W 331-B

Environmental Science — Footprints in the Forest

In this activity, students will learn about making observations and inferences. They will use those skills to observe and explain footprint patterns, making defensible hypotheses or inferences about things that happened in the past.

Adapted from **Teaching About Evolution and** the Nature of Science (1998)
Board on Science Education (BOSE) **http://www.nap.edu/openbook.php?record_id=5787&page=87**

Project Areas: Environmental Science
Forestry & Wildlife

Skill Level: Beginner-Intermediate

Learner Outcomes:
-Understand the difference between observation and inference
-Be able to make observations and inferences
-Understand qualitative and quantitative observations

TN Science Curriculum Standard GLEs:
0607.Inq.2-5
0707.Inq.2-5
0807.Inq.2-5
Embedded Inquiry

Life Skills: Observing, Reasoning, Communicating

Tags: Footprints, observation, inference, general science

Time Needed:
Set up: 0 minutes
In class: 20-30 minutes

Materials:
-Footprint puzzles, available in the "Fossils in the Forest—Puzzles" file, either printed or projected

Set Up

The footprint puzzles used in this activity are included at the end of this document. You can give them to your students either as a printed puzzle or project them on a screen. If you print them, cut into thirds along the lines. If you project, set it up so you can only show one-third of the puzzles at a time.

Introduce the Topic

Ask your student what an *observation* is. Answer: Anything we can gather with our five senses.

Ask your students the difference between qualitative and quantitative observations and provide some examples:

Qualitative observations describe (e.g., color, texture)

Example: The fish is large. The fish is smelly.

Quantitative observations measure and are generally numerical (e.g., size, weight, height)

Example: The fish is 32 cm long. On a smelliness scale of 1 to 5, the fish is a 4.

Explain that *inferences* are explanations for a set of observations. They are based on prior experiences.

To get your students thinking about observation and inference, show a series of pictures (can be anything) and ask them to make observations first, limiting statements to just things that can be observed with the five senses. Once several observations are provided, then ask your students to make inferences based on the observations.

Example: Picture of grass with water drops on it.

Observations: The grass is green, wet

Inferences: It rained last night, morning dew, the sprinklers were on, a dog peed in the grass, someone spilled their lemonade, etc.

Footprints Puzzles

Explain to the students that they will be attempting to reconstruct happenings from the geological past by analyzing a set of fossilized footprints found in the forest. Their problem is similar to that of a detective. They are to form defensible explanations of past events from limited evidence. As more evidence becomes available, their hypotheses must be modified or abandoned. The only clues are the footprints themselves.

Notes:

- There are three puzzle files with this lesson. Use one, two or three as time permits.
- You will present the puzzles one section at a time. Either project or hand out printouts.
- Use a whiteboard or large writing pad to record observations as students make them.

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Adapted by: Jennifer DeBruyn

For each footprint puzzle:

1. Show your students the first third of the puzzle ("A")
2. Ask them to make observations. These should be statements that everyone agrees on (e.g., "These are fossil footprints," or "The dimensions of one of the footprints is 20 cm by 50 cm."). You can lead your students to make observations by asking: How many animals were involved? What size are the footprints? Are the footprints evenly spaced apart? Were all the tracks made at the same time?
3. Ask your students to make inferences: Can you reconstruct a series of events represented by this set of fossil tracks? Inferences are statements that propose possible explanations for observations (e.g., "The two sets of footprints represent a fight between the animals."). Have the students discuss. Accept any reasonable explanations students offer. Try to point out consistently the difference between what they observe and what they infer. If you need to stimulate discussion, try asking the following questions:

   In what directions did the animals move?

   Did they change their speed and direction?

   What might have changed the footprint pattern?

   Can you tell anything about the size or nature of the organisms?

   Was the land level or irregular?

   Was the soil moist or dry on the day these tracks were made? (Answer: moist)

   When did the animals see each other? (Discuss landscapes that might have obstructed the view [e.g., mountains, trees].)
4. For each inference, ask what additional evidence you could look for to support the inference. Note that the primary emphasis for this activity is developing abilities and understandings for science as inquiry.
5. Show your students the second one-third piece of the puzzle ("B") and repeat steps 2-4. Ask them if the addition of new evidence has made their inference from part 1 more or less plausible. Any interpretation that is consistent with all the evidence is acceptable.
6. Finally show your students the whole puzzle ("C"). Make new observations and revisit inferences. A key point for students to recognize is that any reasonable explanation must be based only on those proposed explanations that still apply when all of the puzzle is seen.

Probable explanations for the puzzles (There will be several acceptable answers!):

Puzzle 1. A fight between predator and prey, and the prey gets eaten (or runs up a tree); a mother and baby, the mother picks up the baby and walks away.

