11" illustration (or projection) of the water cycle
- Markers or pens, one per student (optional)
- Nine boxes, about three and one half inches square, for making dice (The type of gift boxes used for coffee mugs work well. Local mailing shops often carry cube-style boxes. To make boxes, use heavy tag board and the **Pattern for a Cube.**)
- **Incredible Journey Labels for Dice**
- Notebook or sheet of paper, one per student
- Clipboards
- Glue or tape
- Bell, buzzer, whistle, or other noisemaker
- Blocks of wood (two inches square), art foam, non-toxic ink pads, hot glue (K-2 Option)



The water cycle connects clouds, lakes, rivers, soil, plants, groundwater, and animals—including fish and people.

Water's most dramatic movements occur during its gaseous phase. Water constantly evaporates as a heat source, such as the sun, warms its molecules. As a vapor, water can travel over the earth's surface through the atmosphere—water vapor surrounds us at all times. Eventually, water condenses, or passes from gas to liquid, and returns to the earth. Where such condensation falls depends upon loss of heat energy, gravity, and the structure of the earth's surface.

Water condensation appears as dew on plants, or as water droplets on the outside of a glass of cold water. In clouds, water molecules collect on tiny dust particles. Eventually, these water droplets become so heavy that gravity pulls the water toward the earth as some form of **precipitation**, such as rain, sleet, or snow. Thanks to gravity, water flows downhill, drawing it from the earth's surface into the ground, or over the ground and into rivers, lakes, and oceans.

Snow and ice are water in solid form. Much of the fresh water on earth is frozen in icebergs and glaciers, where water molecules can remain for a long time. But glaciers and icebergs do melt eventually, releasing water into streams, rivers, and oceans. Evaporation also occurs on the surface of glaciers, where water rises from the ice in the form of water vapor.

Living organisms also move water. All animals, including people, carry water within their bodies. Water is either directly consumed by animals or is removed from foods during digestion. Water is excreted as a liquid, or leaves as a gas—usually through **respiration**, or breathing. Water is also dispersed through the skins of animals (perspiration), and evaporation follows.

Plants move large amounts of water. The roots of plants absorb water. Some of this water is used within the body of the plant, but most of it travels upward through the plant to the leaf surface. When water reaches the leaves, it is exposed to the air—and the sun’s energy—and is easily evaporated. This process is called **transpiration**.

All these processes work together to move water around, through, and over the earth in a perpetual cycle.

Procedure

Preparation

Make the nine dice (or spinners) using the boxes and the information from the **Water Cycle Table**. For each station, make one or two dice. The **Water Cycle Table** provides directions on how to place the labels on each side of the die for each station. You can make labels using only the words (plant, animal, cloud, river, ocean, and so forth) or put illustrations on the labels, too. Mark each die to indicate its correct station placement for the game. Copy the **Incredible Journey Labels for Dice** and **Incredible Journey Station Signs**. You may wish to have students color the pictures. Review the **Water Cycle Table** for the explanations of water movement.

Warm-up

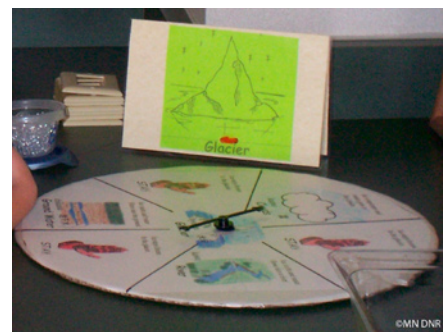
- 1 Ask students to identify the places water goes as it moves over, through, and around the earth. Write responses on the classroom whiteboard.
- 2 From the students’ list, categorize the places into nine stations: clouds, plants, animals, rivers, oceans, lakes, groundwater, soil, and glaciers. Write the names of the stations on large sheets of paper and post them in locations around the room or schoolyard. (Students may illustrate these station labels. You may wish to laminate these for future use.)
- 3 Or, ask for nine student volunteers. Ask them to come to the front of the class, and have each hold an **Incredible Journey Station Sign** representing a different station. Ask the students if they can arrange themselves, facing their classmates, in the order that water moves through the water cycle. (Pathways can vary, so they might arrange themselves in a variety of ways.) Talk about how the sun and gravity provide the energy that moves water. Discuss how water changes form on its travels (solid, liquid, gas). Water’s path, as it travels and changes form, is called the water cycle. Show the



The Incredible Journey dice illustrations match those in the Water Cycle Table. To quicken the pace of the game, you can use more than one die at each station, particularly the clouds and ocean stations.



For younger students, use pictures and words on the dice to show the destinations of water molecules leaving each station.



If you plan to use spinners rather than dice, each spinner needs six pie-shaped wedges, as well as an arrow that stops on a wedge at the end of its spin.

students a poster illustrating water cycle. Discuss the water cycle as illustrated.

Lesson

- 1 Tell students that they're going to be water molecules on a journey through the water cycle.
- 2 Assign an even number of students to each station (clouds, plants, animals, rivers, oceans, lakes, groundwater, soil, and glaciers). (The Cloud Station can have an uneven number of students.) Ask students to identify the various places that water can move to from their station of the water cycle. Discuss conditions that move the water; explain that water movement depends on energy from the sun (electromagnetic energy) and gravity. Explain that, sometimes water doesn't move anywhere for a very long time. After students have made lists, have each group share their work. Hand the appropriate die to each group and have students check the illustrations on the die to see if they've identified all the places that water can go. The **Water Cycle Table** at the end of the lesson (www.montana.edu/wwwwet/watercycl.html) provides an explanation of water movements from each station.
- 3 Tell students they will be acting out water's movement from one place to another. When they move as liquid water, they'll move in pairs, representing the many water molecules in a drop of water. When they move (evaporate) to the Clouds Station, they should separate from their partners and continue moving alone, as individual water molecules. When water comes from the clouds (condenses) as rain or snow, the students should find a partner and move to the next location as a collection of water molecules in precipitation—rain, sleet, or snow.
- 4 In this game, a roll of the die, (or a spin of the spinner) determines where the water will move. Have students line up behind the die at their station. (At the Clouds Station they should line up single file. At the other stations, they should line up in pairs.) Students roll the die, and then proceed to the location indicated by the word on the upward-facing side of the die. If they roll the word *stay*, they must move to the back of the line.
- 5 When students arrive at the next station, they go to the back of the line. Upon reaching the front of the line, they roll the die and move to the next station (or go to the back of the line if they roll *stay*).
- 6 At the Clouds Station, students roll the die individually—but if they leave the clouds, they must take a partner (the student behind them) and move to the next station—the partner doesn't roll the die.
- 7 Students should keep track of their movements.
 - Have them keep a journal or notebook to record each move they make, including each time they rolled *Stay*.
 - Using another approach, half of the class plays the game while the other half watches. Assign each onlooker a student to watch during the game. Have them track this player, recording

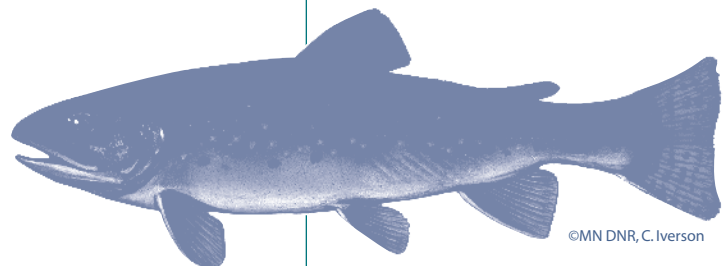


each station to which the player travels. In the next round, the onlookers play the game while the other half of the class watches and does the tracking.

