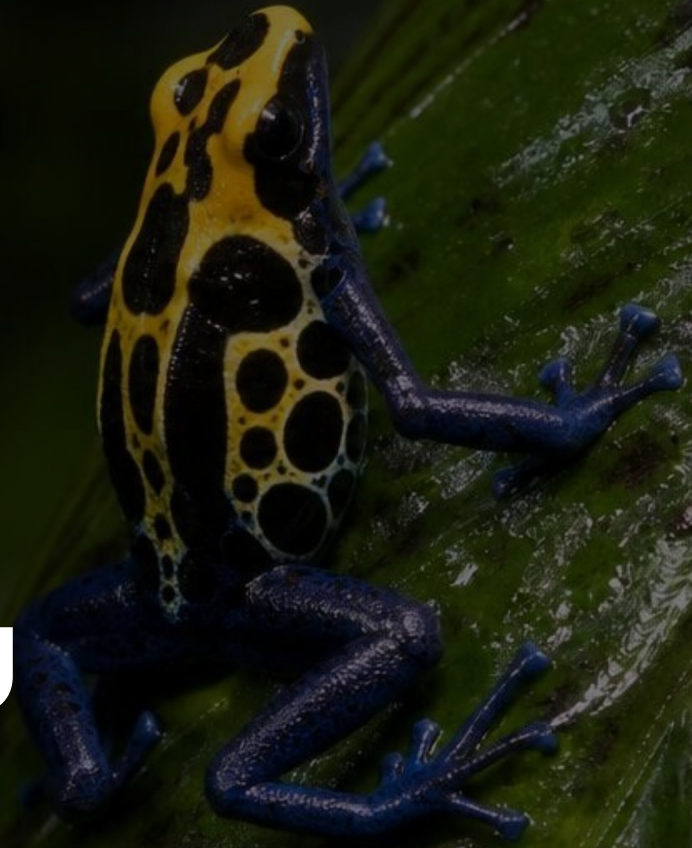


CHAPTER 20 OF 29 · RESOURCES IN ECOSYSTEMS

Chapter 20: Resources in Living Systems

Lesson 20: What do living things need, and what happens when a needed resource runs short?

Angela's Wand · Bring Science Alive! 7th Grade Integrated



PHENOMENON

The frog that stops being poisonous

Tiny, brightly colored rainforest frogs carry poison in their skin; some were once used to coat blowgun darts. Frogs of the same species raised in a zoo or a home tank can be handled safely, and wild-caught frogs slowly lose their poison in captivity. Same frog, same air, about the same temperature. What is missing?

- Notice: what is the same for a wild frog and a captive frog? What is different?
- Wonder: why would the poison fade slowly instead of vanishing the day the frog is caught?
- Predict: if a captive frog ate exactly what a wild frog eats, would it become poisonous?





