# Where the Pronghorn Roam

## Teacher Guide

Students learn about tracking pronghorn, how their migration patterns are affected by changes in the landscape, and what can be done to ensure they have space to roam.

**Grade Level:** Middle school

### Learning Objectives

- Students will learn that observing wild animals can help us understand patterns of migration and preferred habitats.
- Students will analyze tracking data to understand what features of the landscape help and hinder pronghorn migration.
- Students will learn that migration is becoming more challenging for pronghorn as landscapes are changed by human land uses and that careful land planning can help ensure pronghorn are able to migrate.

### Educational Standards

- NGSS MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
- NGSS MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
- NGSS MS-ETS1-1 Engineering Design. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- Literacy CCSS.ELA-LITERACY.RST.6-8.7 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).

### Time:

- Part 1: 20 min
- Part 2: 20 min
- Part 3: 45 min

### Materials

#### Part 1

- Large open space (outside or in a gym)
- Chairs, cones, and/or flags

#### Part 2

- Projector and computer with Internet access
- Chart paper or a whiteboard
- Video: *Argos-4: Tracking from Space* (https://youtu.be/aBc_MeKRMNc)
- Student Pages
- *Pronghorn Tracking Data Analysis* pages 8-9
- *All About Pronghorn* pages 10-11

#### Part 3

- *All About Pronghorn* (from Part 2)
- *Pronghorn Migration Instructions* (one per student) pages 12-13
- *Pronghorn Migration Maps (A-H)* (one set) pages 14-21
- *The Pronghorn Future Is in Your Hands* page 22
- *Land Use Cards* (one set) pages 23-24
- Colored pencils
- Yarn

## Preparation

### Part 1:

Identify a large open area (indoor or outdoor) and set up the migration space with your choice of cones, chairs, ropes, or flags.

### Part 2:

Print copies of *All About Pronghorn* and *Pronghorn Tracking Data Analysis*, one of each per student.

### Part 3:

- Print and cut apart one set of *Land Use Cards*.
- Make copies of *Pronghorn Migration Instructions* (one per student).
- Print one set of the *Pronghorn Migration Maps (A-H)*; each group will need one map.
- Cut yarn into 20-inch segments, one segment per group.

## Directions

### Part 1: What Can Be Learned By Watching Wildlife?

1. In a large open space, assign half the class to be pronghorn and the other half to be scientists. Explain that:
   - Pronghorn are hoofed mammals that are only found in North America. The pronghorn in this game will follow rules about where they go and how they get from place to place.
   - The scientists will watch how the pronghorn move around to figure out what pattern they follow.
2. Share the rules with the pronghorn students (quietly so that the scientist students don't overhear).
   - The pronghorn will migrate from one end of the space to the other and then reverse and migrate back to where they started.
   - Tell students that the features (cones, chairs, ropes, or flags, etc.) in the space are parts of the environment. They need to stay away from some features and close to other features as they migrate.
     - Choose one feature that all pronghorn must stay 2 arm-lengths away from at all times.
     - Choose a different feature that all pronghorn must stay within 2 arm-lengths at all times.
3. After the scientists have watched the pronghorn migrate for a few minutes, have the pronghorn freeze their motion and allow the scientists to discuss what they learned about the patterns.
4. If the scientists haven't fully uncovered the pattern, have the pronghorn start moving again so that scientists can take more observations.
5. Have the scientists share their conclusions with the rest of the class. And allow the pronghorn to respond about whether they were correct.
6. Discuss what can be learned from observing animals and the benefit of watching multiple animals in a population. (Understanding patterns of migration and preferred habitats helps wildlife managers protect areas that are essential for animals; multiple animals would help researchers notice patterns in animal behavior.)
7. Explain that it was pretty easy for our scientists in this exercise to observe the pronghorn. However, this isn't always the case. Have students turn and talk to the person next to them and consider the following question(s):
   - How can scientists keep track of animals moving fast over huge distances? (Pronghorns have been documented running 35 miles per hour nonstop for more than two miles!)
   - Optional question if time allows: Some animals behave differently when people are nearby, so how can scientists observe them without influencing their behavior?
8. Share that satellite technology has allowed scientists to better understand how animals move through a landscape. By placing collars with Argos satellite tracking tags on pronghorns, scientists can get location information sent to their computers, collecting information from many animals in a large geographic area.
9. Return to the classroom and watch the video Argos-4: Tracking from Space (3:04) (https://youtu.be/aBc_MeKRMNc) for more information about how satellites are used to track animals.

## Part 2: What Did the Pronghorn Researchers Find With Tracking Data?

Provide students with more of an introduction to pronghorn. Hand out the *All About Pronghorn* reference page and orient students to the sections. Review the general facts at the top of the first page and let students know that they will refer to this information during the rest of this lesson (Parts 2-3).

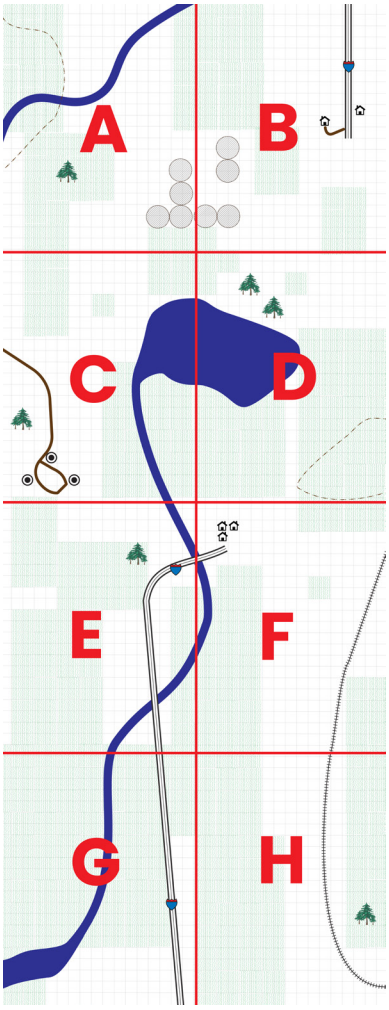
1. Project a map or Google Earth to introduce students to the region where pronghorn were studied in Montana, Alberta, and Saskatchewan. Orient students to the map by noting the border between the United States and Canada, the locations of states/provinces, and (with a satellite view) the landscape, which is dominated by grass-covered plains, rolling hills, and some areas of forest.
2. Introduce the research that students will explore.
    - Researchers wanted to know what areas within the region the pronghorn prefer, and what areas they avoid. They placed collars with Argos satellite tags on 185 pronghorn and tracked where they went.
    - They compared the pronghorn locations with the land features in those locations. Overall, they learned from the data that pronghorn preferred to migrate through grasslands and avoided conifer forests.
    - Tell students that they are going to look at the pronghorn tracking data to learn what other parts of the landscape pronghorn preferred and avoided.
3. Hand out the Pronghorn Tracking Data Analysis. Orient students to the graphs and their axes.
4. Each graph shows the likelihood that pronghorn will use land that includes a particular feature. Some of the features are natural (such as slope, terrain, vegetation, waterways) and others are human built (paved roads, unpaved roads, and oil and gas wells).
5. All seven graphs include the same y-axis, which shows the predicted probability that pronghorn will use land with the feature.
6. Have students analyze and interpret the graphed data on the student page. Students should check the *All About Pronghorn* reference sheet and consider whether their observations in the graphs are consistent with the facts about pronghorn.
7. Share all answers as a group and create lists of what the pronghorn prefer and avoid (see the table below). This should include the seven items that students analyzed in the graphed data as well as the information from the *All About Pronghorn* reference page. After creating the list together as a group, have students add the list to the table on their *All About Pronghorn* reference page. They will need this information for Part 3.

| Pronghorn Prefer: | Pronghorn Avoid: |
|---|---|
| Grasslands | Oil and gas wells |
| Green vegetation | Roads (paved and unpaved) |
| | Steep slopes |
| | Rugged terrain |
| | Conifer forests |
| | Rivers and streams |
| | Farmland and fences |

## Part 3: Planning For the Pronghorn Migration

1. Introduce the next part by reminding the students that pronghorn populations can travel hundreds of miles when they migrate and typically follow the same path every year. However, their journey between their breeding and wintering grounds is becoming more challenging because the land is changing. Identify this as a problem the pronghorn are facingand write it on the board.
2. Divide the class into groups of three or four students.
3. Have students read the *Where the Pronghorn Roam* comic.
    - Within their groups, have students discuss the following:
        - What obstacles did the pronghorn avoid? Did these obstacles have anything in common?
        - Were there any solutions, such as engineering, that helped pronghorn migrate?
    - Have a few groups share out. Students should have recognized that many of the obstacles are a result of how humans use the land and that a bridge allowed pronghorn to cross a road.