- Create a one-page sheet for recording the students' journeys, numbering their movements as they roll each die, and listing that number under an illustration of the station to which they've traveled.
- 8 Signal the beginning of the game with a bell, buzzer, or whistle.
 - 9 Stop the game periodically to discuss the forms of water as it moves from one location to another. Much of the movement from station to station occurs when water is in its liquid form. Gravity draws water downhill, but water moves to the clouds in the form of water vapor, with molecules moving rapidly and apart from each other. The sun provides the energy that evaporates water from the earth's surface. When water moves from clouds to the glacier, it condenses and can fall as snow, a solid. Again, gravity draws the snowfall to the earth's surface.
 - 10 If you notice a large congregation of students at one or two stations (glacier, clouds, or ocean), stop the game to discuss possible reasons. Ask students if this happens during the journey of a real water molecule. (For example, a water molecule can remain in liquid form in Lake Superior for more than a century before it evaporates. Or, on land, a plant's roots might quickly absorb a water molecule just after it falls as rain.)
 - 11 After approximately ten to twelve minutes, signal the end of the game.

Wrap-up

Have students use their travel records to write or verbally share stories about their journeys as water molecules. Have them describe the conditions that allowed them to move to each location, and their state or form as they moved. Discuss any *cycling* that may have occurred—did any students return to their original station? How do their experiences as water molecules in the game compare to the illustration on the water cycle poster?



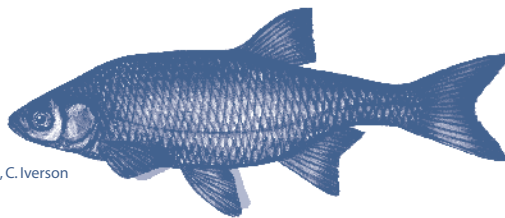
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Assessment Options

- 1 Observe the students as they portray water molecules. Look for evidence that they understand the following:
 - the path of water molecules moving through the water cycle;
 - changes in state from solid to liquid to gas to liquid, and so forth along the path through the water cycle;
 - that water *evaporates* into the air;
 - that water molecules *condense* to form droplets in clouds;
 - that the sun provides the energy for evaporation;
 - and that gravity is another force that moves water through the water cycle.

Evaluate how well the students identify water's state or form as it moves through the water cycle.

- 2 Using their written or oral stories describing water movement, evaluate if the students have identified the sun as the provider of energy for evaporation, that gravity is an additional force that moves water through the water cycle, and an understanding that water changes form as it moves through the water cycle.
- 3 Have older students teach *The Incredible Journey* to younger students. Evaluate accuracy in describing the path of water molecules through the water cycle, and the states or forms that water takes as it moves through the water cycle.
- 4 Provide students with a location that is different from the stations in the game, such as a parking lot, their back yard, the school rooftop, a nearby forest, a local hilltop, or an organ of the body such as the bladder, and have them apply what they learned in the water cycle activity. They should be able to identify the ways in which water moves to and from those sites. How would water travel to and from the site in winter? Have them identify the states of the water as it moves to each new site.
- 5 Assessment options include the Checklist and Rubric on the following pages.



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The Incredible Journey Checklist

Possible Points	Points Earned	Points Earned	
	Student	Instructor	
4	_____	_____	Student accurately shows all movement of water in the water cycle.
4	_____	_____	Student names evaporation, condensation, precipitation, and transpiration accurately.
3	_____	_____	Student can name and define the three states of water.
3	_____	_____	Student gives an example of each of the three states of water.
4	_____	_____	Student can identify and explain the two forces that provide the energy that drives the water cycle.
4	_____	_____	Student can define <i>precipitation, evaporation, condensation, and transpiration.</i>
2	_____	_____	Student can explain how all living things are connected by the water cycle.
Total Points			
24	_____	_____	Score _____

Checklists are tools for students and instructors. Checklists involve students in managing their own learning. They help students understand and set learning goals before the lesson begins, and help them monitor their progress during the lesson, ensuring that they meet learning goals and objectives by the end of the lesson. Students can also use checklists to discover areas that may need improvement. Checklists help instructors monitor each student's progress throughout the lesson, facilitating appropriate adjustment of instruction to ensure learning by the end of the lesson. The instructor may wish to have students add several of their own learning goals to the checklist to personalize it, and to accommodate varied learning needs and styles.

Grade

21-24 points = A

Excellent. Work is above expectations.

18-20 points = B

Good. Work meets expectations.

15-17 points = C

Work is generally good. Some areas are better developed than others.

11-14 points = D

Work does not meet expectations; it's not clear that student understands objectives.

0-10 points = F

Work is unacceptable.

The Incredible Journey Scoring Rubric

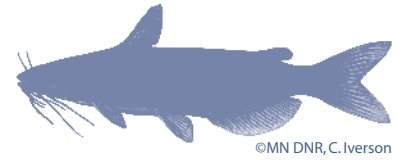
Water Cycle Criteria	4 Excellent	3 Good	2 Fair	1 Poor	0 Unacceptable
Water cycle	Can name and describe all parts of the water cycle. Accurately illustrates all movement of water in the water cycle. Appropriately names evaporation, condensation, precipitation, and transpiration.	Can name all parts of the water cycle. Definition lacks clarity. Accurately demonstrates movement of water in the water cycle.	Can name most parts of the water cycle. Description of each part is unclear. Misses one or two connections in movement of water in the cycle.	Can't name all parts of the water cycle. Description of each part is inaccurate or unclear. Can't demonstrate correct water cycle movement.	Doesn't attempt to learn terms and process of the water cycle.
States of water	Can name and define the three states of water and gives an example of each within the water cycle.	Can name and define the three states of water. Definition lacks clarity. Can give an example of each.	Can name the three states of water but clearly defines only two states.	Can't name or correctly define the states of water correctly.	Doesn't try to name or identify the states of water.
What drives the water cycle?	Can identify and explain how the sun and gravity are the forces that power the water cycle.	Can identify the sun and gravity as the forces that power the water cycle.	Can identify the sun or gravity as a force that powers the water cycle.	Can't identify sun or gravity as forces that power the water cycle.	Doesn't attempt to identify a force that powers the water cycle.

Score _____ (Calculate score by dividing total points by number of criteria.)

Diving Deeper

Extensions

- 1 Instead of recording their journeys in a notebook, have the students create a water cycle bracelet during the water cycle journey. Give each student a length of elastic cord with a knot tied in one end. At each of the nine stations, provide a container of colored beads—use a different color for each station. When each water molecule (student) arrives at a station, have the student take a bead to add to the bracelet. (If the roll of the die says *Stay*, add another bead.) At the conclusion of the game, have students wear their bracelets, and pointing to each bead, relate the water molecules' journeys through the water cycle.
- 2 Have students compare the movement of water during different seasons and locations on the globe. They can adapt the game by changing the faces of the dice or adding alternative stations to represent these different seasons or locations.
- 3 Have students investigate how water becomes polluted and is cleaned as it moves through the water cycle. For example, water picks up contaminants as it travels through the soil, leaving them behind as it evaporates at the surface. Challenge students to adapt *The Incredible Journey* to include these processes. For example, balls of rolled-up masking tape can be used to represent pollutants and stuck onto the students as they travel to the Soil Station. Some pollution can be filtered (left behind) as the water moves to the lake—and demonstrated by the students rubbing their arms to slough some tape. If they roll *clouds*, they remove all of the tape, indicating that pollutants are left behind when water evaporates.
- 4 Demonstrate water's changes of state. Heat water until it evaporates, and carefully use a potholder or insulated glove to hold a dinner plate or glass bowl above the heated water to demonstrate condensation. Go outside and look for morning dew, fog, ice, or snow. Have students hold snow in their hands and watch it melt—can they describe what happens to the water? Ask students if they've noticed that ice cubes shrink when left in the freezer for a long time—why does this happen? Explain **sublimation**, the process by which water changes from a solid to a gas without becoming liquid.