LEARNING TARGETS

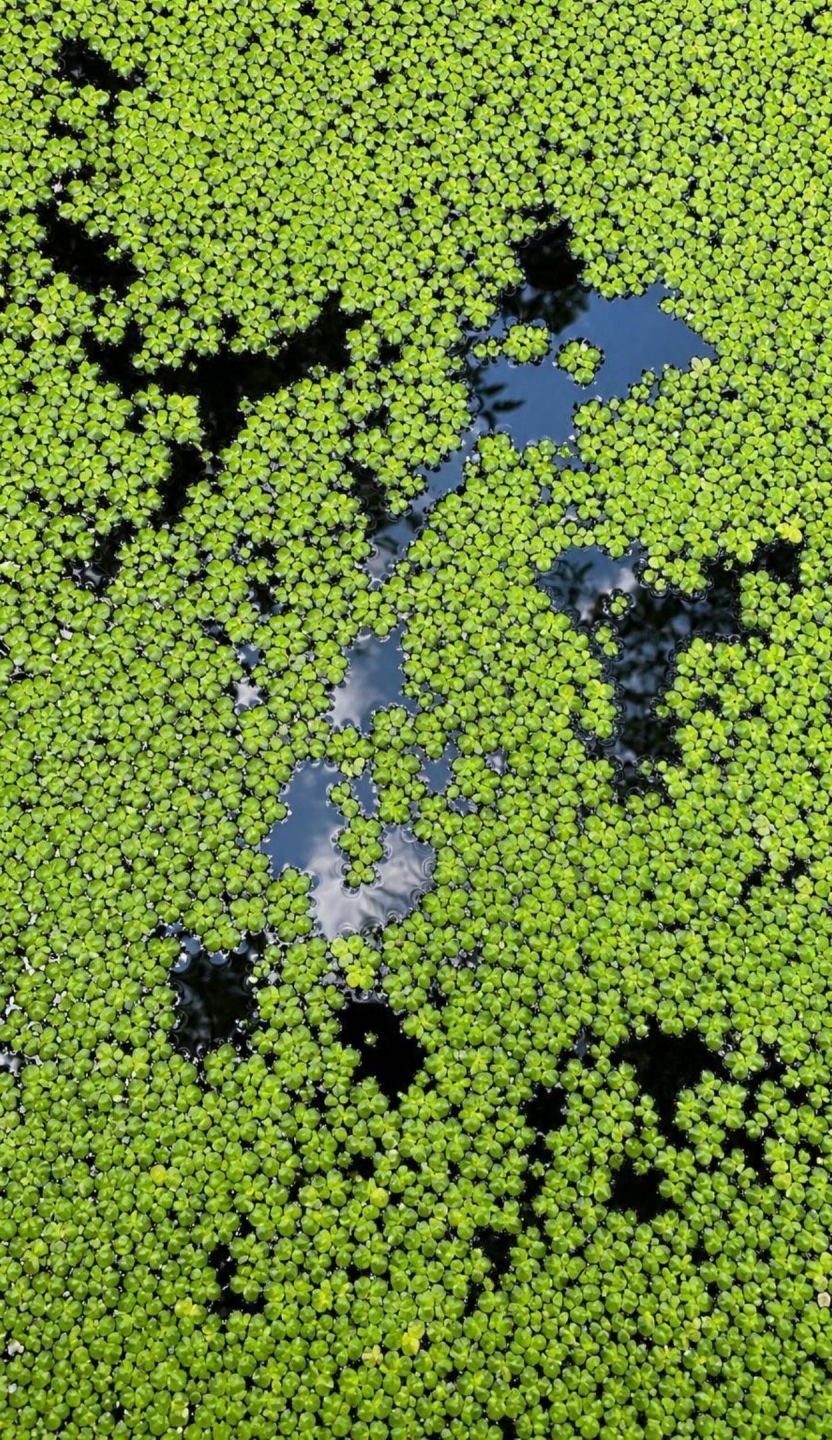
What you will be able to do

- 1 Sort what an organism needs into living and nonliving resources, and tell a resource from a condition.
- 2 Explain how competition for a limited resource changes how many individuals survive and reproduce.
- 3 Use data on a resource and a population to find a carrying capacity and predict change.
- 4 Explain why a pattern in data is not proof of cause, and name the mechanism that links them.
- 5 Describe how water, light, nutrients and temperature shape biomes, and order the levels of life.

What counts as a resource?

- A resource is anything a living thing must take in to survive, grow and reproduce.
- Biotic resources come from living things: grass for a horse, ants for a frog.
- Abiotic resources are nonliving: water, oxygen, sunlight, soil nutrients, space.
- A resource can be used up. What one organism takes, another cannot have.
- Temperature is not a resource. It affects organisms, but nobody consumes it.





VOCABULARY IN CONTEXT

Three words to keep straight

resource: Material or energy a living thing must take in from its surroundings to survive, grow and reproduce. *Water, oxygen and grass are resources for a horse; sunlight, water and soil nitrogen are resources for grass.*

organism: One individual living thing. *One foal, one dandelion, one duckweed frond, one bacterium.*

population: All the organisms of one species living in the same area at the same time. *The deer of one valley; the duckweed in one cup; the ants on one rainforest floor.*

