SCIENCE 3D

CANOPY CRITTERS

In this packet, sample student answers are provided in red and notes to teachers are in blue.

In this **Science Mission**, students will start by exploring the body systems and sensory systems of canopy animals. They will graph and analyze data to discover differences in vision between species and how their digestive systems work. Then, they will use maps and data to make and test predictions about how animals will respond to human use of the environment and how it influences their ability to disperse seeds.

There are many different animals that live in the canopy. These animals depend on the trees that make up the canopy and the other plants that live high above the ground. Some canopy animals rely on the plants for shelter. Some rely on the plants for food. Many animals, like kinkajous and monkeys, need the plants for both food and shelter. Many plants need the animals too. They need them to pollinate their flowers and move their seeds to new places.

Your mission is to explore kinkajous and other animals of the canopy. Let's see how they might help plants. Also, let's learn how human actions might affect these canopy critters.

Activity 1: Body Systems in the Canopy

Before we start our research, let's compare and contrast some canopy critters.
Note: Expand this lesson to have students classify each animal (e.g. mammal, bird, reptile, invertebrate). Then, you could have them draw or investigate their internal body systems as well.

1. **Compare** and **contrast** monkeys and kinkajous for the following characteristics.

   Body Covering: Both have fur.

   How they move: Both move using arms and legs and have prehensile tails. Monkeys have hands that grasp and can swing. Kinkajous have to walk on tree branches.

   When they are active: Monkeys are active during the day. Kinkajous are active at night.

   What they eat: Both eat fruit. Some students may remember that kinkajous also drink nectar.

2. **Compare** and **contrast** woolly opossums and bats for the following characteristics.

   Body Covering: Both have fur.

   How they move: Woolly opossums climb; bats use their wings to fly.

   When they are active: Both are active at night.

3. **Compare** and **contrast** snakes and toucans for the following characteristics.

   Body Covering: Snakes have scales; toucans have feathers.

   How they move: Snakes slither; toucans fly.

   What they eat: Toucans eat fruit; snakes eat small animals.

How good is a kinkajou's vision? We know from past research that they can see in low light. They can also sense small differences between the brightness of light. But, can they see colors? Let's compare kinkajou vision to the vision of their relatives that are active during the day - the coatis.

Scientists conducted an experiment to see whether kinkajous and coatis could tell the difference between colors. They tried to train the animals that food was in a box with a colored card on it. If the animals could tell the difference between a black card and the colored card, they would get food. If the animal was just guessing, they would choose the correct color 50% of the time. Each coati and kinkajou got tested on each color many times. The graphs below show how often the coatis and kinkajous got it right!

