

Bears of Banff

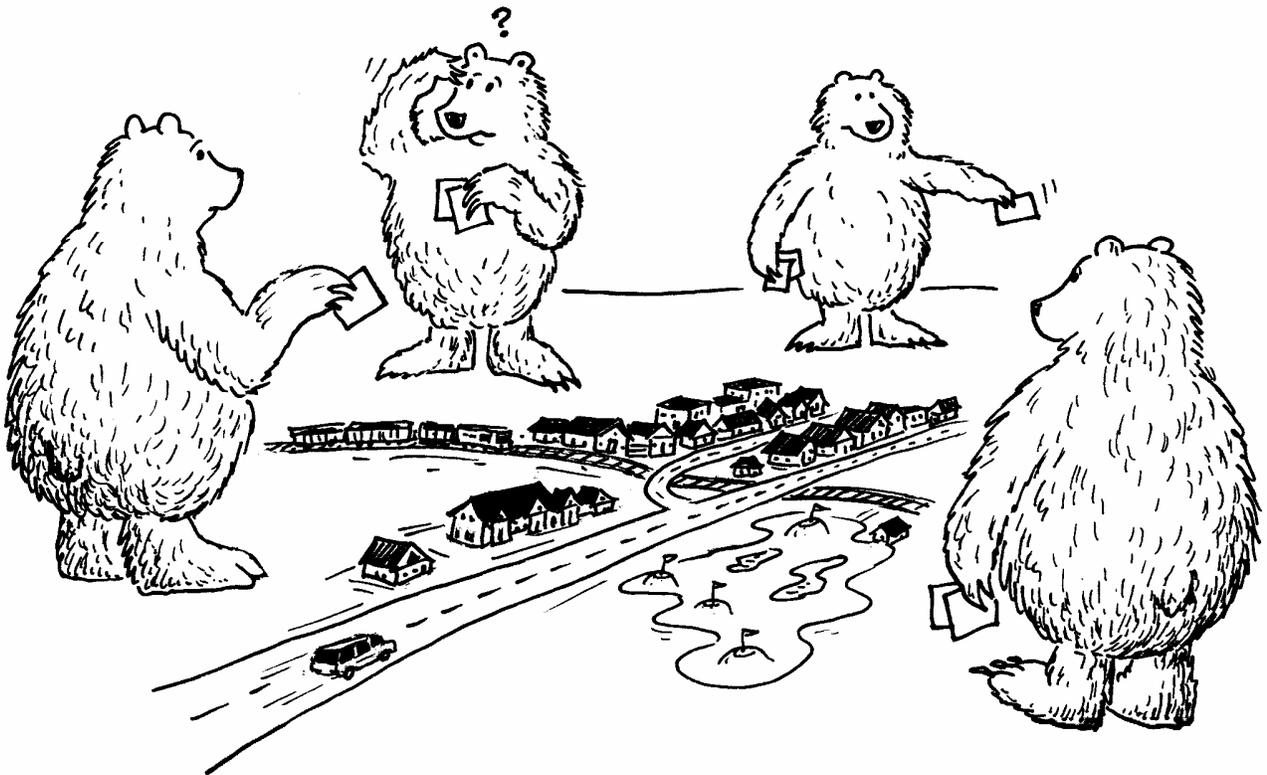
In this simulation activity, students assume the role of grizzly bears as they try to survive and pass on their genes in Banff, Canada's 'flagship' national park. Students will discover how human activities can sometimes "get in the way" of a bear's procreation opportunities...This activity compliments Births and Deaths.

Materials

- ❑ Two or three large sheets of fabric or paper
- ❑ two 5 metre lengths of coloured twine or rope
- ❑ two short (30 cm) boards or two pieces of construction paper
- ❑ enough coloured cards so that each student has a set of five cards (i.e. in a class of 30 students you'll need 30 blue, 30 green, 30 red, 30 yellow, and 30 black cards)
- ❑ an open space of at least 3 x 5 metres

Time

- ❑ 30-40 minutes



Instructions for the Teacher

1. This activity is all about breeding! If needed, review the key words below and then begin this activity by inviting students into a large area that can comfortably hold the entire group. This could be as simple as the classroom with desks moved aside.

Key Words

- **Population genetics:** the study of how the principles of genetics function in populations
- **Genes:** a unit of heredity composed of deoxyribonucleic acid (DNA)
- **DNA:** deoxyribonucleic acid, the genetic material of living organisms
- **Genetic diversity:** differences in the genetic make up of an animal population; these differences are passed from the parents to the young. Genetic diversity improves the ability of a species to survive in a changing environment
- **Gene pool:** the sum of all the genes present in a population of organisms
- **Inbreeding:** mating between closely related individuals
- **Inbreeding depression:** when continued inbreeding results in harmful characteristics in a population because of poor genetic diversity
- **Dispersing:** when an animal travels long distances from their birthplace to mate with individuals from other families

2. Tell students that they have just entered a national park, and show them the boundaries of the park. Tell them that the park borders are all impassable mountains, that all activities must occur within the park area you have defined and that, in this activity, they will play the role of grizzly bears!

3. Ask the students to name three very basic things that every animal needs to survive. They should answer ‘food, water, and shelter.’ Tell students that in this game, it is assumed that they can meet these basic needs - what they will be tested on is their ability to *mate*!

4. Distribute the cards so that every student has five differently coloured cards. Tell the students that the long-term *sustainability* of animal populations requires the mixing of *genes* to keep the population healthy, and that normally individuals ensure proper genetic mixing by *dispersing*.