MODEL

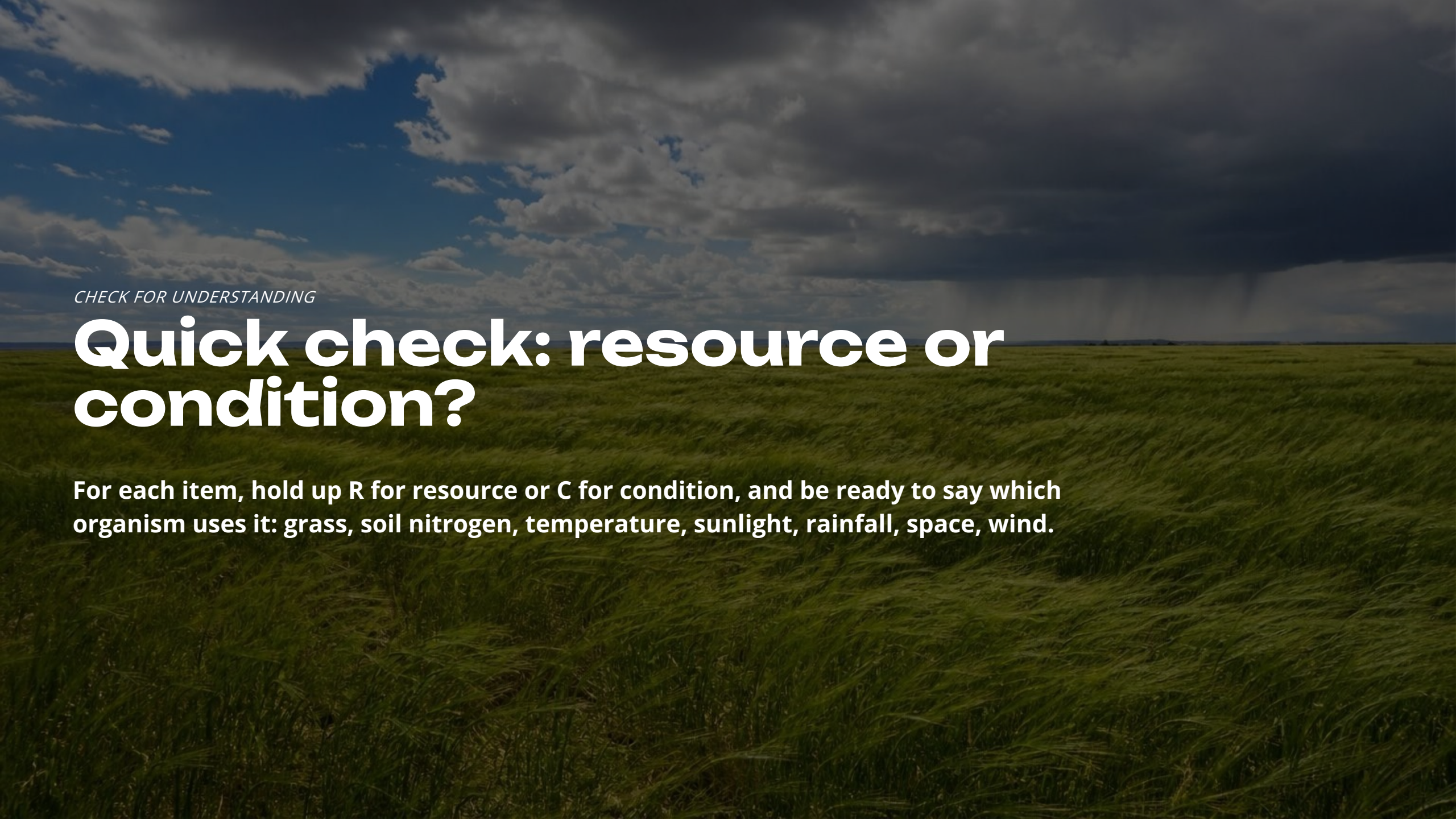
Same meadow, different shopping lists

Model: What a grass plant needs and what a horse needs

A meadow grass plant	A horse
Sunlight (energy)	Grass and other plants (food, a biotic resource)
Carbon dioxide from the air	Salt and minerals from a salt lick

Every species has its own mix of resources. Some are shared, which is where competition between species begins.





CHECK FOR UNDERSTANDING

Quick check: resource or condition?

For each item, hold up R for resource or C for condition, and be ready to say which organism uses it: grass, soil nitrogen, temperature, sunlight, rainfall, space, wind.