For the Small Fry

K-2 Option

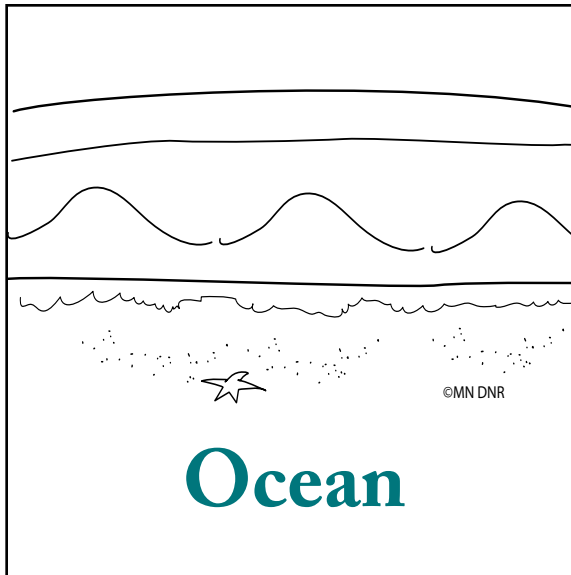
- 1** Introduce the water cycle and trace it as a group. Follow Step 2 of the Warm-up.
- 2** Use art foam to create individual rubber stamps for each station. Hot-glue these art foam shapes to two-inch-square blocks. As students travel to each station, they rubber-stamp a sheet of paper marking their progress through the cycle. (Students like to use the stamps, so allow some time for them to do some extra stamping beforehand.)
- 3** Follow the steps in the lesson, eliminating Step 6 and using the rubber stamps to record the journey, as described in Step 7.
- 4** Have the students tell the stories of their journeys, following the order of the stamps on their sheets.
- 5** The bead activity described in Step 1 of the Extensions can work, but because it's somewhat abstract, it may be slightly more difficult for younger students to relate the beads to steps on their journeys.

Water Cycle Table

Station	Die Face Labels	Explanation
Soil	one side <i>plant</i>	Water is absorbed by plant roots.
	one side <i>river</i>	The soil is saturated, so water runs off into a river.
	one side <i>groundwater</i>	Water is pulled by gravity; it filters into the soil.
	two sides <i>clouds</i>	Heat energy is added to the water, so the water evaporates and goes to the clouds.
	one side <i>stay</i>	Water remains on the surface (in a puddle, perhaps, or stuck to a soil particle).
Plant	four sides <i>clouds</i>	Water leaves the plant through the process of transpiration.
	two sides <i>stay</i>	Water is used by the plant and stays in the cells.
River	one side <i>lake</i>	Water flows into a lake.
	one side <i>groundwater</i>	Water is pulled by gravity; it filters into the soil.
	one side <i>ocean</i>	Water flows into the ocean.
	one side <i>animal</i>	An animal drinks water.
	one side <i>clouds</i>	Heat energy is added to the water, so the water evaporates and goes to the clouds.
	one side <i>stay</i>	Water remains in the current of the river.
Clouds	one side <i>soil</i>	Water condenses and falls on soil.
	one side <i>glacier</i>	Water condenses and falls as snow onto a glacier.
	one side <i>lake</i>	Water condenses and falls into a lake.
	two sides <i>ocean</i>	Water condenses and falls into the ocean.
	one side <i>stay</i>	Water remains as a water droplet clinging to a dust particle.
Ocean	two sides <i>clouds</i>	Heat energy is added to the water, so the water evaporates and goes to the clouds.
	four sides <i>stay</i>	Water remains in the ocean.
Lake	one side <i>groundwater</i>	Water is pulled by gravity; it filters into the soil.
	one side <i>animal</i>	An animal drinks water.
	one side <i>river</i>	Water flows into a river.
	one side <i>clouds</i>	Heat energy is added to the water, so the water evaporates and goes to the clouds.
	two sides <i>stay</i>	Water remains within the lake or estuary.
Animal	two sides <i>soil</i>	Water is excreted through feces and urine.
	three sides <i>clouds</i>	Water is respired or evaporated from the body.
	one side <i>stay</i>	Water is incorporated into the body.
Groundwater	one side <i>river</i>	Water filters into a river.
	two sides <i>lake</i>	Water filters into a lake.
	three sides <i>stay</i>	Water stays underground.
Glacier	one side <i>groundwater</i>	Ice melts and water filters into the ground.
	one side <i>clouds</i>	Ice evaporates and water goes to the clouds (sublimation).
	one side <i>river</i>	Ice melts and water flows into a river.
	three sides <i>stay</i>	Ice stays frozen in the glacier.

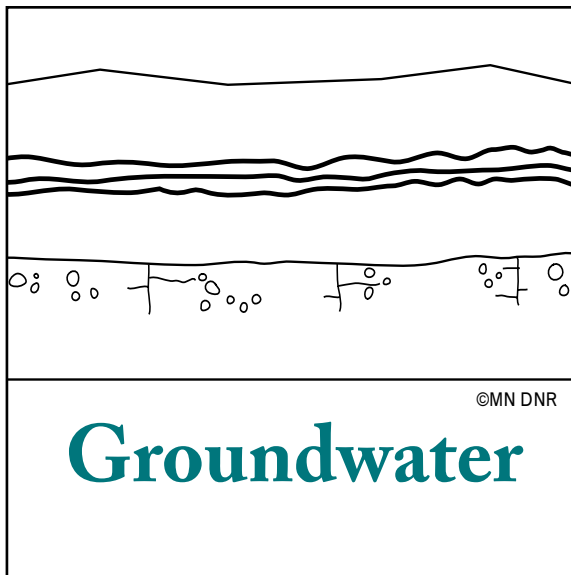
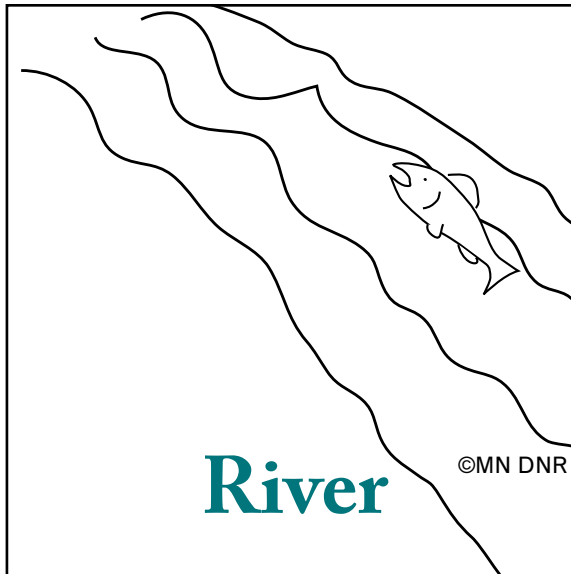
Incredible Journey Labels for Dice