Puzzle 2. A horse walking through a pasture, a man walks up to it, gets on and rides away.

Puzzle 3. A deer (or similar) gets hit by a car. The carcass is visited by scavengers (a terrestrial scavenger, like a coyote, and an avian scavenger, like a vulture).

Generalize and Apply

Discuss with your students how they were able to come up with explanations. Point out that they, like scientists, constructed reasonable explanations based solely on their logical interpretation of the available evidence. They recognized and analyzed alternative explanations by weighing the evidence to decide which explanations seemed most reasonable. Although there may have been several plausible explanations, they did not all have equal weight. In a manner similar to the way scientists work, students should be able to use scientific criteria to find, communicate and defend the preferred explanation.

Variations and Extensions

1. Have your students work in small groups to create a scenario and create their own fossil puzzle, either by drawing, using stickers/stamps, or creating footprints in playdough. Trade puzzles between groups. Can the other students guess the story?
2. Go outside! Take your students for a walk in the forest, and see if you can spot footprints. Have them propose explanations for a real-life footprint puzzle. You could tie this into a *Scats & Tracks* identification activity.
3. Tie into a language arts or extemporaneous speaking activity: Have students craft and deliver stories about the animal scenarios.

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Can you unravel the mysteries?

Words to Explore

Observation

Inference

Qualitative

Quantitative

When it comes to understanding nature, we have to be like detectives. We have to gather lots of evidence before they can figure out what might have happened. So how do we solve these mysteries?

Observe! One thing we can do is OBSERVE. Observations are gathered using our five senses. Look at the picture of the grass.

Observations can be *qualitative*: These are descriptions based on size, color, etc.

Example: The grass is wet.

Can you think of another qualitative observation _____

Observations can also be *quantitative*: These use numbers and are based on measurements.

Example: The grass is 10 cm tall.

Can you think of another quantitative observation?

_____

Infer! Once you gather observations, then you can make an INFERENCE. This is an explanation for the observations you collected.

Example: It rained last night.

Can you think of other inferences that would explain why the grass is wet?

1. _____
2. _____
3. _____

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Footprints in the Forest!

Part A: What do you observe?

1. _____
2. _____
3. _____

Now make three inferences to explain these footprints:

1. _____
2. _____
3. _____

Part B: What do you observe?

1. _____
2. _____

Based on your new observations, which of your inferences seems most likely now?

_____

Can you make a new inference?

_____

Part C: What do you observe?

1. _____
2. _____

What is the most likely inference that explains these footprints?

_____

_____

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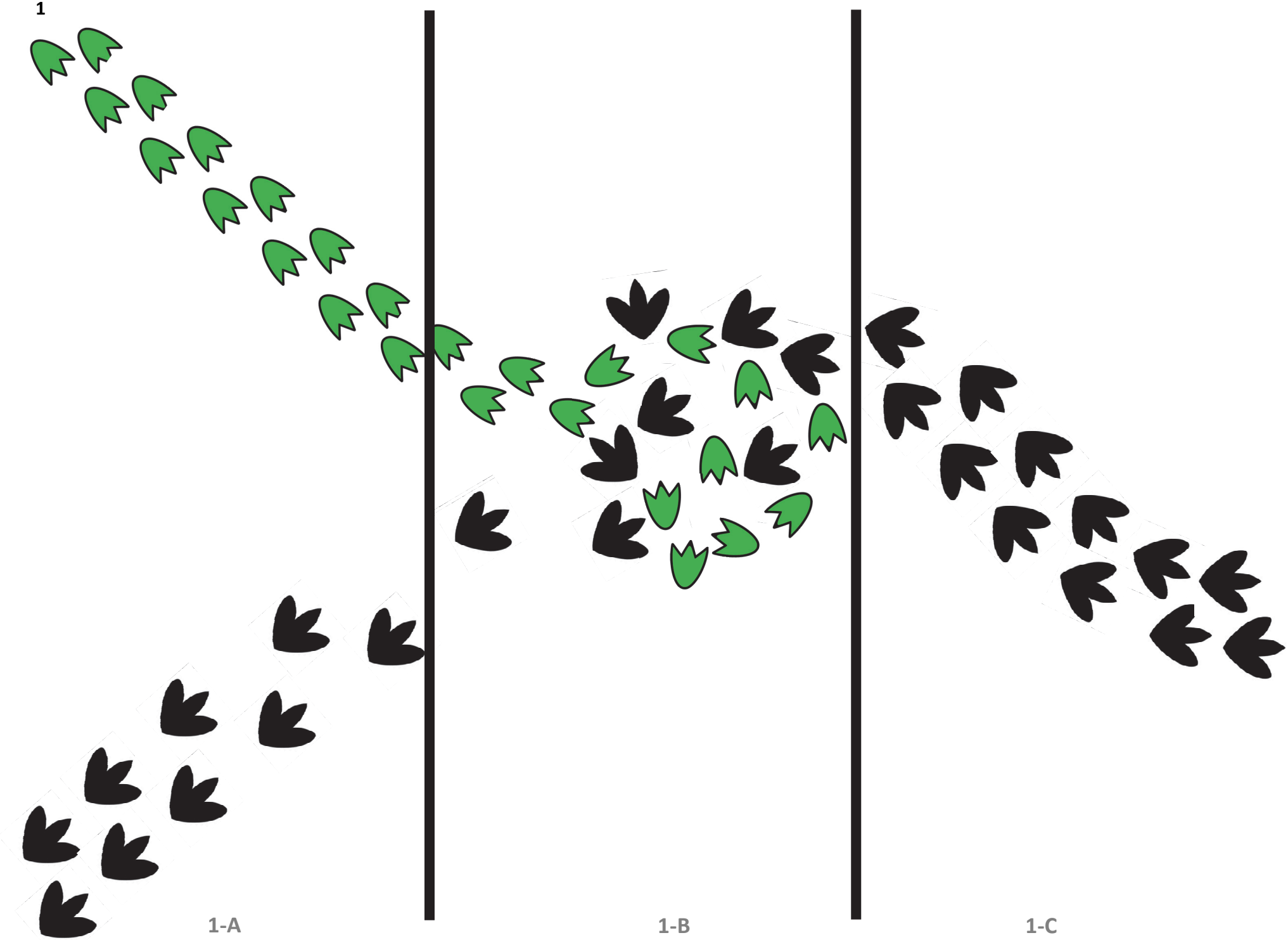
1