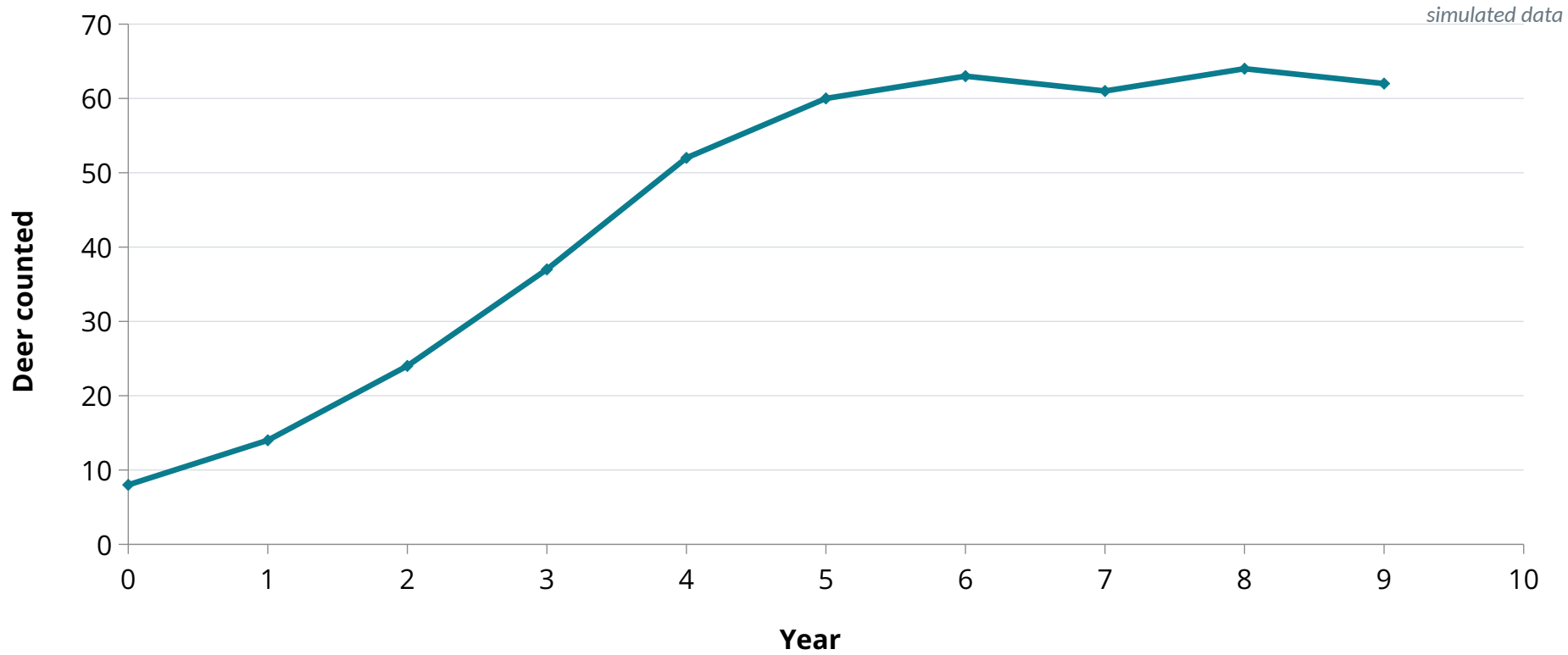
Why a population cannot grow forever

- Every area holds only so much of each resource: so much grass, so much water, so much space.
- When individuals of one species need the same scarce resource, they compete for it.
- Those that get enough survive and leave offspring; those that do not, go hungry or die.
- The resource that runs short first is the limiting resource. It sets the ceiling.
- The ceiling has a name: the carrying capacity of that area for that species.

MODEL

A population levels off

Model: Deer in a fenced meadow (teaching data)



Simulated counts for a fenced meadow with no predators. Growth is fast while grass is plentiful, then flattens near about 62 deer.



VOCABULARY IN CONTEXT

Words for the ceiling

competition: An interaction in which organisms need the same scarce resource, so what one takes the others cannot have. *Two seedlings under one patch of light; two herds on one hillside of grass.*

limiting resource: The resource in shortest supply compared with need; it caps growth even when everything else is plentiful. *In a dark cupboard, light limits duckweed no matter how much fertilizer is added.*

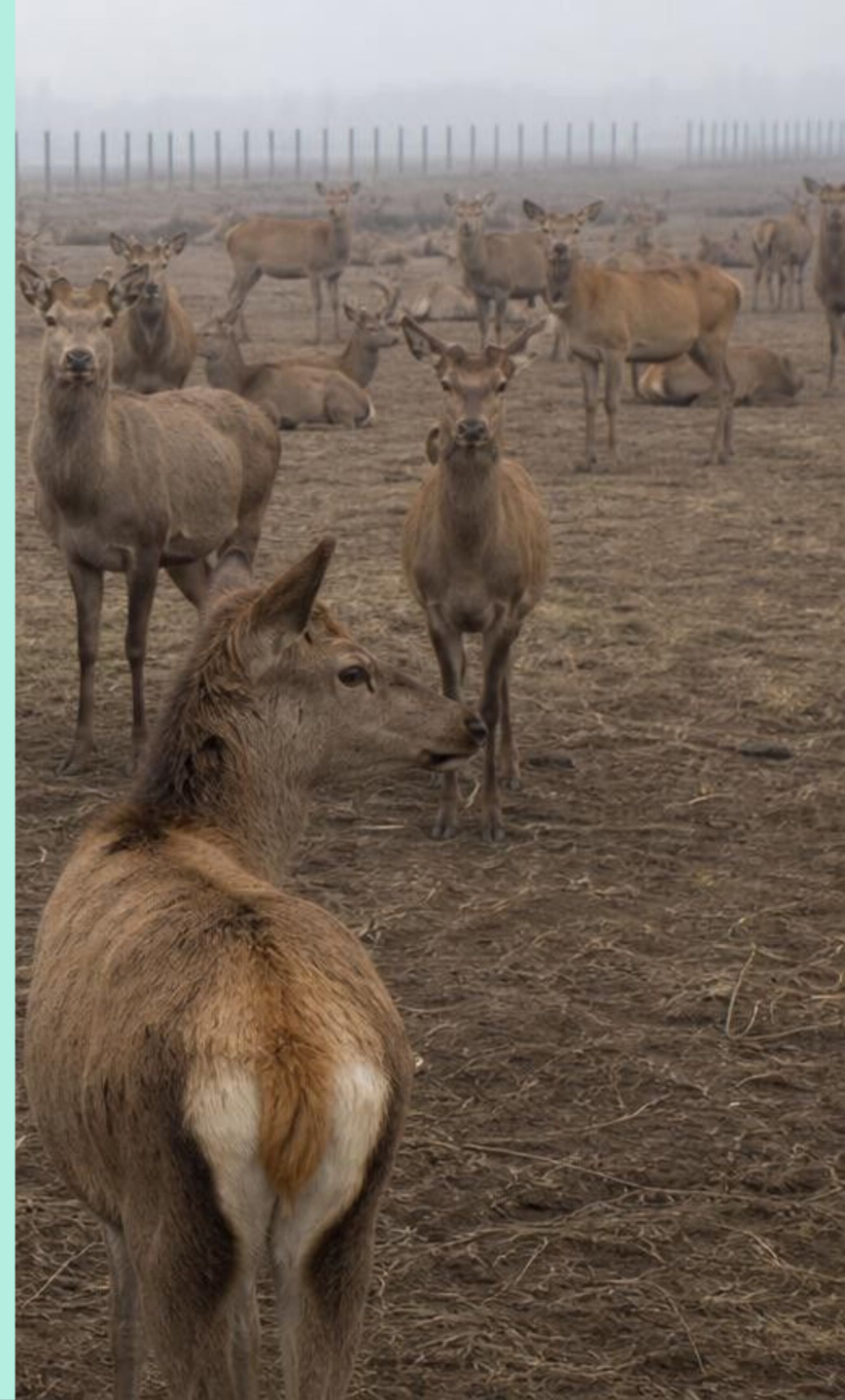
carrying capacity: The largest population an area's resources can support over time; it rises or falls when the resources change. *A meadow that feeds about 60 deer in normal years may feed only 30 in a drought.*