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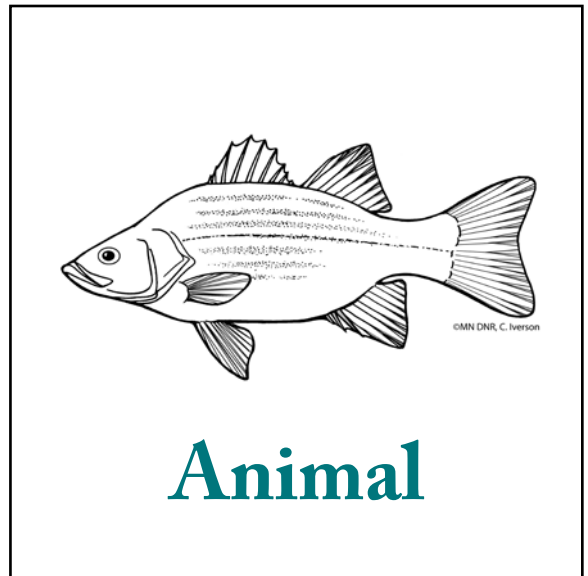
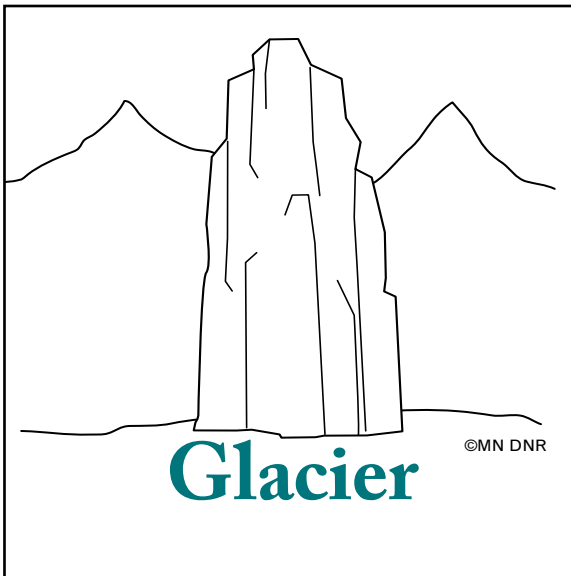
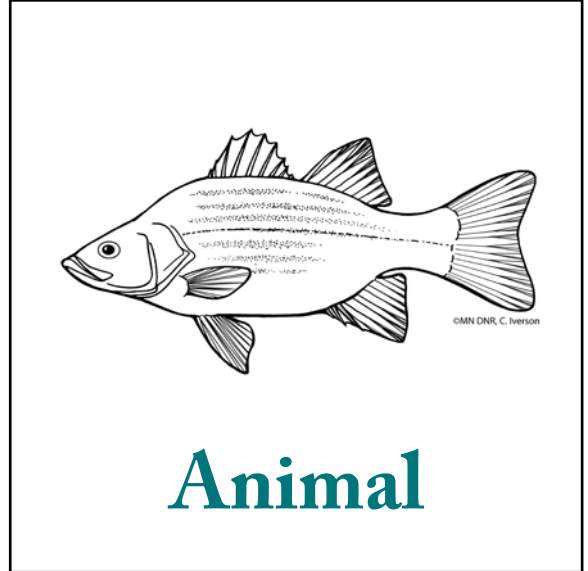
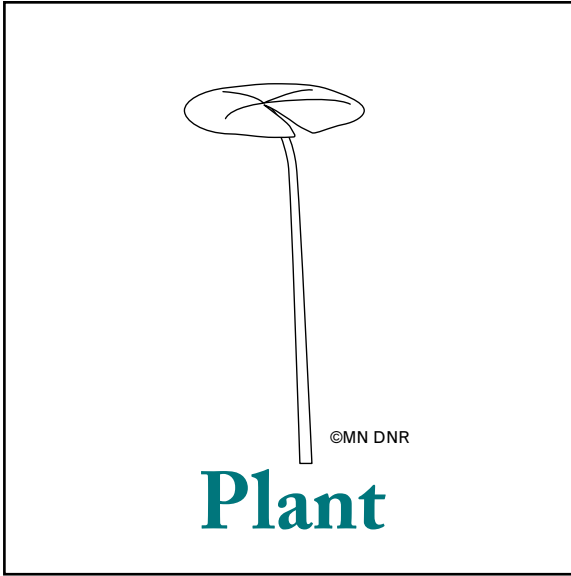
Incredible Journey Labels for Dice

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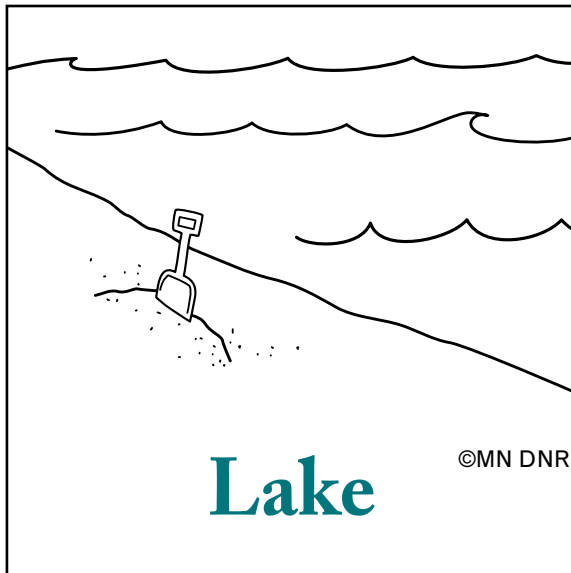
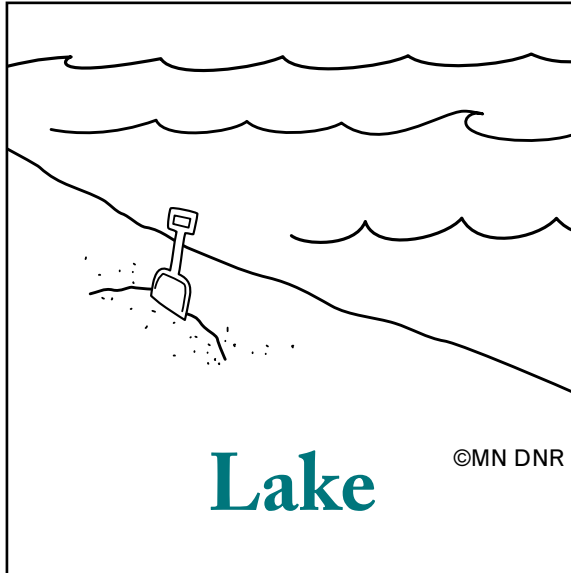
Incredible Journey Labels for Dice

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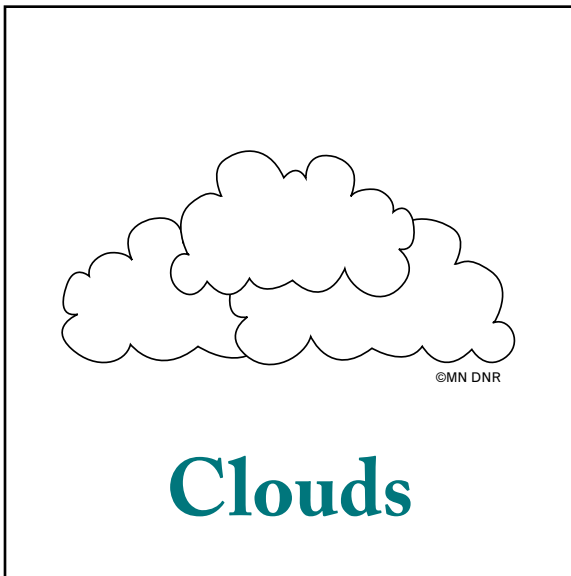
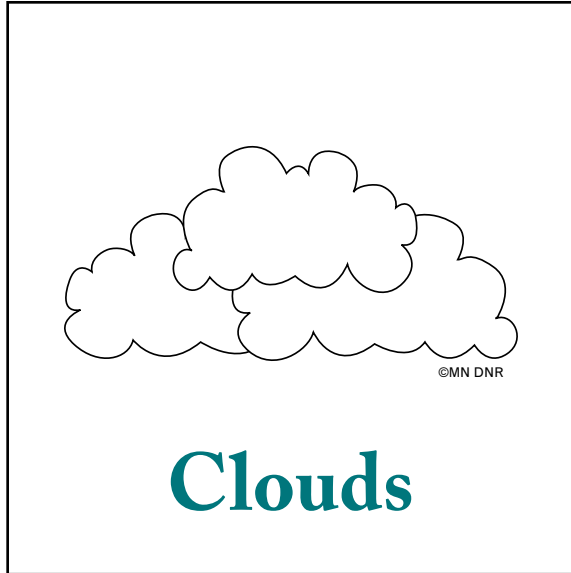
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Incredible Journey Labels for Dice