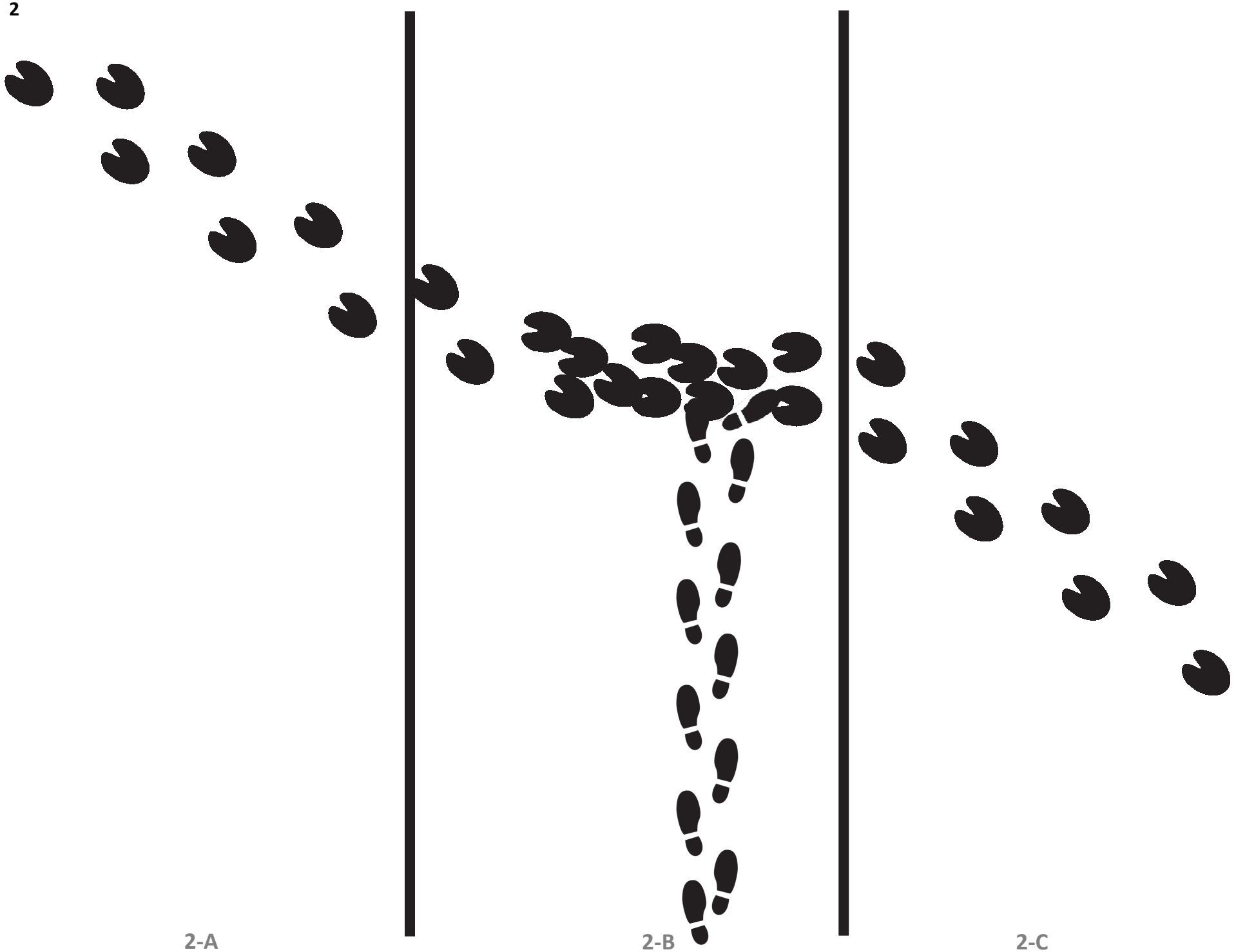


1-A

1-B