4. Explain to the students that we are going to use what we have learned so far about pronghorn to help a population safely migrate in a simulation.
    - You may want to revisit the list of items that pronghorn avoid and prefer by either projecting the list or writing it on the board.
5. Make sure each group has: a copy of the *All About Pronghorn* reference sheet from Part 2, one *Pronghorn Migration Map*, copies of the *Pronghorn Migration Instructions*, one 20-inch piece of yarn, and colored pencils.
    - Orient students to their map. It includes natural features such as forest, grasslands, and waterways and some human land-use features such as homes, fences, roads, oil and gas wells, cultivated land, etc.
        - Note: each group's map is slightly different. At the end of the activity all maps will fit together to form a larger landscape. Do not tell students that the maps will fit together (they may figure it out if they compare maps, so avoid distributing adjacent maps to nearby groups).
        - If you have less than eight student groups, then use maps A-F to include a variety of different types of land uses and ensure they will all fit together at the end of the simulation.
6. Show students how to mark the migration pathway (also called a corridor) using yarn and instruct students to make sure that their pathway is at least two boxes wide so that pronghorn can move through (which is approximately 2 km, or 1.2 miles wide). Point out the direction of migration - from south (wintering grounds) to north (breeding grounds).
    - Note: The width of this pathway is based on the Path of the Pronghorn, a 70+ km long U.S. federally designated migration corridor for pronghorn, linking the animals summer range in Grand Teton National Park to the Green River Basin, where pronghorn spend the winter (see References). The width of other corridors in other locations may be different.
7. Students will begin by mapping out their ideal pronghorn migration pathway using the yarn.
8. As students are working on their map, draw a negative *Land Use Card* and announce that there is a new item they have to add to their map. Depending on the card, it may take the students a few minutes to decide how to add the land use to their map. They may also need to change the location of the yarn migration pathway depending on the new land use.
    - Note: Students will most likely have additional questions that are not addressed in the rules (such as, "can fences go across roads?"). These are great creative questions that you can either answer or ask the class to come up with an answer that makes sense.
9. Repeat the process with another two negative *Land Use Cards*, each time having students add the land use changes and modify the migration pathway on their maps.
10. Draw a positive *Land Use Card* and have students adjust their maps.
11. Continue this pattern of three negative *Land Use Cards* to one positive *Land Use Card* based on time or until you run out of cards.
12. After 15-20 minutes, have the students discuss the following questions within their groups:
    - Which land use change was the most difficult to plan for the pronghorn?
    - Which land use changes had little impact on the pronghorn?
    - Were you able to add anything to your map that helped the pronghorn migrate?
13. **Zooming Out**: Let the students know that each land map is just one piece (or fragment) of a larger land "puzzle." Collect the maps from the groups. Arrange and display the completed land puzzle (use the image of the completed puzzle above as a guide) in a place where everyone can see it, such as on the table or on the floor.
    - Have students take a moment to compare the maps and note any differences. (Some maps started out with a lot more vegetation or open space than others).
    - Ask: Are the pronghorn able to migrate through the whole area?
        - Have students move the strings to see if it is possible to make a continuous migration path.



How the map "puzzle" fits together.

- Explain that fragmentation is when continuous habitat, ecosystems, or migratory pathways are broken up into smaller pieces and become surrounded by human land use. This can make it difficult for pronghorn to migrate.
    - Ask: Did the migration path of our pronghorn become fragmented? If so, is there a way we can connect the different fragments? Students should realize that they need to work together to make sure pronghorn can migrate between maps (like different land owners or governmental agencies).
    - Ask: Are there areas that are really important and might need to be protected? (Students should realize that areas of grassland are really important. You can relate this to why there are Wildlife Refuges and other protected areas.)

14. **Wrap Up/Assessment:** Have students create a recommendation for future land use for all eight connected maps. Pass out the *The Pronghorn's Future Is In Your Hands!* student page and have students write a response to the prompt:
    - Students should write 1-2 paragraphs explaining and justifying their recommendation, addressing it to a land developer. Students can work individually or as a group.
    - If you are running short on time, this can be done as a large group discussion. Put the main points of the prompt up on the board so the students can refer to it as needed.
    - Depending on the result of their large map, students will likely focus on different recommendations.
        - If the maps show a clear and easy pathway for pronghorn, then student recommendations should reflect conserving that land.
        - If the maps don't show a clear pathway, then the recommendations should address the current issues.

**Additional options for Part 3:**

- Take an additional class period to repeat the map activity with all groups working together to plan over the larger area.
- Assign roles to the students within each group to replicate how wildlife agencies, governments, and land owners have to work together when planning the use for an area. Potential roles and responsibilities could include:
    - Mapper puts items on the map in consultation with the biologist and land use planner. They are also in charge of the Map Key and making sure that their team understands it.
    - Biologist acts as the pronghorn specialist and is responsible for identifying which land use the pronghorn avoid by consulting the *All About Pronghorn* resource sheet and the list of pronghorn preferences and avoidances.
    - Land use planner makes sure the needs of the growing community are being met and makes sure the rules are followed.
    - Pronghorn defines the path of the pronghorn population on the map with yarn. They also make sure that the migration pathway is at least 2 km wide and tell the rest of the team if they see an issue or a challenge for the pronghorn.

**Extensions:**

- Consider migration on a larger scale as wildlife shifts its range in response to climate change. Have students read about this survival strategy and the availability or lack of wildlife migration corridors. Are creating wildlife corridors a good solution? Why or why not?
- Have students compare aerial images from the past to more current aerial images using Google Earth Pro. On the view menu, select "Historical Imagery" and use the time slider control to quickly access past images of an area. Students can record their observations of how the study site (or a local site) has changed over time. They can also draw on the map with polygons to note areas that have become more fragmented over time. (This extension aligns with the National Geography Standard #18: How to apply geography to interpret the present and plan for the future)
- Discuss habitat fragmentation in students' local area. What examples of fragmentation are evident? How can a region be managed to avoid fragmentation? Have students create habitat murals or maps of a local wildlife species (this can be left up to the student and can be 2D or 3D—drawn, digital, legos, clay, diorama). Ask students how future development and other factors such as climate could impact migration patterns and/or home ranges. Can students effectively plan for the land use of their area represented by the mural or map?
    - Questions to incorporate:
        - Why do more roads lead to increased land use?
        - What factors would you consider if you had to decide between operating your large farm and an offer to sell your property for development?
        - How could you decrease fragmentation and the loss of habitat?

## Background

This lesson focuses on pronghorn, a North American hoofed mammal, in order to help students understand how scientists study large herds of animals that migrate long distances. Refer to the *All About Pronghorn* page to learn more about these animals. Even though the scientific name of the pronghorn (Antilocapra americana) means "American antelope goat," pronghorn are not antelopes. Their closest living relatives are giraffes and okapi.

Pronghorn's preferred habitat is broad open grasslands, both because grasses and flowering plants are preferred food, and because they are well adapted to deal with predators in a landscape where they can see over vast areas. Pronghorn have excellent eyesight (and have large eyes), so are able to spot threats from a great distance. As the fastest land animal in North America and second-fastest in the world after the cheetah, pronghorn are well adapted to flee from predators as well. They adapted to be so speedy when, in the past, they needed to avoid a now-extinct predator that resembled the cheetah. The predator may be extinct, but the pronghorn is still adapted to run fast. For this reason, some say pronghorn are running from ghosts of past predators.