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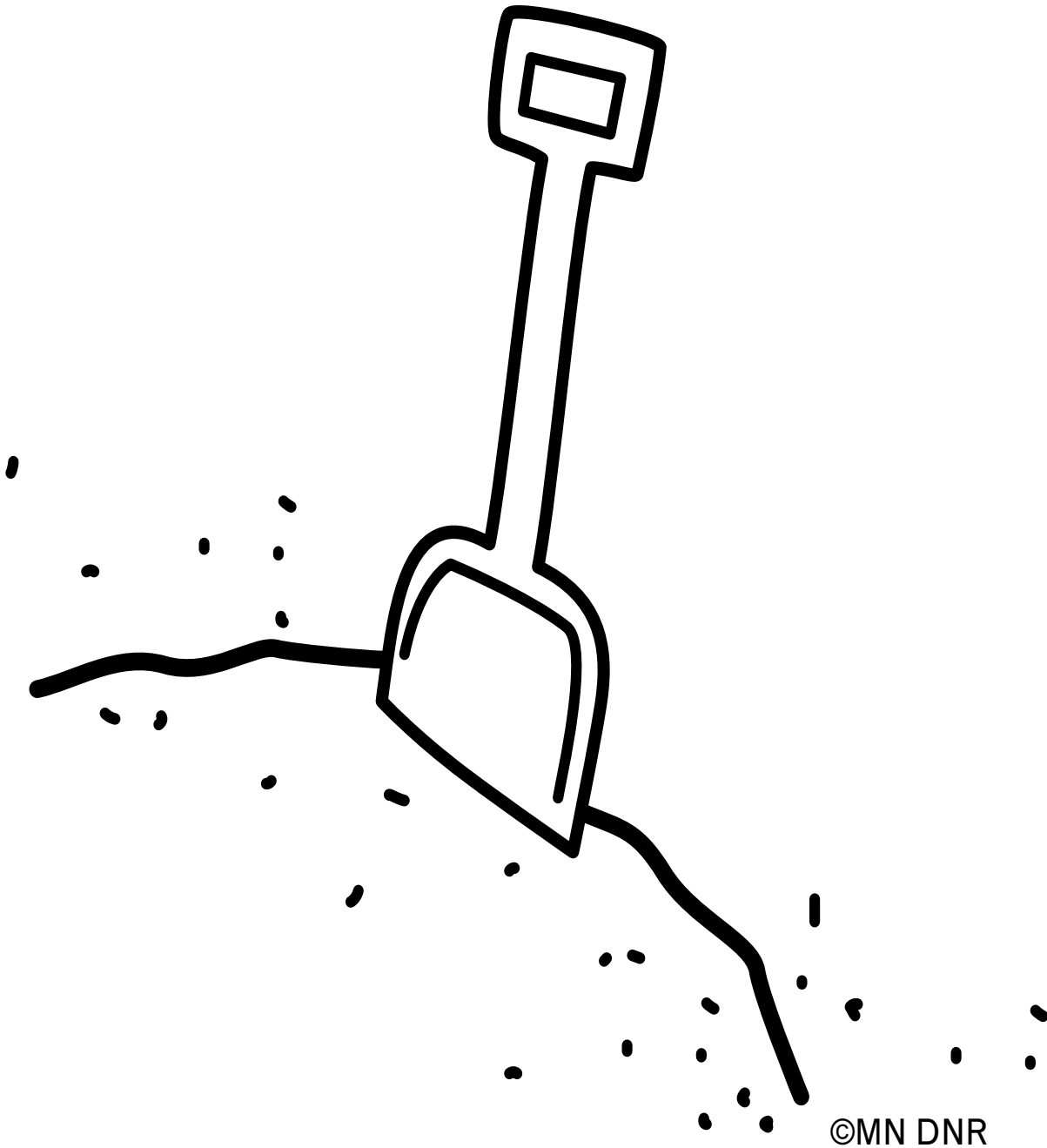


Incredible Journey Labels for Dice

Make seven copies of this page.