CHECK FOR UNDERSTANDING

Quick check: read the deer graph

Between which two years did the deer population grow the most? In which years was grass per deer probably smallest? If 30 deer were removed in year 9, what would you expect in year 10 and why?





When two species want the same thing

- Yaks and horses both eat grass. Every mouthful a yak takes is gone for the horses.
- In a dry year with little grass, both populations are likely to shrink.
- Species that use a shared resource in slightly different ways compete less.
- Yaks tend to wrap taller grass with the tongue; horses can crop grass very short.
- If each style works best on grass of a different height, both species can share a meadow.



THINK, PAIR, SHARE

Discuss: two herds, one dry summer

A meadow feeds a horse herd and a yak herd. Rain fails and grass grows at half its usual amount. What happens to each herd this year? What would change if the yaks ate only tall grass and the horses only short grass?

Rain to grass to grazers: a chain of causes

Model: How a dry year reaches the herd

1 **Less rain falls →**

(water is a resource for grass)

2 **Less water in the soil →**

(grass growth needs water)

3 **Less grass grows (kg per hectare) →**

(grass is a resource for grazers)

4 **Less food per grazer; competition rises →**

(scarce resource is divided)

5 **Fewer young raised, more deaths →**

(births fall, deaths rise)

6 **Grazer population shrinks**

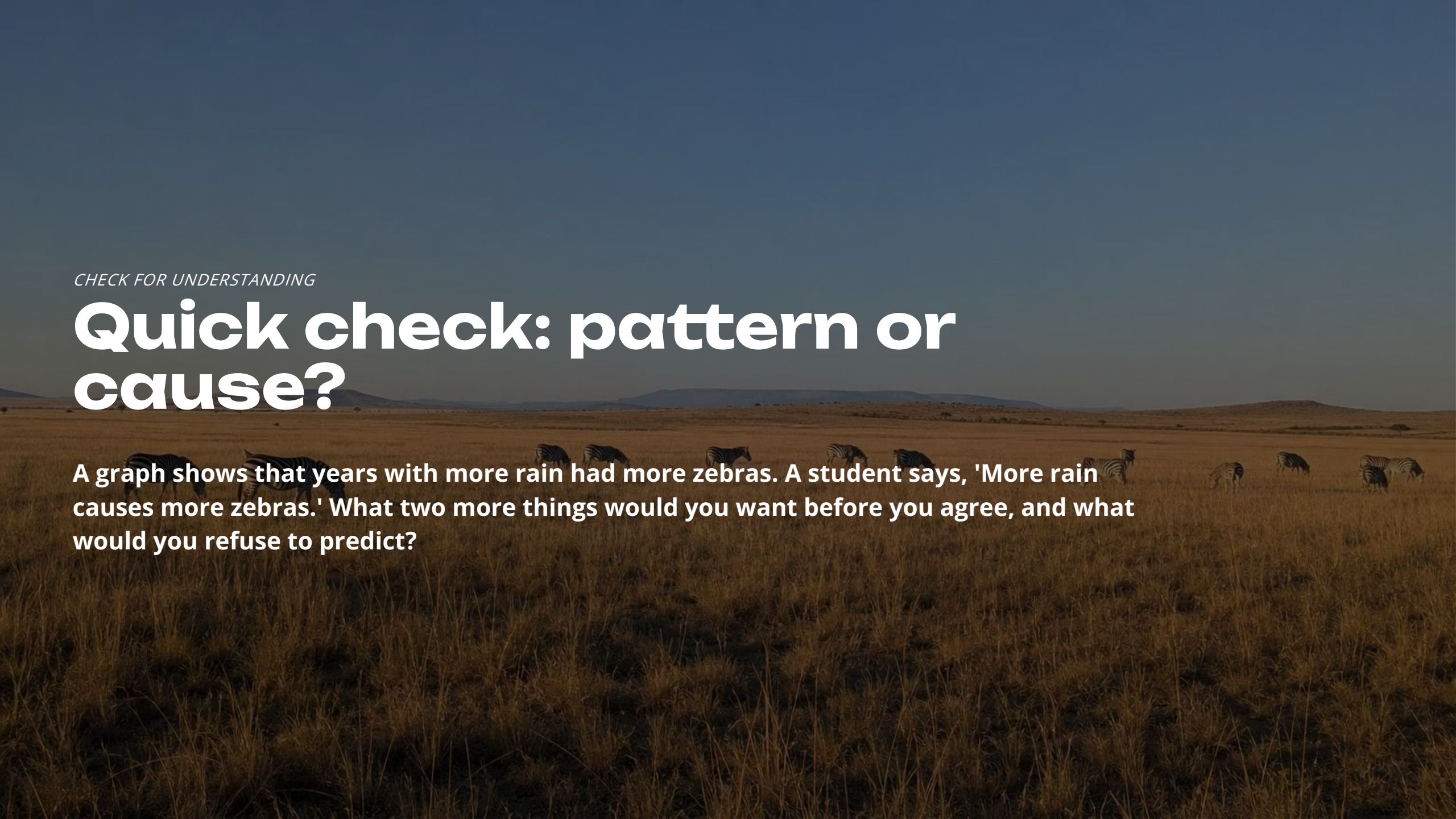
Each arrow is a mechanism you can name. That is what turns a pattern in data into a cause-and-effect explanation.