This lesson also helps students understand how the changes to the land can affect wild animals like pronghorn. Students will learn about some of the human-built obstacles that pronghorn face in the All About Pronghorn student page and will encounter some of these obstacles with the *Land Use Cards* as they create their maps in Part 3. For example, fences intended for livestock are barriers for pronghorn. Pronghorn are unable to jump fences and are often injured if they attempt to go under low fences. Pronghorn also avoid human-built structures, like houses and towns. Areas in migration pathways are becoming fragmented, or broken up, by the development of roads, towns, fences, and energy facilities. Agriculture is also fragmenting pronghorn habitat (approximately 50% of Saskatchewan's mixed-grassland ecoregion, has been cultivated). Students will also get a sense of how weather and climate can impact pronghorn in Part 3. For example, there's less food available for pronghorn in winter.

Students model pronghorn migration in Part 3 and, as with any model, there are limitations and assumptions made. For simplicity, pronghorn "react" to and keep the same distance away from land uses equally. In reality, how pronghorn react to different land uses depends on a multitude of factors, with some having more of an impact than others during different times of the year. If time allows, you can have your students reflect on how the model and simulation they did is similar to, and different from reality.

How biologists track wildlife

In order for wildlife agencies and wildlife biologists to manage animal populations, they need to understand the health of individual animals, population fluctuations, migration patterns, feeding behaviors, and location of home range or other areas important to the life cycle of the animal. To collect this information, scientists may use a combination of techniques including firsthand observations, radio telemetry, GPS tracking, satellite tracking, remote cameras, and catch and release. Tracking collars or tags are a common method to monitor wildlife.

Satellite tracking using the Argos satellite system allows researchers to collect more data, more often, and uses satellites to nearly continuously observe and record animal movements. This has helped researchers learn more about animals that travel long distances or animals they are not able to monitor all of the time. The Keeping it Wild video (see References below) summarizes some of the benefits of using this type of technology to monitor pronghorn.

The information and inspiration for the activities in this lesson is from a study focusing on Pronghorn migration across borders and human-made landscapes (see References below) in which scientists used satellite telemetry collars and the data collected by Argos, which helps us understand what aspects of the landscape pronghorn avoid and how land planning can help ensure pronghorn have migration pathways that are safe. Students analyze summarized data from this research in Part 2 of the lesson. Using what's learned from satellite tracking data, scientists and managers can identify key areas of habitat to protect and preserve. To overcome obstacles, wildlife managers have implemented wildlife crossings (such as over- and underpasses) to help prevent road mortalities, along with working with landowners to install wildlife-friendly fencing on their property.

## Links to Learn More

### Pronghorn research and management

- Pronghorn migration across borders and human-made landscapes, Argos news story: https://www.argos-system.org/pronghorn-migrations/
- Multiscale habitat assessment of pronghorn migration routes (Jakes et al., 2020) This article is the source of the data that students analyze in Part 2. (https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0241042)
- Pronghorn Management Plan
  - Whiklo, Todd, 2019. Management Plan for Pronghorn (Antilocapra americana americana) in Saskatchewan. Wildlife Unit, Fish, Wildlife and Lands Branch, Saskatchewan Environment. 30 pp.
- Path of the Pronghorn, a 70+ km long U.S. federally designated migration corridor for pronghorn (https://beingwildjh.com/crucible-of-conservation/success-stories/path-of-the-pronghorn/.)

### Learn more about pronghorn

- Canadian Georgraphic: Pronghorn Facts (https://www.canadiangeographic.ca/article/animal-facts-pronghorn)
- The National Wildlife Federation (https://www.nwf.org/educational-resources/wildlife-guide/mammals/pronghorn)

### Animal tracking

- Keeping it Wild (Texas Parks and Wildlife Foundation) (https://www.youtube.com/watch?v=aQPdsudtPXE)

NOAA and CNES have been partners in the Argos data collection system since 1978. For NOAA's latest contribution to the Argos system, NOAA has partnered with CNES to host their Argos-4 instrument aboard a commercial satellite. NOAA is working with USSF to utilize their hosted payload solutions contract and selected General Atomics and their Orbital Ted Bed-3 satellite to host the Argos-4 instrument.

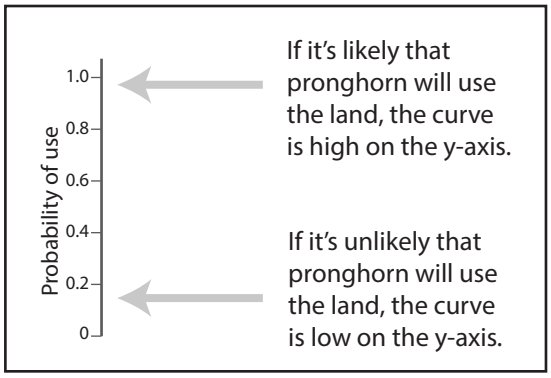
This activity was developed at the UCAR Center for Science Education as an outreach effort of the Argos program under award NA21OAR4310383 from the National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Commerce. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of NOAA or the U.S. Department of Commerce.

Name:

# Pronghorn Tracking Data Analysis

## Part 2: Where the Pronghorn Roam

The graphs below show how likely it is that pronghorn will use land that has particular features. These are predictions based on pronghorn tracking data that scientists collected during the spring pronghorn migration. In the space next to each graph, write a sentence about what you see in the graph and then write a sentence about what it tells you about what pronghorn prefer and avoid.




| | What I see in this graph: | What it means about what pronghorn prefer and avoid: |
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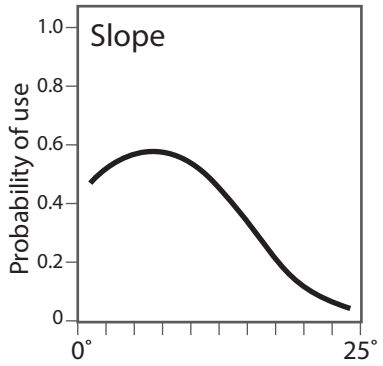
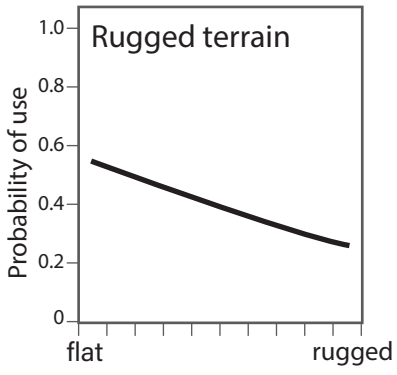
|   | | |
|   | | |





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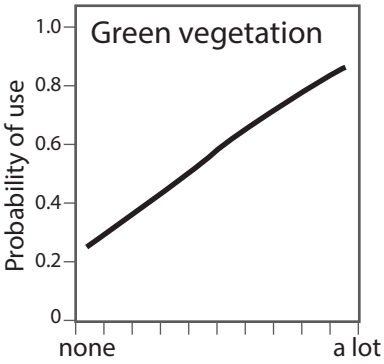
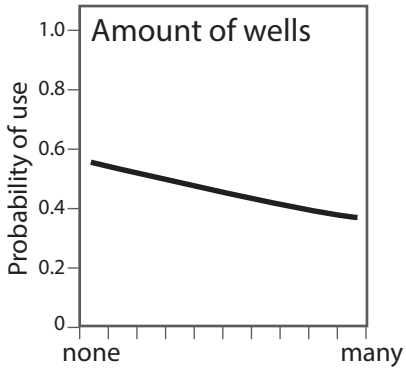
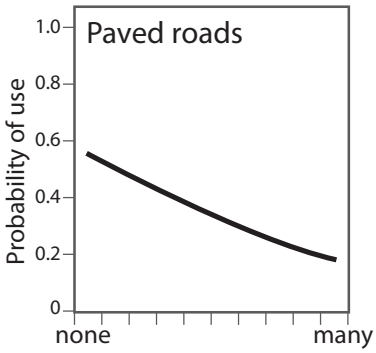
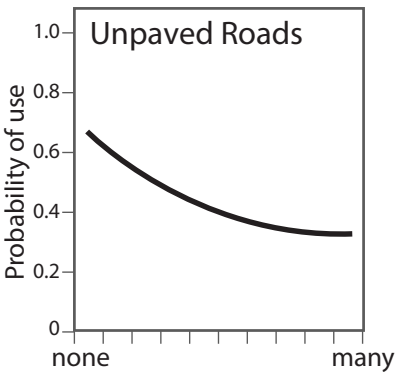
| | What I see in this graph: | What it means about what pronghorn prefer and avoid: |
|---|---|---|
|  | | |
|  | | |
|  | | |
|  | | |

Name:

# All About Pronghorn

The information below will help you as you analyze data collected from the satellite tracking collars and plan for pronghorn migration in a landscape.