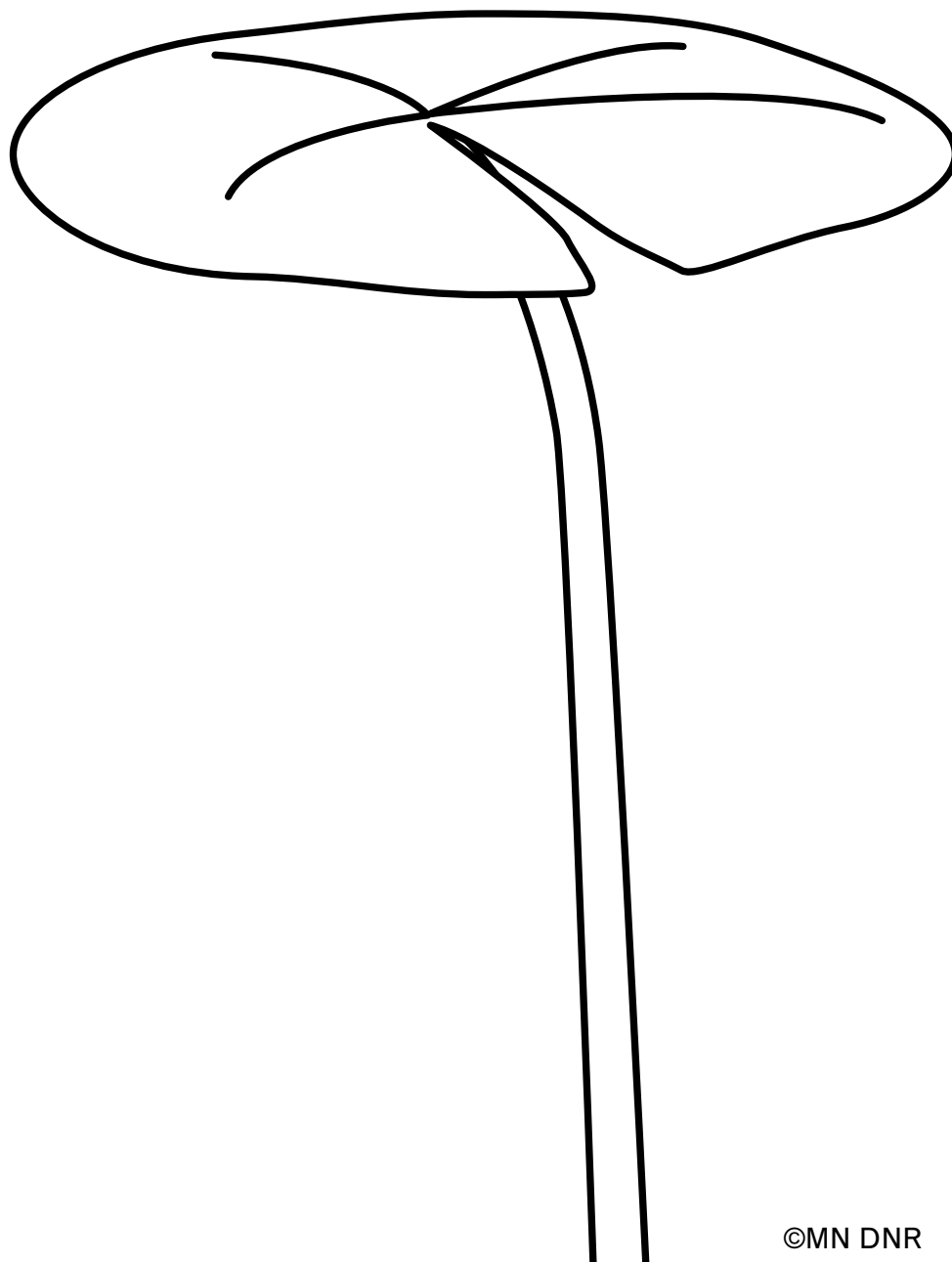


Incredible Journey Station Sign



Soil

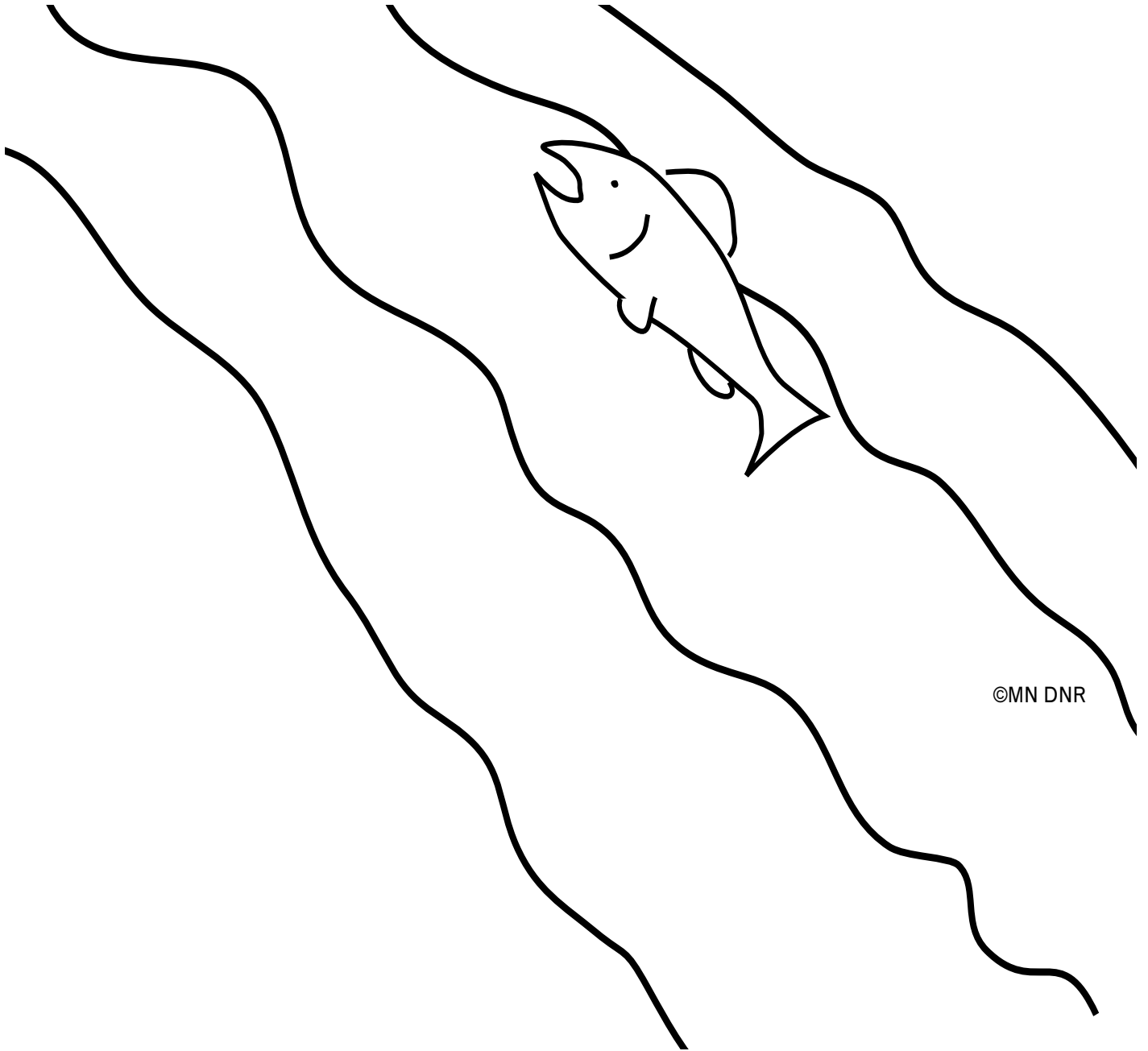
Incredible Journey Station Sign



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Plant

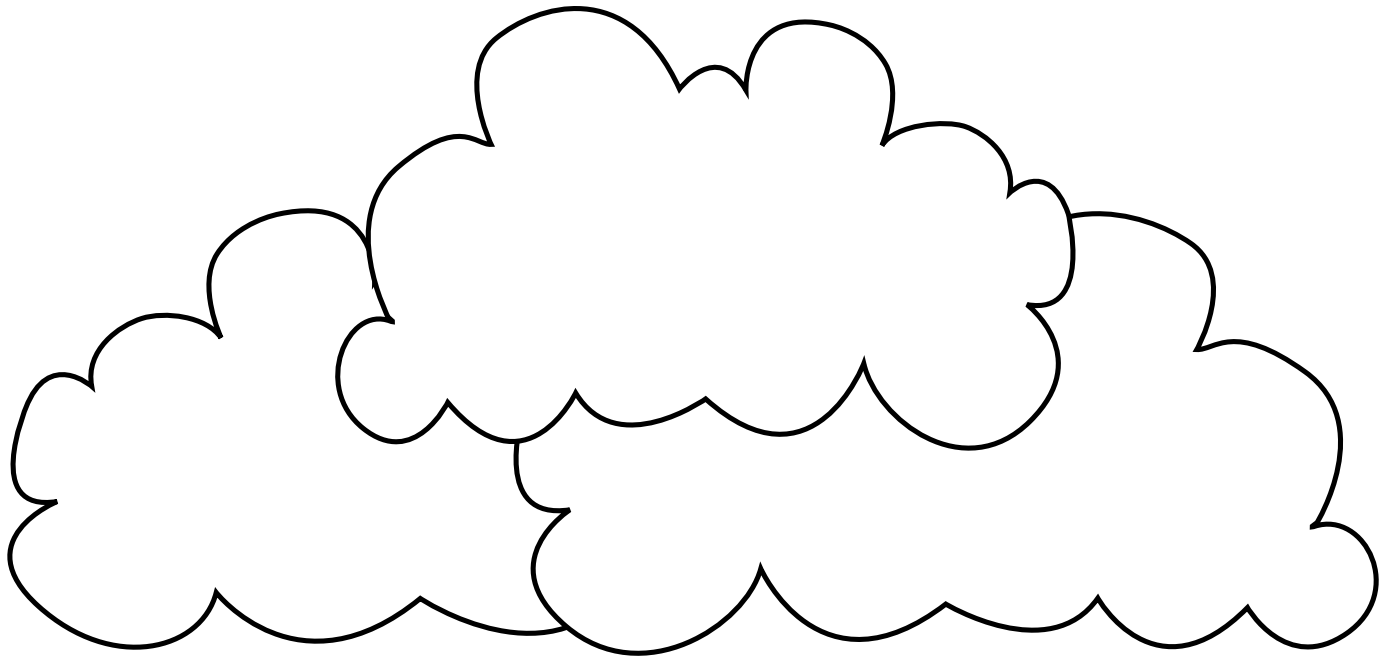
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River