Teaching Tip

Handing out all those cards can really take up time...

Save time by asking 5 students to stand in a circle while each holds a stack of cards (one student has all blue, one has all red, etc.)

Get the remaining students to walk around these students in a circle and take one card from each.



5. Tell students that the cards they are holding represent their genes, and that when you give the word to “Disperse” their task is to trade cards with other bears from across the room until they have five identical cards.

6. Say “Disperse!” It should only take a minute until all trading ceases. Ask students to put up their hands if they were able to achieve the task; you should see all or the vast majority of students put up their hands. Congratulate them on their ability to disperse and their good genetic prospects.

7. Next, find out how many students were unable to fill their hand with five identical cards. Tell these unfortunate individuals that they are the victims of **inbreeding**, a genetic phenomenon in which mating with related animals results in not enough genetic mixing. Inbreeding may result in the appearance of harmful recessive traits or body asymmetry. Tell students that any bears who suffer from inbreeding in three successive rounds will be diagnosed as suffering from so much **inbreeding depression** that they can no longer reproduce, or even survive long enough to reproduce. These bears will be forced to leave the game.

Remind students that inbreeding depression is one of the more obvious reasons our human society has *taboos* against incest and inbreeding.

8. Tell students:

“Great news! Humans have finally come to live in the valley, and will be located in a modest townsite in the centre of the park, with a simple road crossing through the park to supply essential services to the town.” (place a large sheet of paper or fabric in the centre of the space, and a rope through the sheet that bisects the park area).

“Sorry, bears, but as you know towns and roads are dangerous for bears; bears are asked not to step onto the sheet, and any bear seen stepping across the road will be killed by myself, who today will also playing the role of a truck.”

9. Tell students that when you say “Disperse” this time, their task is to fill their hand with five differently coloured cards (i.e. it will look like the hand they started off with). Say “Disperse” and let the next round proceed.

10. Play several more rounds with the students: after each “Disperse!” their task is to fill their cards either with five identical cards or five differently coloured cards. Have students give a show of hands so that you can all monitor the onset of inbreeding depression!

Inbreeding Depression

Occurs when individuals in a population are harmed by generations of inbreeding (not enough genetic mixing).

These individuals may not be able to reproduce as well as healthy individuals, may suffer from mutations and may have a lowered resistance to disease.

The Florida Panther (pop = 30-50 cats) show signs of inbreeding: 80% of males show reduced sperm count and there is a failure of reproductive organs to develop properly.

Add any of the following changes to the park after each round:

- Round 3: Add a railway track at right angles to the road (divides the game area into quarters).
- Round 4: Double the size of the town by adding commercial shopping area “to give people something to do when they come to the national park.”
- Round 5: Build a large oil refinery just outside the park boundary - the “halo” around this development creates a large area inside the park where bears will not go (put a sheet here).
- Round 6: Build an affordable housing unit and an airfield in two different places, reaching from the townsite to the boundary, causing yet more habitat fragmentation.
- Round 7: Pause here and tell the bears that there has been a proposal by an environmental group to build a wildlife overpass that would allow animals to cross the highway (place the board over the highway to show them what it would look like). Ask the ‘bears’ if they are in favour of this proposal - but then tell them, “Who ever asks bears for their opinion?!” Tell the bears that the proposal has been turned down, and say “Disperse!”
- Round 8: Pause again and tell students that the government has twinned the highway, but to make up for it has built two wildlife overpasses over the highway (put these two boards in place). Also, the Banff-Bow Valley Study spent two years (and two million dollars) and to come up with a set of recommendations that included closing the airfield. Ask the bears again if they are in favour of these changes; there may be some dangerously inbred populations that are very happy about this restoration! Take out the airfield, put overpasses on the highway in two places, and find out if these changes help cure any bad cases of inbreeding depression.

Discussion

11. The main intent of this game is to demonstrate how incremental development in this park makes genetic mixing more difficult. Scientists have noticed the first signs of inbreeding depression in the park’s grizzly populations, which might eventually lead to the extirpation of the species within and south of Banff. Please see the next activity (“Bear Genetics”) for specifics.

Ask students:

In future rounds of this game, do you think it would get easier or more difficult for the bears?

Things could go either way, but one thing is for sure: even in a national park, humans have a hard time saying, “That’s enough.” Incremental development, in which human structures advance in tiny increments year after year, is a major threat to our remaining natural areas.

12. Banff National Park is the site of discussion between those who believe that “Parks are for

People,” and those who believe that the first job of a national park is to protect the animals that live in it. Ask your students to discuss what they believe parks are for. As a follow-up, remind students that our National Parks Act holds protection of plants and animals to be of primary importance.

13. **Bio 30 Extensions**

Use this activity to engage students in discussion of the Hardy-Weinberg Equilibrium.

- ***Hardy-Weinberg Equilibrium:*** a situation where allele frequencies and genotype frequencies remain constant from one generation to the next under certain assumptions (no mutation, no migration, random mating, no selection, infinitely large population)

Ask your students

In this activity, which of the assumptions in Hardy-Weinberg is/are violated?

Large population. The population in this activity is very small, which can cause inbreeding.

Inbreeding causes a loss in heterozygosity, leading to inbreeding depression, the appearance of harmful recessive traits, or body asymmetry.

Does the Alberta Rocky Mountain population of grizzly bears meet the Hardy-Weinberg Equilibrium?

No. Bears migrate over great distances; this violates one of the assumptions of Hardy-Weinberg.