### What are pronghorn?

Pronghorn are hoofed animals that have long legs, a short tail, and a long snout. Their fur is reddish-brown, tan, or brown in color. With white markings on their neck, face, stomach, and rump, they camouflage well with their surroundings. The hair on their white rump is longer and sticks up when the pronghorn senses danger. Pronghorn live in herds, which can range in size from 10-1000 individuals.

Credit: David Thielen / Unsplash

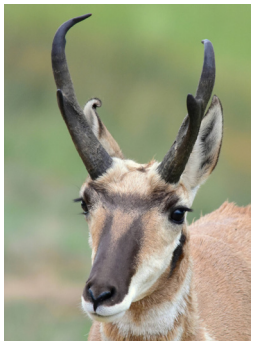
**Average height:** about 1 meter (3 feet) at the shoulder

**Average weight:** 40-60 kilograms (87-125 pounds)

**Average lifespan:** 7 to 10 years in the wild

**Diet:** Sagebrush, flowering plants, grasses, and cacti

**Predators:** wolves, foxes, coyotes, bobcats, and golden eagles. To avoid becoming someone's dinner, pronghorn use their quick speeds and amazing eyesight (they can detect movement up to 4.8 km, or 3 mi, away).



Credit: Tom Koerner / USFWS

### Do pronghorn have horns or antlers?

Horns and antlers are different. Antlers are made of bone, shed each year, and have forks or branches. Horns are never shed, have only one point, and are made of keratin (the same material as your fingernails) that grows from a bony core. The horns of a pronghorn are forked and shed each year (like antlers) and are made of bone covered in keratin (like horns). So pronghorn actually have elements of both horns and antlers!

### Where do pronghorn live?

Pronghorn live in western North America and prefer shrubland, grassland, and desert habitats. Some pronghorn populations migrate long distances, hundreds of kilometers, while other populations remain in the same area all year. The pronghorn that do migrate, tend to follow the same general route every year between summer breeding areas and their winter grazing areas. Research has found that pronghorn avoid conifer forests and farmland as they migrate.


A map of North America with pronghorn habitat marked in much of the western and north-central US, along the Rocky Mountain corridor, as well as some patches in northern Mexico, and some patches in southern Canada along the US-Canadian border.

Credit: NatureServe 2008. Antilocapra americana. The IUCN Red List of Threatened Species. Version 2021-3.





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**Did you know?**

- Pronghorn are able to swim, but swimming long distances takes a long time and is exhausting. Pronghorn try to avoid crossing rivers and lakes over 2 km wide during migration.
- Pronghorn have been known to reach speeds of 80-96 kph (50-60 mph)! They are the fastest land animal in North America and second-fastest in the world after the cheetah.
- Fences can be a big problem for pronghorn since they are not the best jumpers. So when pronghorn encounter a fence, they try to go under rather than over (which can be dangerous if the fences are made of barbed wire). Pronghorn try to avoid fences.
- Railroads can be dangerous to pronghorn. During snowy conditions, pronghorn will use the railroad as a path so they can more easily move through the snow. However, when pronghorn congregate on tracks, they may get hit by a train.
- Pronghorn eyes are quite large relative to the size of their head and body, about 3.8 centimeters (1.4 inches) in diameter– which is roughly the size of an elephant's eye!
- The closest living relatives to pronghorns are the giraffe and the okapi. Even though some call them American antelopes, the pronghorn is not actually an antelope.
- Both males and females have horns. A female's horns are much smaller than a male's. The horns of a male pronghorn can grow to 10-12 inches long.

Make a list in the table below of what the pronghorn prefer and what they avoid.

| Pronghorn Prefer: | Pronghorn Avoid: |
|---|---|
| | |

Name:

# Pronghorn Migration Instructions

## Part 3: Where the Pronghorn Roam

Your Team's Goal: Create a migration pathway on your map that will allow pronghorn to safely move to and from their breeding grounds.

**Directions:**

1. Use the Map Key to figure out what type of land use is on your map.

2. Work together to mark where the pronghorn population will migrate on your map using yarn, making sure to follow the rules listed below. Different land use changes might impact the pronghorn differently.

3. When a Land Use Card is introduced, you will need to follow the instructions on the card to change your map.

4. Adjust your migration path (yarn) if needed to make sure the pronghorn are able to move to their breeding grounds safely and all of the rules are still being followed.

**Rules:**

- The migration pathway of the pronghorn needs to be at least 2 km wide.
- Migrating pronghorn exert a lot of energy and need to refuel along their journey. Pronghorn will need to have access to green vegetation along their migration route at least every 5 squares.
- If a land use change is listed as something pronghorn need to avoid, you must leave two empty squares between the icon on the map and the pronghorn migratory path. (Hint: use your *All About Pronghorn* resource sheet to determine which land use changes pronghorn need to avoid)
- If a Land Use Card pulled by your teacher asks you to place an X on an icon, that spot becomes empty and available for other land use.
- The following land uses remove green vegetation and the forest when built:
  - Energy production
  - Homes and structures
  - Railroads
  - Unpaved roads
  - Highways
  - Cultivated land
- Fences can be built on green vegetation without removing it. However, fences can not go through forests.
- An unpaved road must be built to get to and from each set of oil and gas wells (energy production).
- Either an unpaved road or paved road needs to be next to each set of houses or structures.