Reading resource data without fooling yourself

- A graph that rises together shows a pattern. A pattern is evidence, not proof of cause.
- To claim cause and effect, name the mechanism: grass needs water; zebras eat grass.
- Check what else changed. A new competitor, a hard winter or disease can hide behind rainfall.
- Predict only inside the range you measured. Beyond the last data point, you are guessing.
- Populations recover by births, so they lag behind the resource when it comes back.



CHECK FOR UNDERSTANDING

Quick check: pattern or cause?

A graph shows that years with more rain had more zebras. A student says, 'More rain causes more zebras.' What two more things would you want before you agree, and what would you refuse to predict?

APPLY IT

Task: six years in Cedar Hollow



Year	Rainfall (mm)	Spring forage (kg/ha)	Deer counted in fall	Average fawn mass (kg)	Cattle on the range
1	420	840	300	30	0
3	290	560	230	25	0
5	510	1050	350	32	0
7	470	950	320	29	200
9	270	520	160	23	200
11	520	1060	260	30	200

Simulated data for practice.

Which years were scarce? What happened to deer numbers and to fawn mass in those years? Cattle arrived in year 7. Predict the deer count and fawn mass for a year with 280 mm of rain, and say what you cannot predict.

REAL-WORLD CONNECTION

California connection: tule elk behind a fence

At Point Reyes National Seashore, north of San Francisco, a herd of tule elk at Tomales Point lived inside a fence and could not roam to find more forage. In the dry years of 2012 to 2015, the National Park Service's counts of that herd fell from about 540 elk to about 280. Park biologists found no sign that the elk died of thirst; there were too many elk for the poor dry-year forage inside the fence.





Biomes: resources and conditions draw the map

- A biome is a huge region defined by its climate and the living things that climate supports.
- On land, water (from rain) and temperature decide which plants can grow; plants decide the animals.
- Temperate grasslands (prairie, steppe, pampas) sit at middle latitudes; savannas are tropical.
- Boreal forests get enough water for trees but face long snowy winters; mostly evergreen conifers win.
- In water, light and nutrients are the limiting resources. Light fades fast with depth.