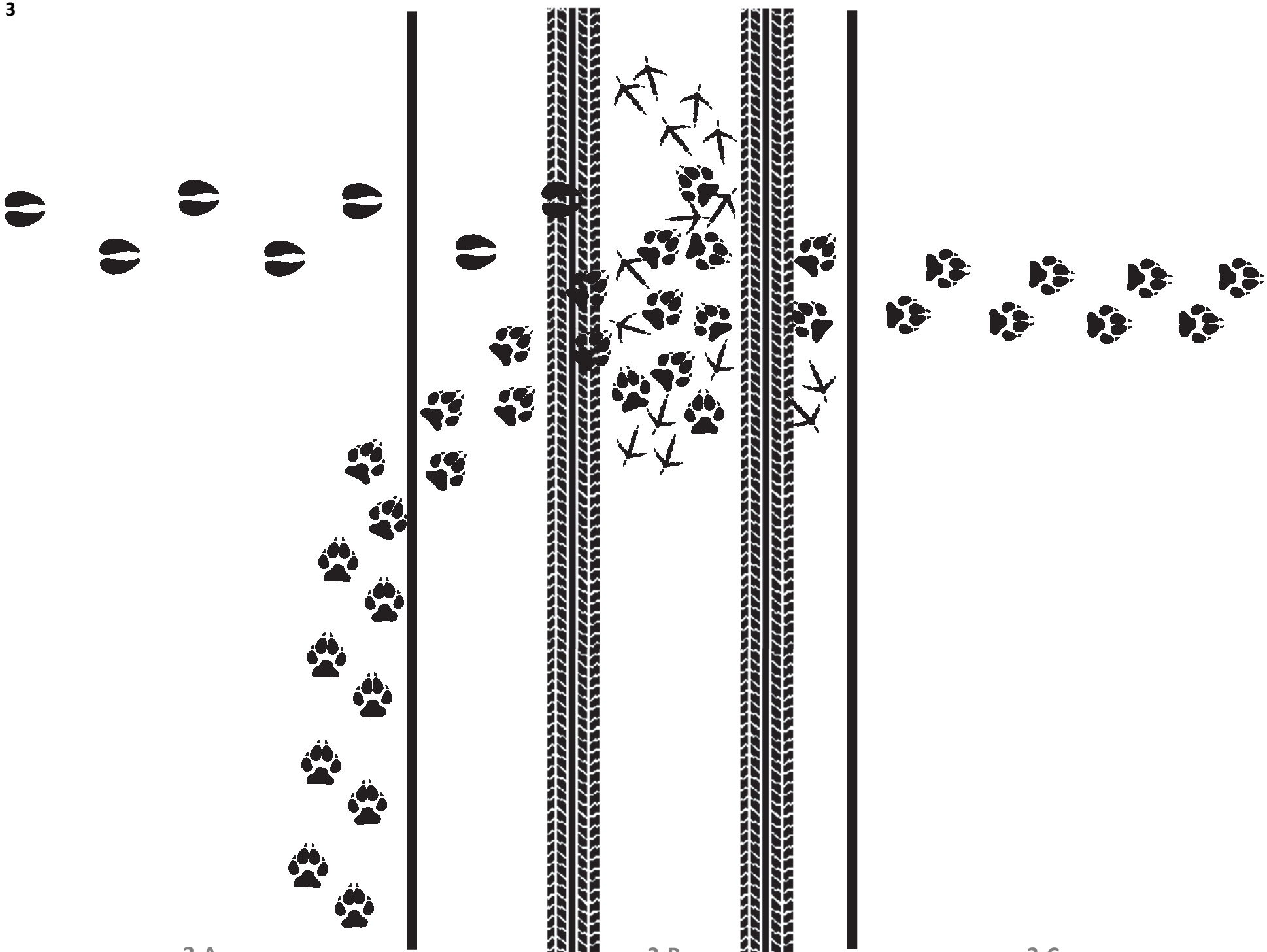
1-C

2



2-A 2-B 2-C

3



3-A 3-B 3-C