## Map Key

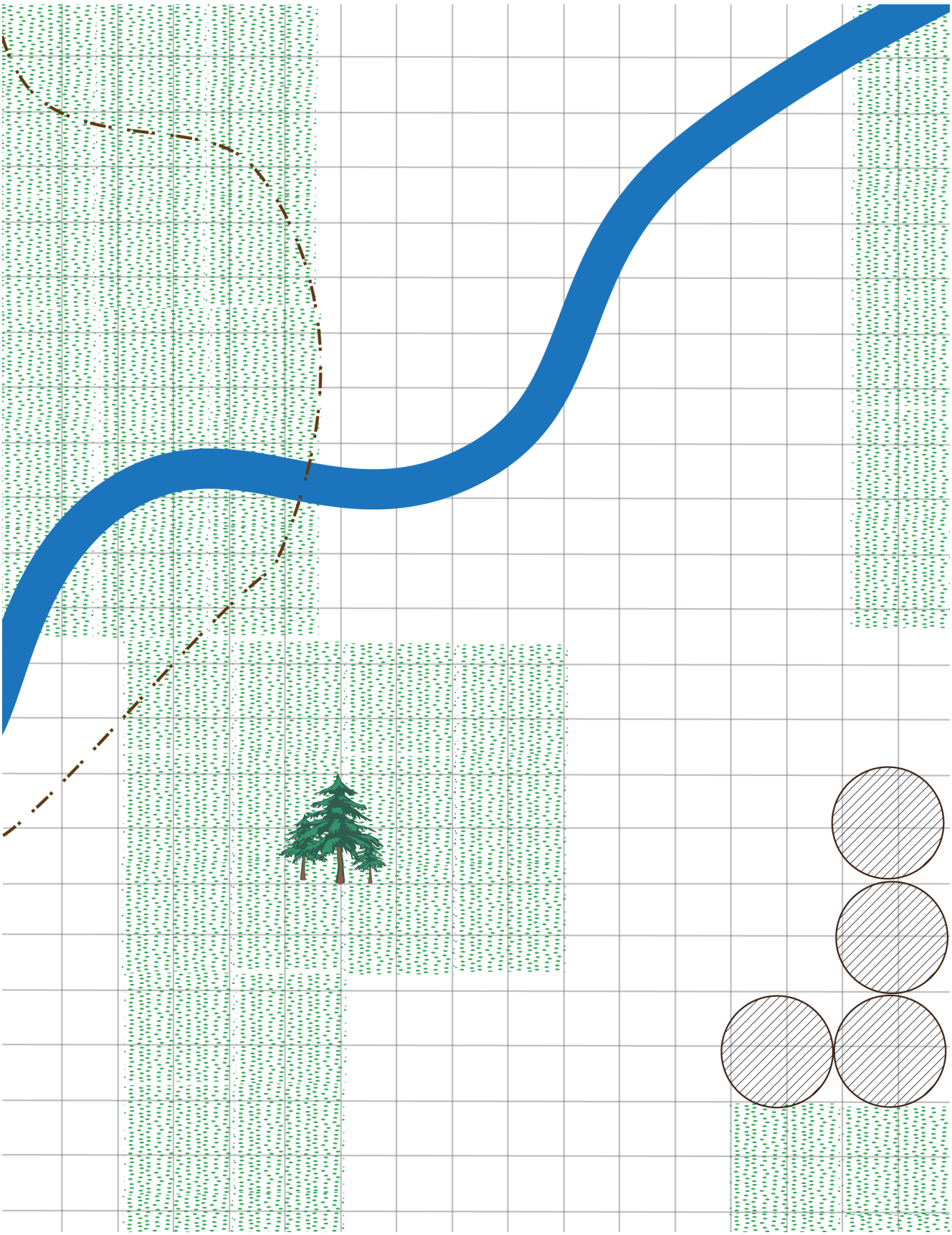
| | |
|---|---|
|  | This house icon takes up one square on the map and equals 3 houses or buildings. |
|  | This circle icon takes up one square and represents energy production from a set of 5 oil and gas wells. |
|  | This icon represents a forest of conifer trees and takes up four squares on the map. |
|  | This icon represents a lake. |
|  | This icon represents a river. |
|  | Railroads |
|  | Unpaved road |
|  | Highway (or other paved road) |
|  | This circle icon with diagonal lines represents farmland (agriculture/crops).<br>Each circle icon takes up four squares on the map. |
|  | Fences |
|  | These dots represent green vegetation, or food for the pronghorn. |
|  | This represents a wildlife overpass or bridge. These large bridges are used to help wildlife cross large highways. This icon should take up 1-2 squares on your map. |
|  | Scale for map. 1 square on the map = 1 square kilometer (.6 mile). For this particular group of pronghorn, they require a migration pathway that is 2 km wide (= 2 squares). |
|  | Cardinal directions for the map. For this activity, the pronghorn will be moving from the South (wintering grounds) to the North (breeding grounds). Note: Pronghorn can move west or east on your map, but the overall migration pathway should be heading north. |