MODEL

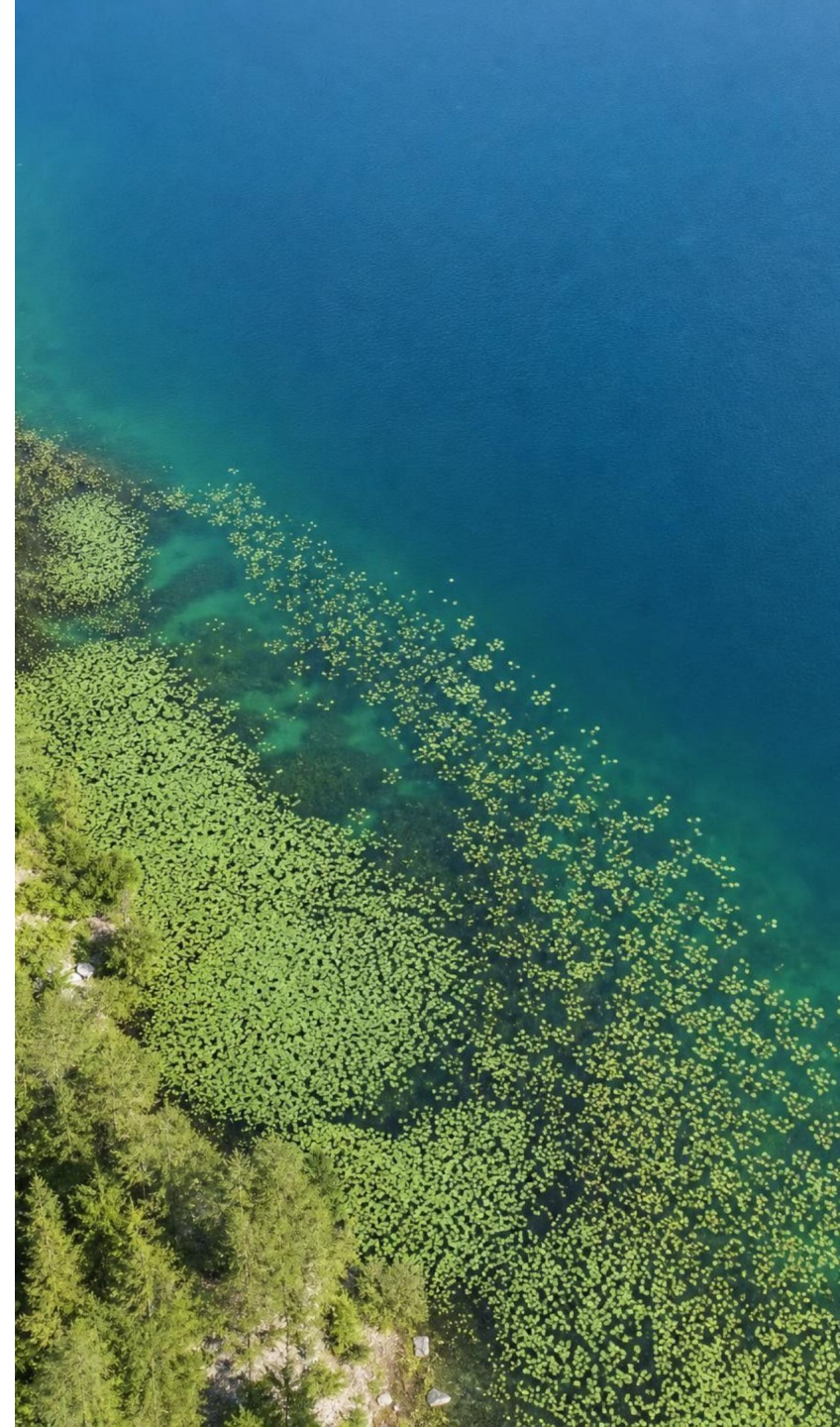
A lake from top to bottom: where the light goes

Model: Light and life at different depths of a lake

Top to bottom:

1. Surface: full sunlight; floating leaves of lilies and duckweed
2. Shallow water: enough light for rooted plants and algae
3. Deeper water: dim; few plants, animals that eat what sinks
4. Bottom: dark; decomposers live on fallen material

Water absorbs light, so the resource that powers plants is richest at the surface and fades with depth. Nutrients often do the opposite, collecting near the bottom.





THINK, PAIR, SHARE

Discuss: where would you look for a grassland?

You are given only two numbers for a region: how much rain falls in a year and how warm it is. Could you predict whether it holds a grassland, a forest or a desert? What third fact would help most?

MODEL

Life in nested levels

Model: From one organism to the whole biosphere

Top to bottom:

- 1 Biosphere: every ecosystem on Earth, from deep rock to the high atmosphere
- 2 Ecosystem: a community plus its water, soil, air and light
- 3 Community: all the populations that live and interact in one area
- 4 Population: all the horses of one valley
- 5 Organism: one horse

Each level contains the one below it. The textbook skips the community level; most biology references include it.