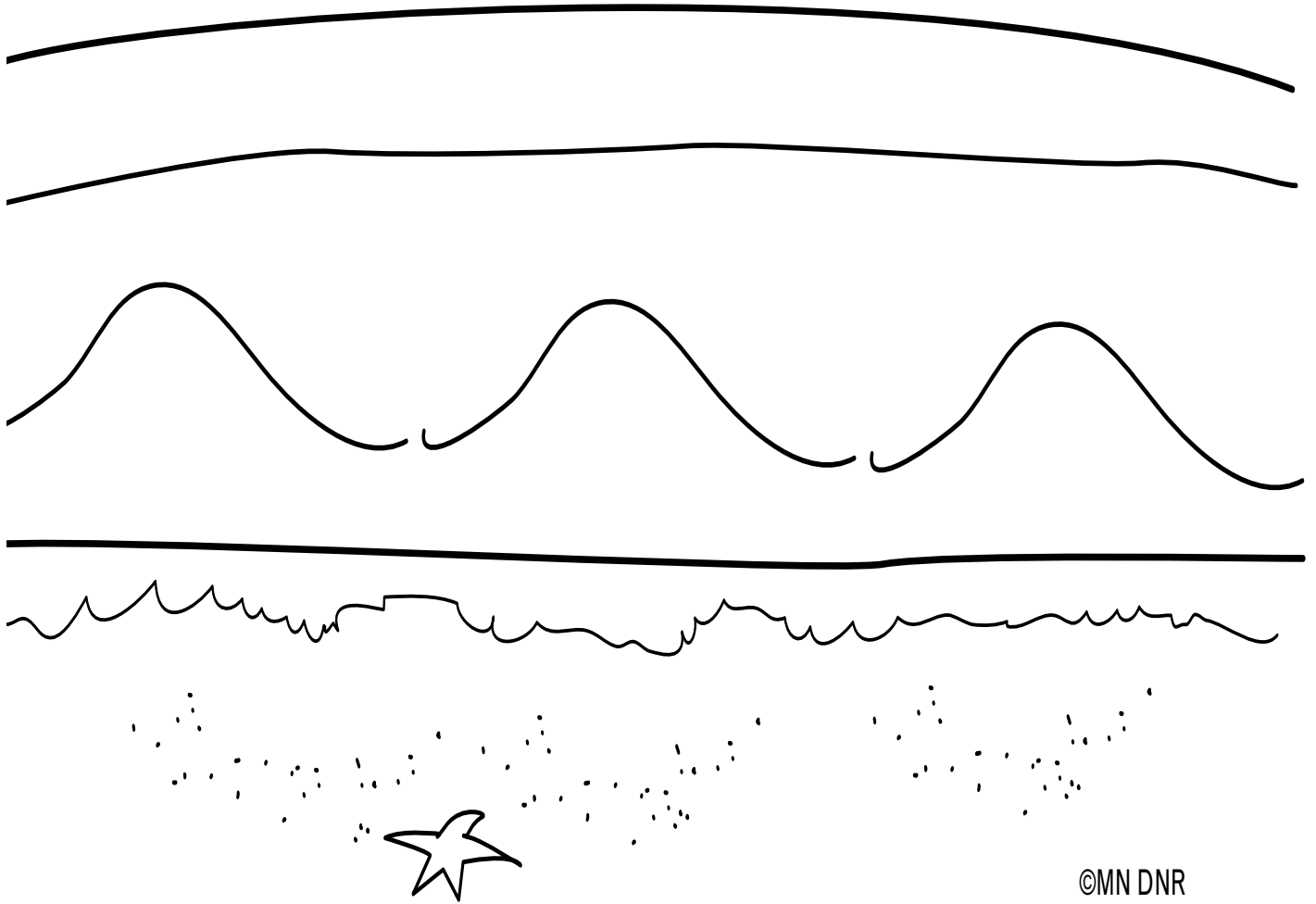
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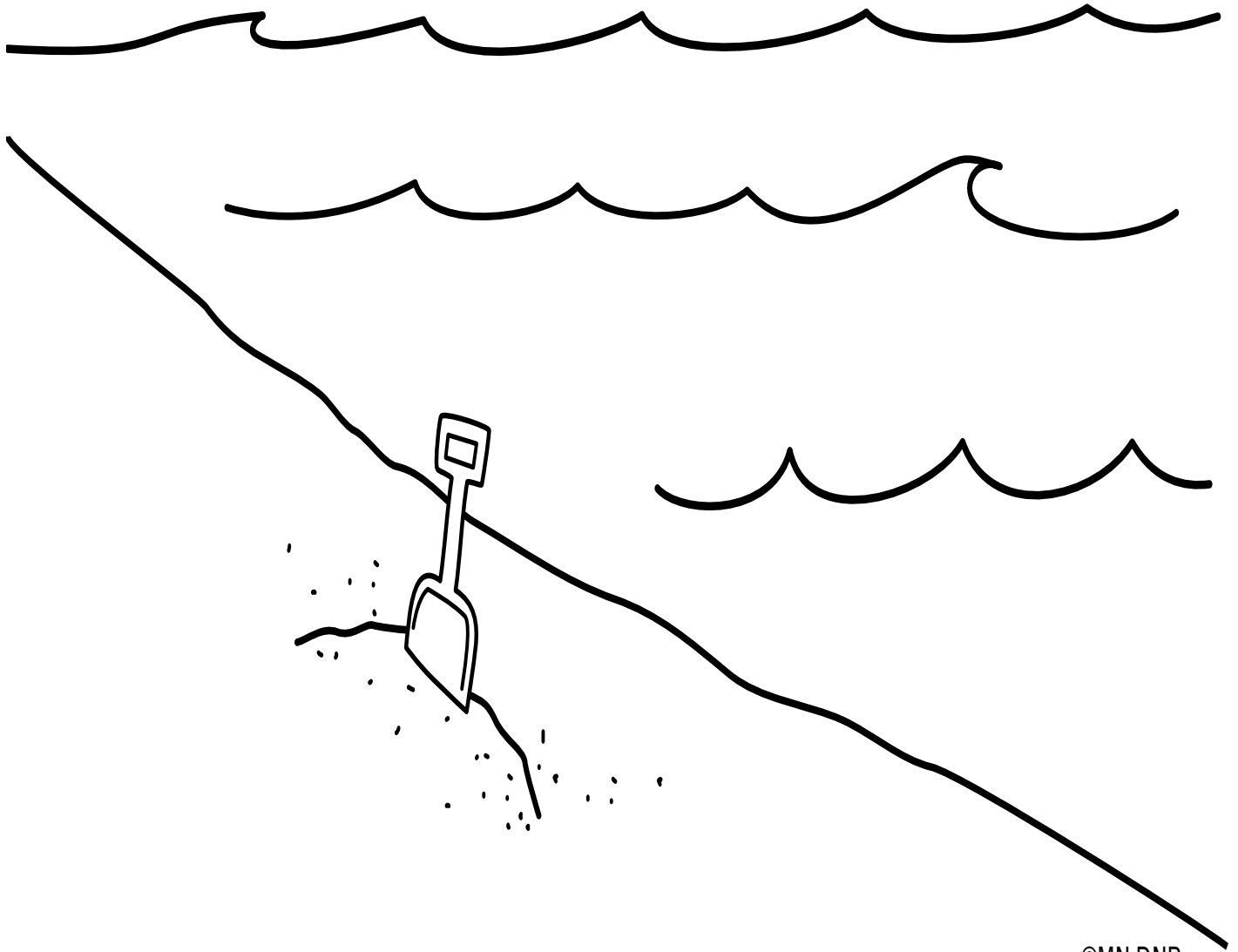
Clouds

Incredible Journey Station Sign



Ocean

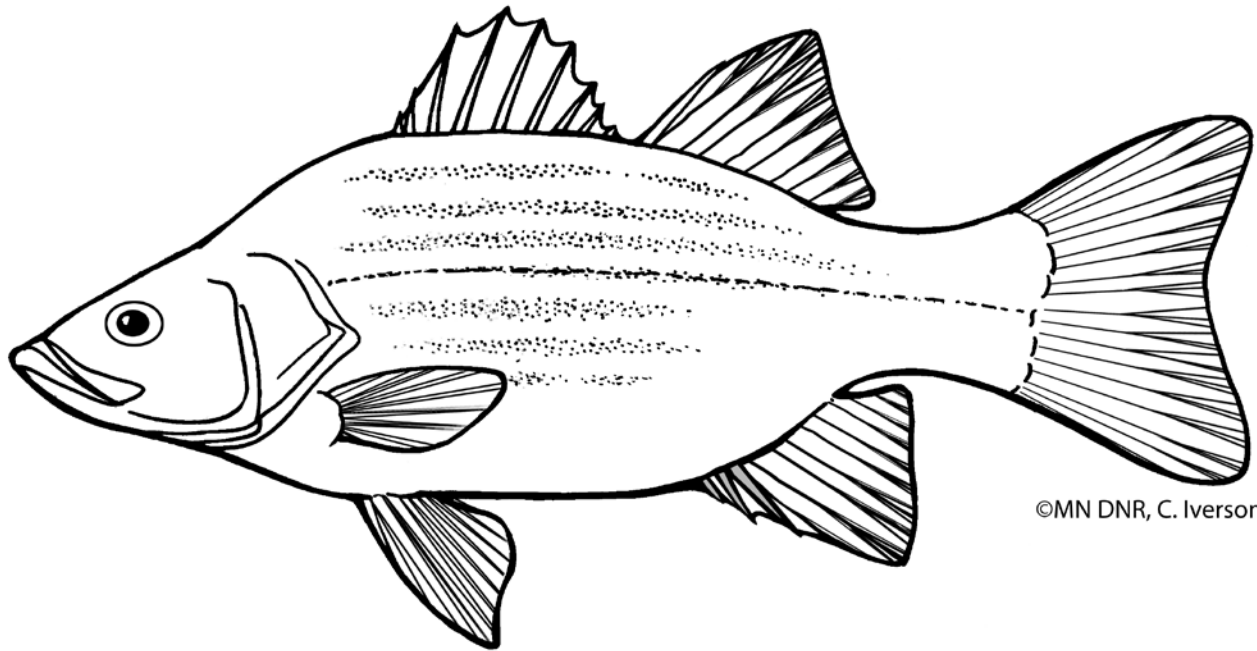
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Lake