UPDATED: MAY 2022

## Map A

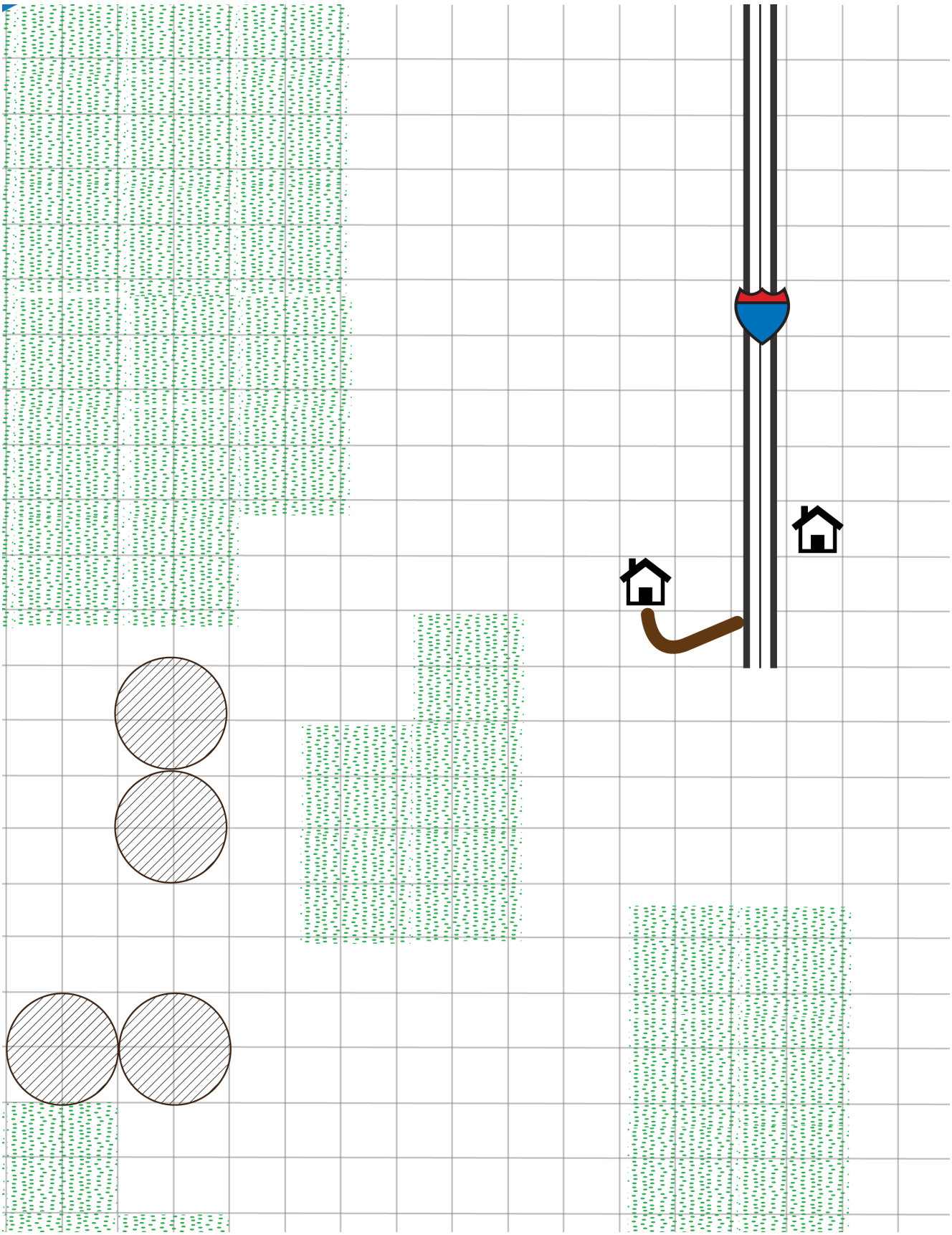




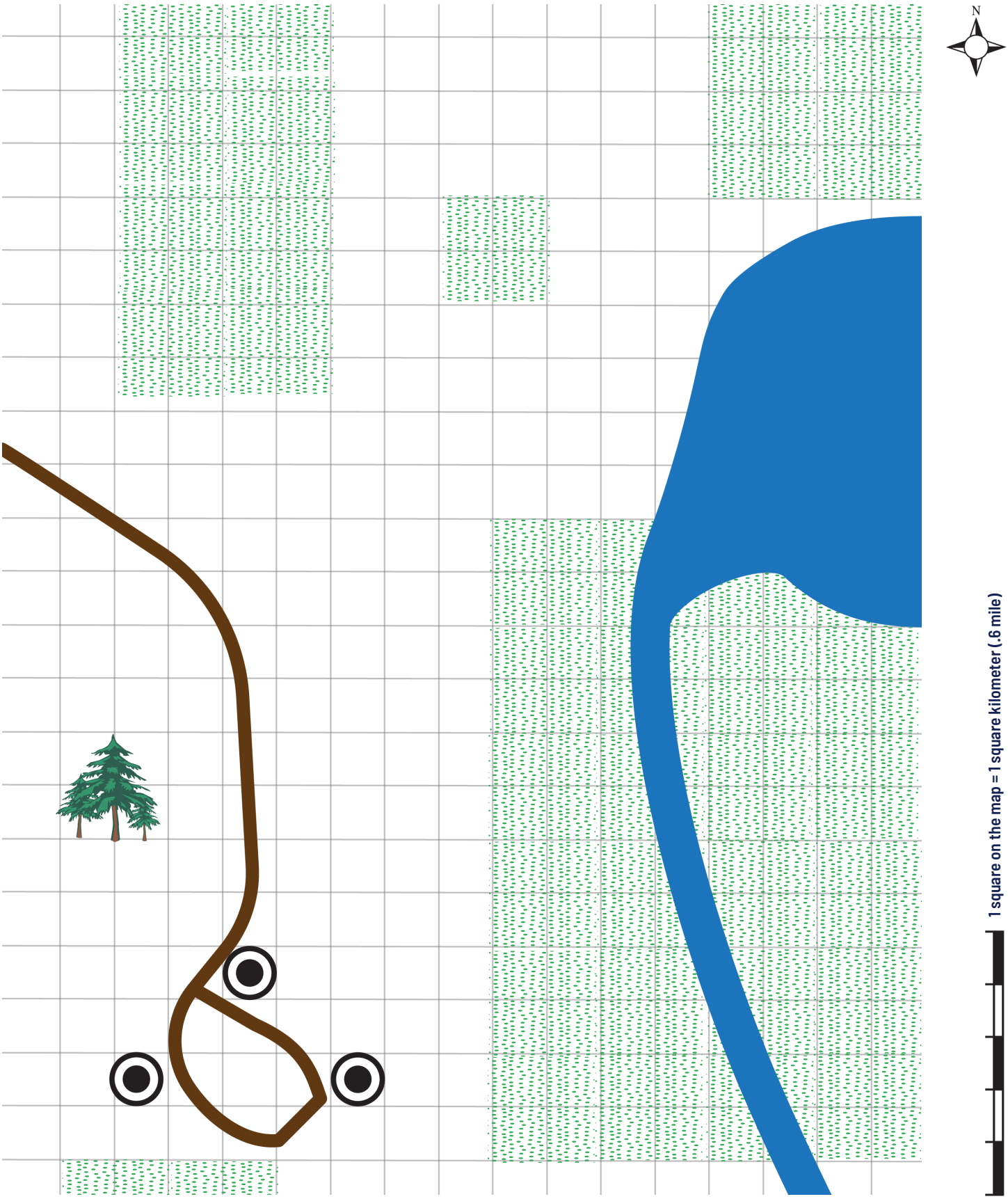



UPDATED: MAY 2022

## Map B



## Map C

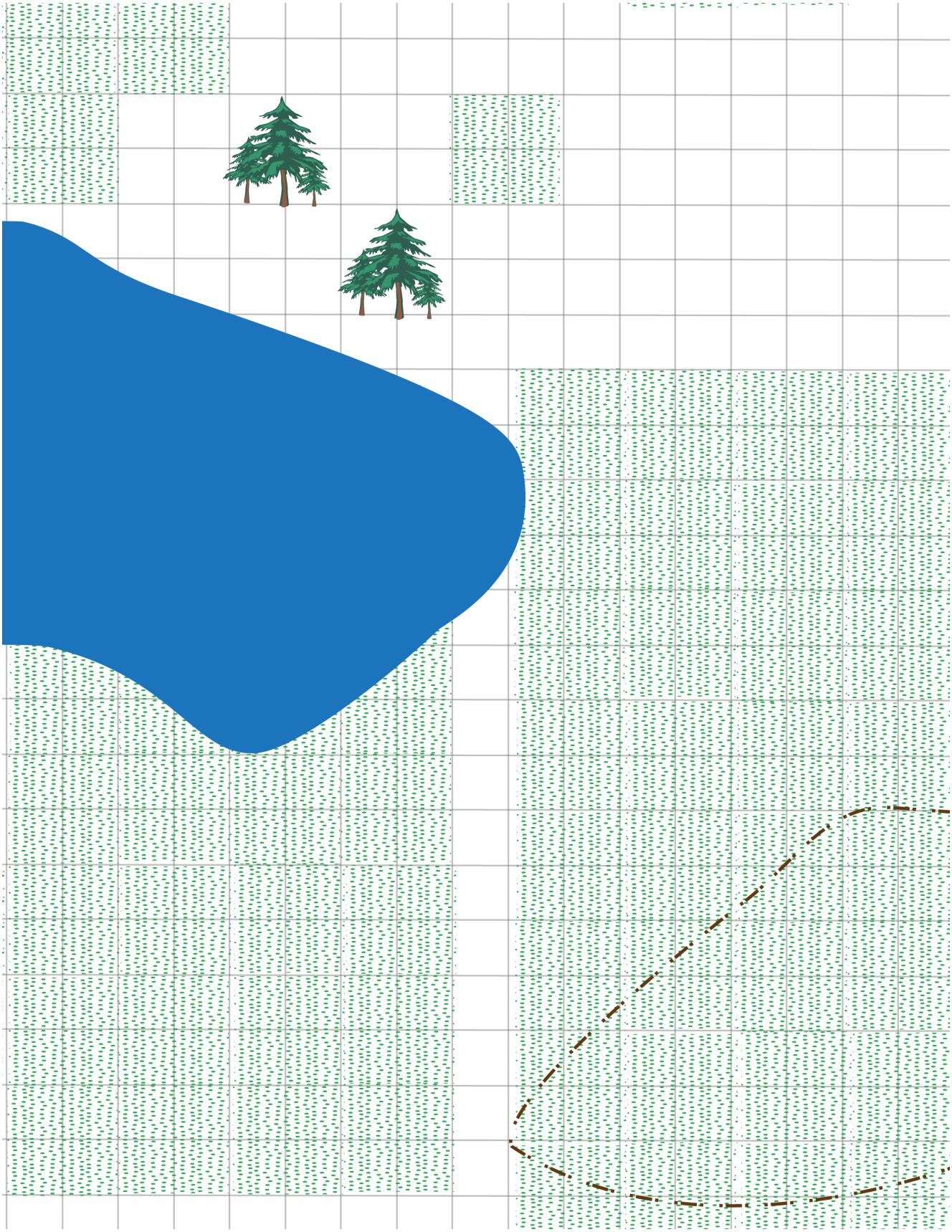




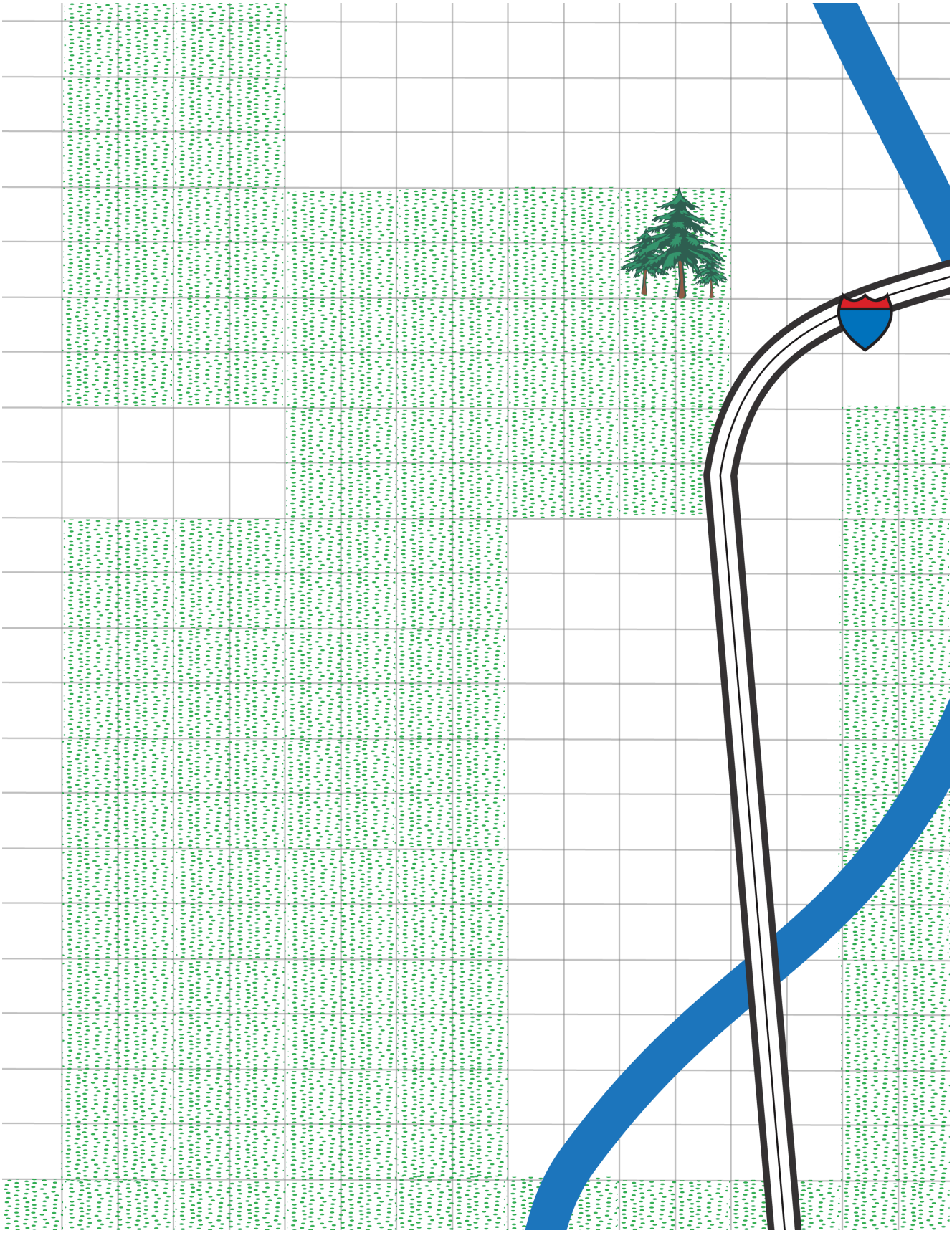



UPDATED: MAY 2022

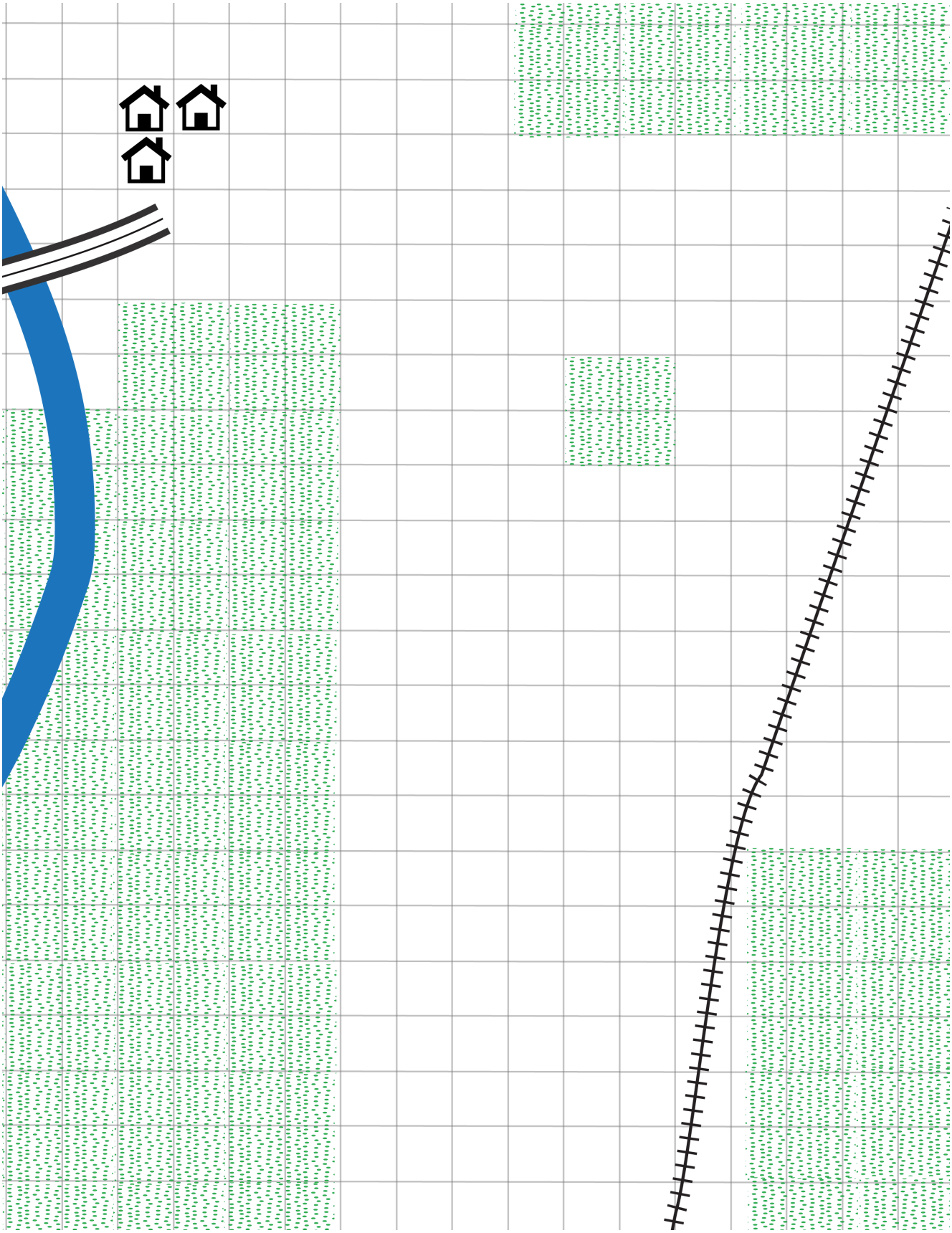
## Map D



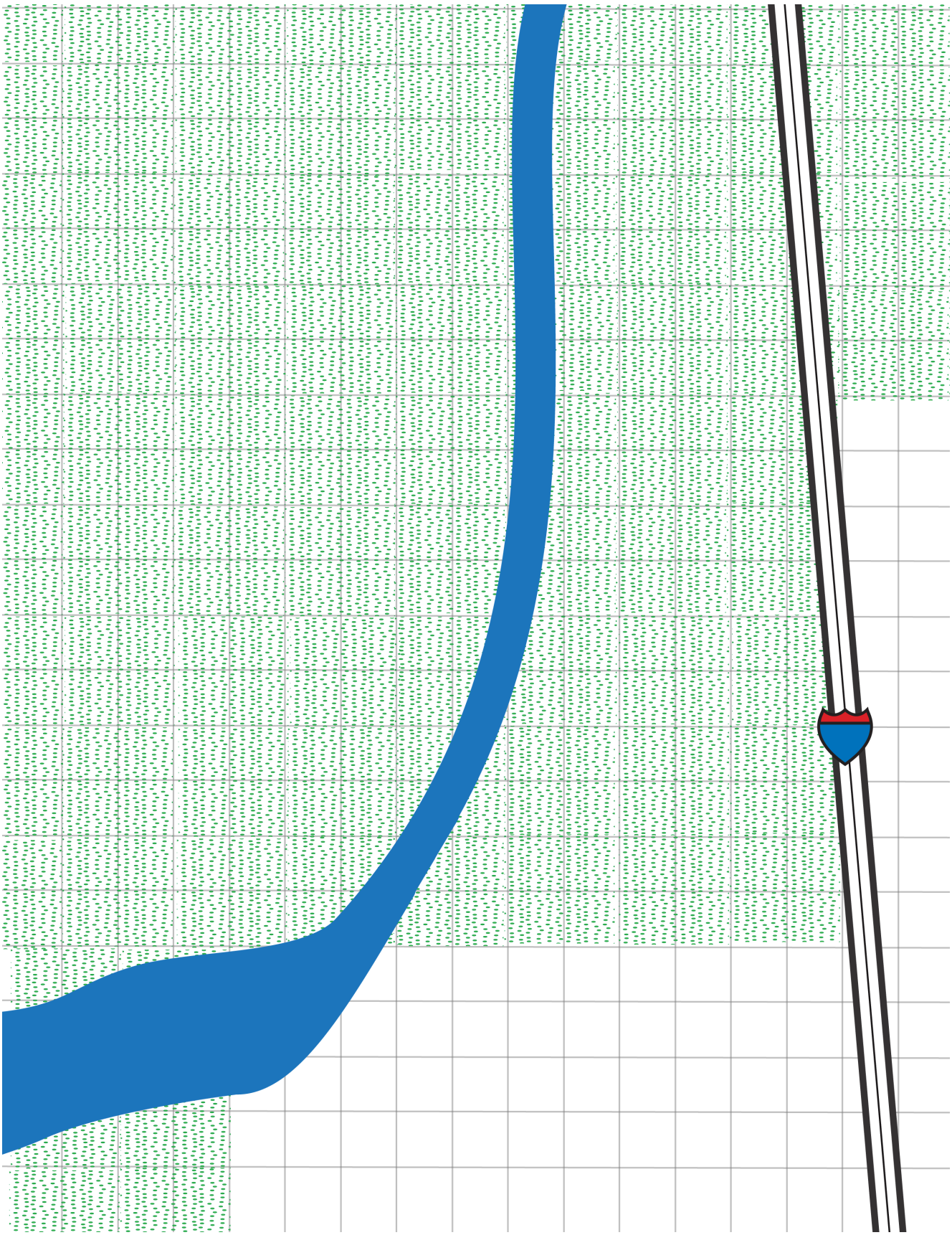
## Map E



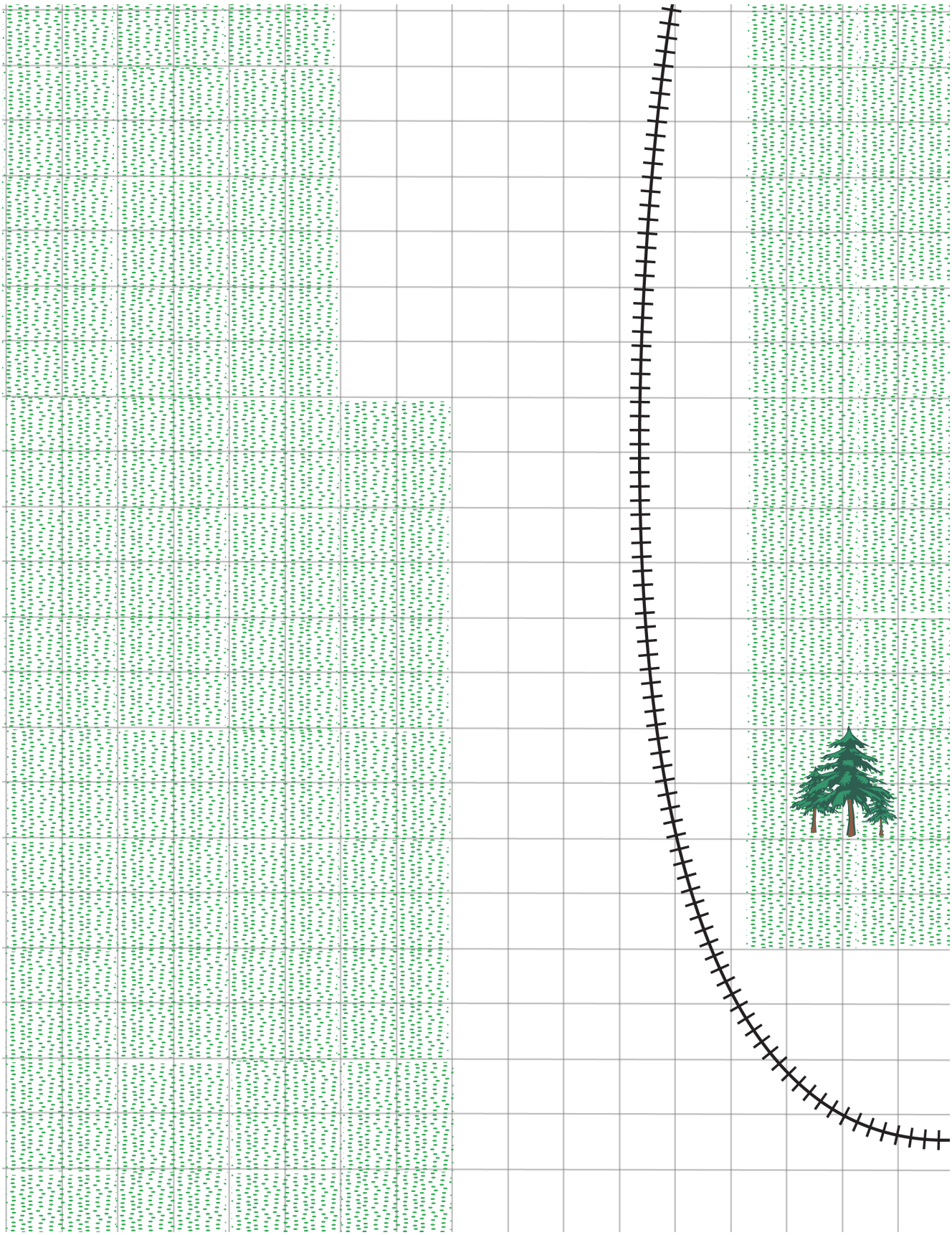
## Map F



## Map G



## Map H



Name:

# The Pronghorn's Future Is In Your Hands!

In 30 years, it is projected that the human population in this area will continue to increase, which will require additional energy, roads, and homes to be built. What would your recommendations be for a land developer that needed to add 90 homes (and roads to connect all of them) within this large area. How will you ensure that the pronghorn population has a safe migration? And how will you know if your recommended plan works?

# Land Use Cards

## Part 3: Where the Pronghorn Roam

**TEACHER INSTRUCTIONS:** print and cut out each card

+