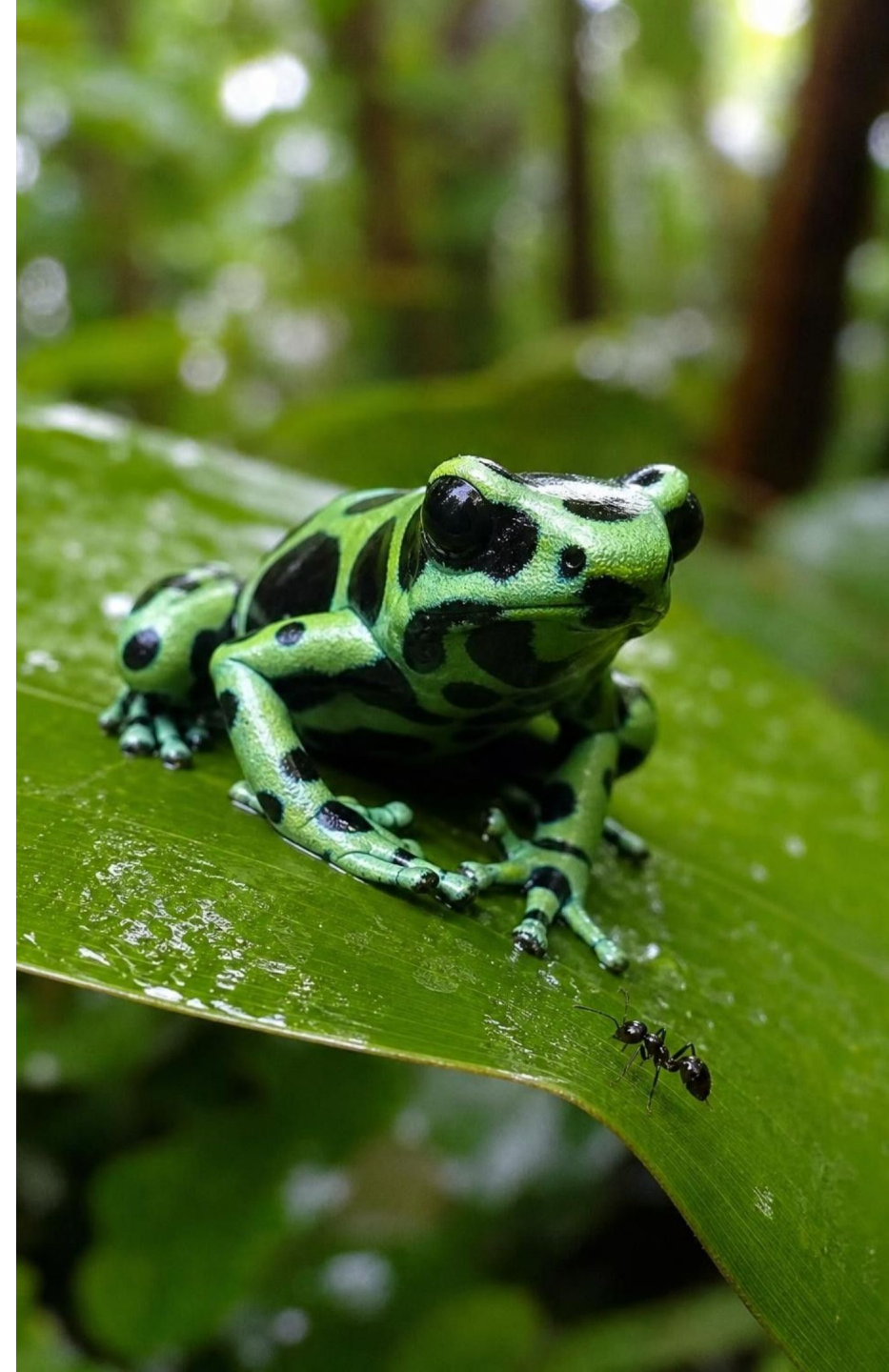


Humans use resources too

- Every person is an organism in an ecosystem, even in a city; food and water come from somewhere.
- Grazing cattle, sheep and goats on grasslands adds competitors for the same grass.
- Turning grassland into farms and neighborhoods shrinks the ecosystem that was there.
- Taking water from rivers and wells lowers the resource other populations depend on.
- Because people live almost everywhere, our resource use reaches the whole biosphere.

Back to the frogs: a resource that shapes the organism

- Wild dart frogs eat tiny prey, especially certain ants, mites, beetles and millipedes.
- Those prey carry bitter chemicals called alkaloids. The frog stores them in its skin glands.
- A frog cannot make these alkaloids itself. No alkaloid prey, no poison.
- Captive-bred frogs eat fruit flies and crickets, which carry none, so they never become poisonous.
- Wild-caught frogs slowly use up the alkaloids they stored, so their poison fades over time.



A large number of rabbits are scattered across a grassy hillside under a cloudy sky. The rabbits are in various positions, some sitting, some standing, and some looking in different directions. The hillside is covered in low-lying vegetation, and the sky is filled with soft, grey clouds.

MISCONCEPTION CHECK

True or false? No predators, no limit

"If a population has no predators and no disease, it will keep growing year after year for as long as the area exists."

True or false? Explain your reasoning.



PUTTING IT TOGETHER

Putting it together

- Organisms take in biotic and abiotic resources; conditions like temperature set limits but are not used up.
- A limiting resource is divided by competition, so a population levels off near a carrying capacity.
- Two species that share a resource both shrink when it is scarce; using it differently eases the competition.
- Patterns are evidence; a cause claim adds a mechanism, rules out other changes, stays in the measured range.
- Water, light, nutrients and temperature draw the map of biomes; life nests from organism to biosphere.
- A resource can even shape what an organism is: no alkaloid prey, no frog poison.

EXIT TICKET

Exit ticket

- 1 Name one biotic resource, one abiotic resource and one condition for a horse.
- 2 A meadow supports about 40 deer. A drought halves the grass. What happens to the herd, and why?
- 3 A graph shows more rain and more zebras together. What sentence must a scientist add before saying 'because'?
- 4 Why is a dart frog born in a zoo not poisonous? One sentence.