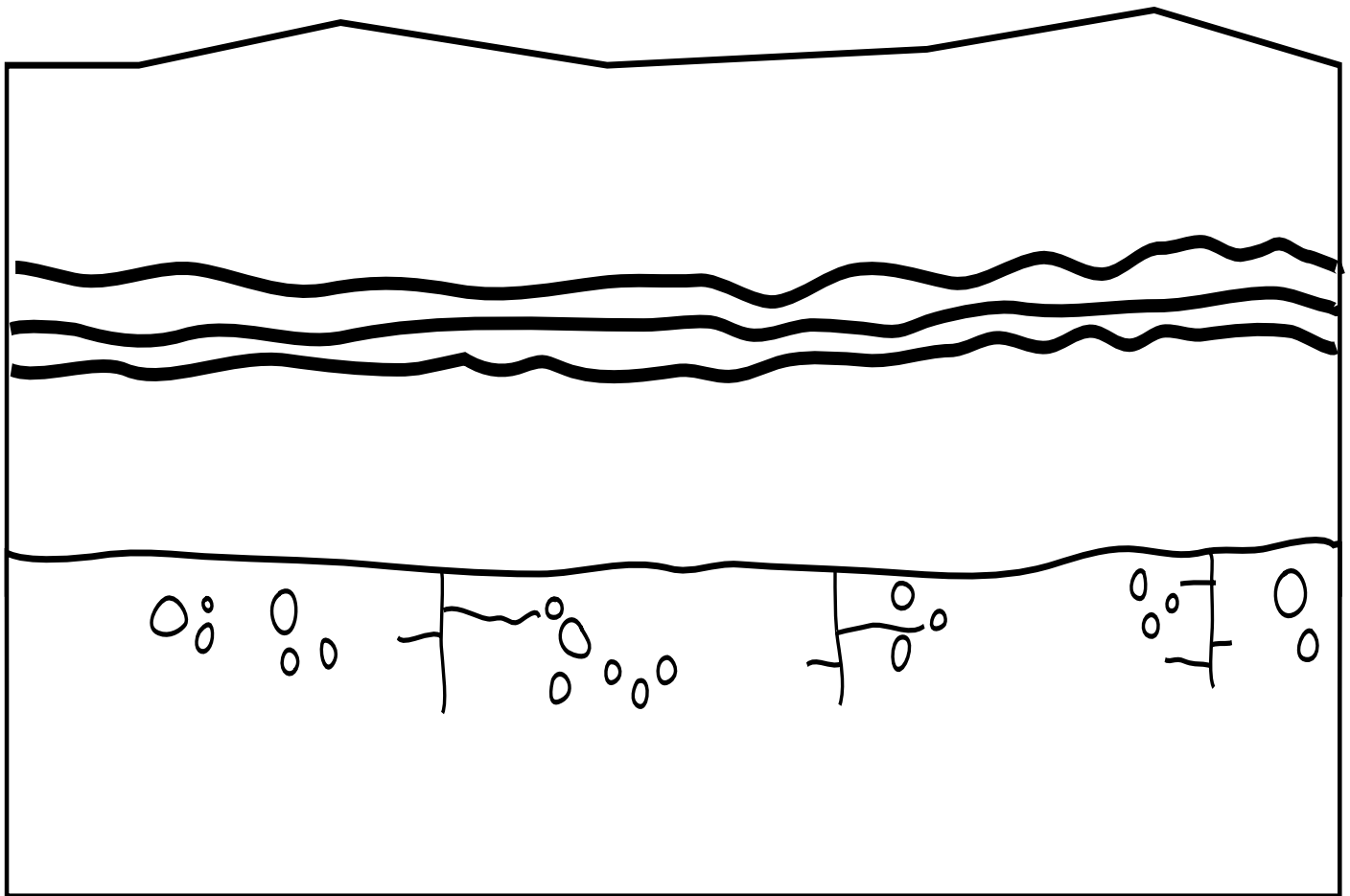
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Animal

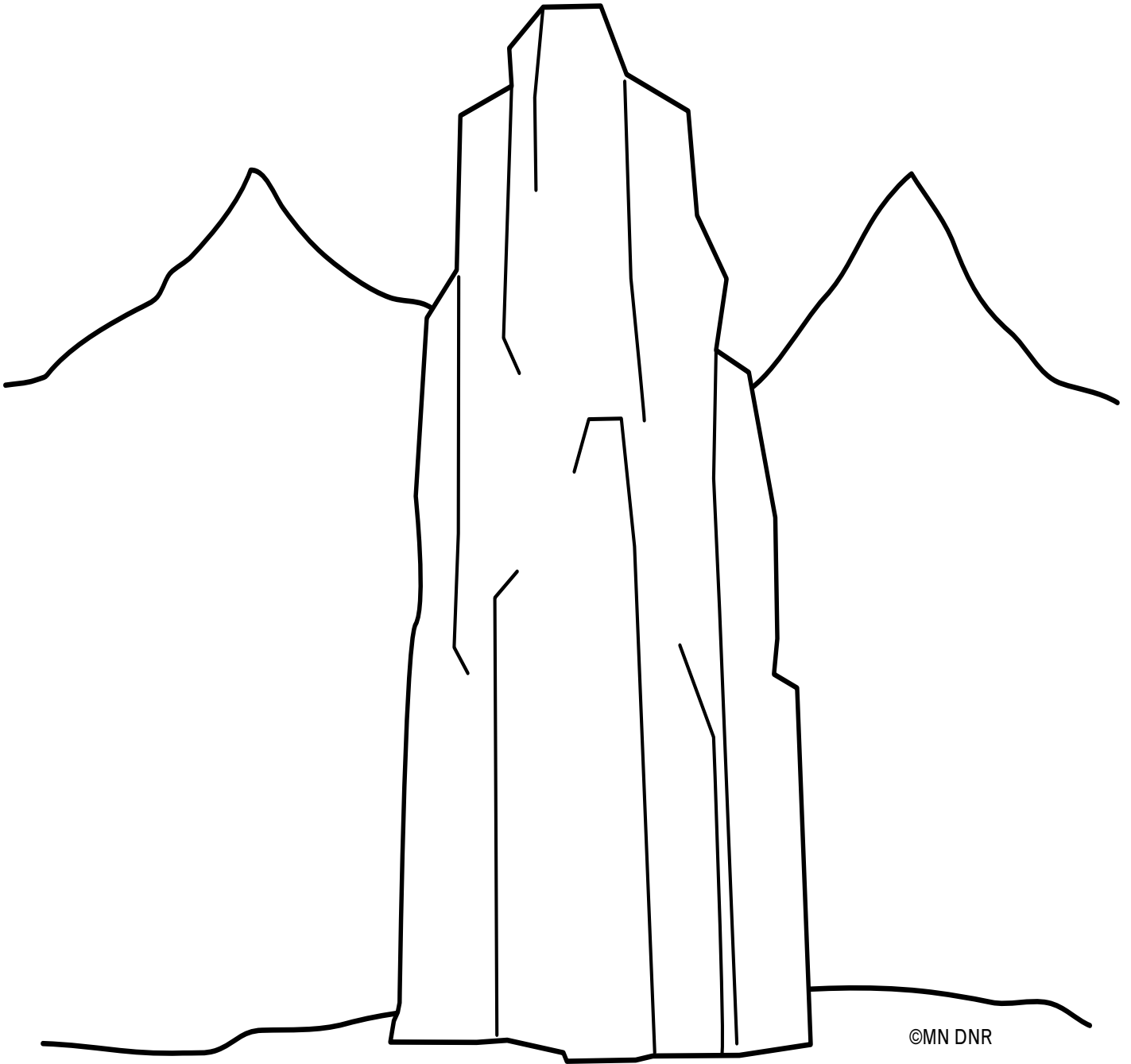
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Groundwater

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Glacier

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Pattern for a Cube

If you are making your own dice, the pattern across both pages makes one three-inch cube.

Glue

Glue