### Positive Land Use Change

**Conservation Action!**

**You received grant money to help with pronghorn migration!**

**Place an X on 8 of the fence squares OR draw a wildlife bridge over a road.**

+

### Positive Land Use Change

**Conservation Action!**

**Landowners have started to restore green vegetation in your area!**

**Add 4 vegetation squares to your map.**

+

### Positive Land Use Change

**Climate / Weather Impacts**

**Spring rain showers help the vegetation recover.**

**Add 5 vegetation squares.**

–

### Negative Land Use Change

**Human Land Use**

**A new railroad line needs to be installed.**

**Add 10 squares of track to your map.**

–

### Negative Land Use Change

**Human Land Use**

**New homes and structures are being built to accommodate people moving into the area.**

**Add 15 squares of homes. Make sure to connect the homes with an unpaved road.**

–

### Negative Land Use Change

**Human Land Use**

**More people means there are more mouths to feed!**

**Add 5 cultivated land icons to your map.**







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## Negative Land Use Change

**Human Land Use**

An increase in the human population has called for more oil and gas extraction.

Add 3 well icons. Make sure to also add roads to the wells.

## Negative Land Use Change

**Human Land Use**

More people are traveling to your new town and you need paved roads.

Add 25 squares of highway that connect with at least one house or unpaved road.

## Negative Land Use Change

**Human Land Use**

Ranchers in your area need to add a fence for their livestock.

Add fencing around 25 squares.

## Negative Land Use Change

**Climate / Weather Impacts**

An unexpected storm covered some of the vegetation in deep snow.

Place an X on 4 vegetation squares. The squares do not need to be touching.

## Negative Land Use Change

**Climate / Weather Impacts**

An intense drought caused much of the vegetation to die off.

Place an X on 6 vegetation squares.

## Negative Land Use Change

**Climate / Weather Impacts**

A wildfire burns large patches of the grassland and removes some of the vegetation.

Place an X on 6 vegetation squares that are touching one another.







UPDATED: APRIL 2022