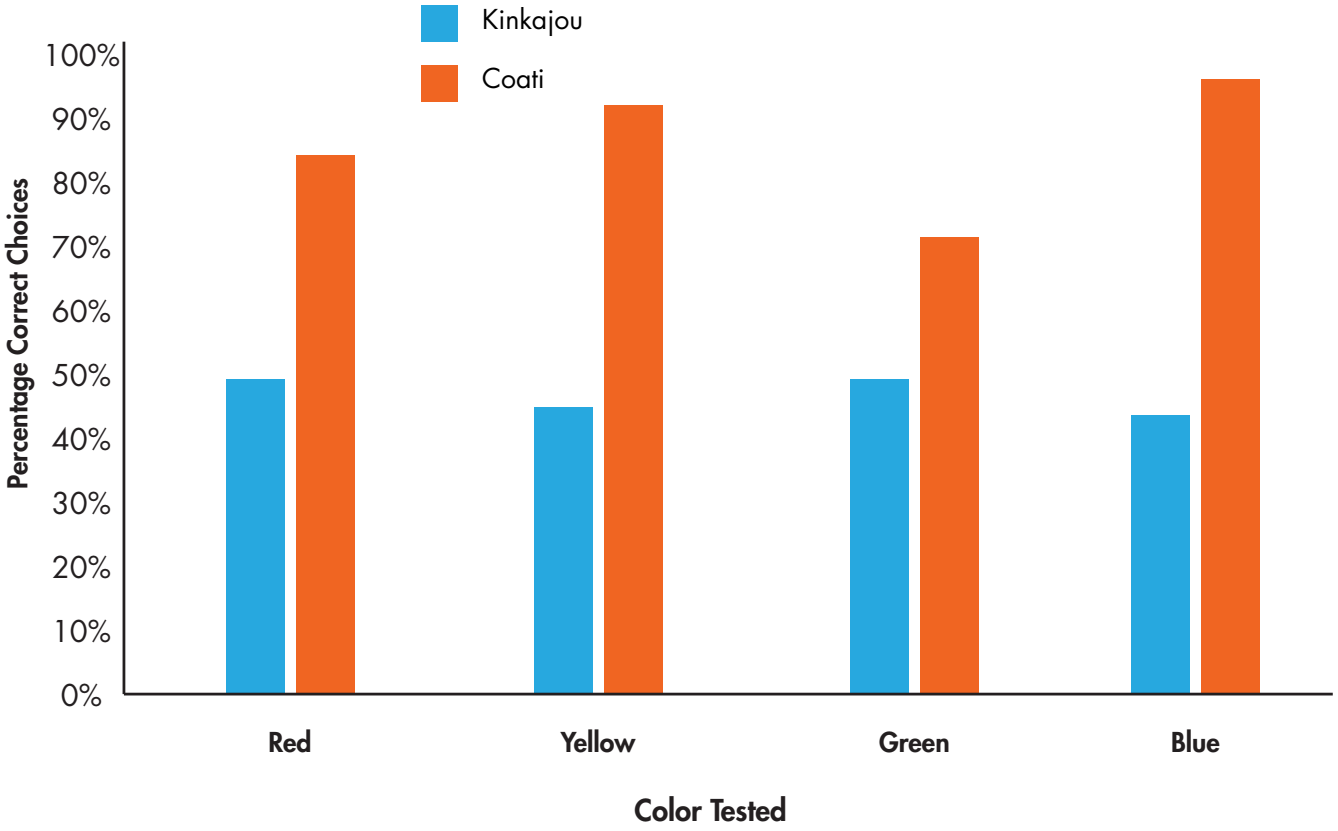


Figure 1. Percentage of time that coatis and kinkajous chose the correct color during experiments

4. Use the data above to **make an argument** about whether or not coatis and kinkajous have color vision.

Based on the data, it looks like coatis have color vision. They chose the right color most of the time. Kinkajous only chose the right color half of the time or less. That means they couldn't tell the difference in colors. Kinkajous don't have color vision.

5. Construct an argument about the difference in the kinkajou and coati's vision. Hint: Think about the conditions in the environment when they are active.

Complete answers should suggest that kinkajous don't need color vision at night as much as coatis do during the day. Students who read carefully might mention that kinkajous have good vision in low light and can see differences in brightness. [Students are unlikely to know this, but you can discuss how the need for better night vision means kinkajous need more receptors (the rods) for seeing in low light. This means there is not as much space for color vision receptors (cones). For coatis, answers might include that having color vision in the day should help them be alert for danger or choose the right foods based on their color.

Activity 2: Does Passing Through a Kinkajou Digestive System Hurt Seeds?

For an animal to be able to disperse seeds, the seeds need to pass through the digestive system of the animal. This isn't always easy! Acids and chemicals break down food as it passes through the digestive system. The body absorbs what it needs. The rest passes through and is removed from the body. But, seeds can be difficult to digest! Use the data in Table 1 to see if kinkajou digestive systems can digest the seeds.

The team found seeds that kinkajous pooped out. They then harvested seeds that had not been eaten by any animals. They planted these seeds and waited to see if they grew (germinated).

1. Based on the paragraph above, what was the **control** group?

Seeds that had not been eaten

2. Based on the paragraph above, what was the **experimental** group?

Seeds that had passed through kinkajous

3. **Complete** the hypothesis below with a prediction about whether the seeds that passed through kinkajous should germinate "as often" or "less often" than seeds that had not been eaten by kinkajous.

If kinkajous help disperse seeds, then seeds that have passed through kinkajous should germinate as often as seeds that have not been eaten by kinkajous.

Table 1. What happened to seeds that had and had not passed through kinkajous

Seed number	Passed through kinkajou	Did not pass through kinkajou
1	Germinated	Did not germinate
2	Germinated	Did not germinate
3	Germinated	Germinated
4	Germinated	Germinated
5	Germinated	Germinated
6	Germinated	Germinated
7	Did not germinate	Germinated
8	Germinated	Germinated
9	Germinated	Germinated
10	Did not germinate	Germinated

4. **Calculate** the percent of seeds that germinated in each part of the experiment. Hint: Count the number of seeds that germinated in a treatment. Divide by the total number of seeds planted in that treatment. Then multiply by 100. Show your work.

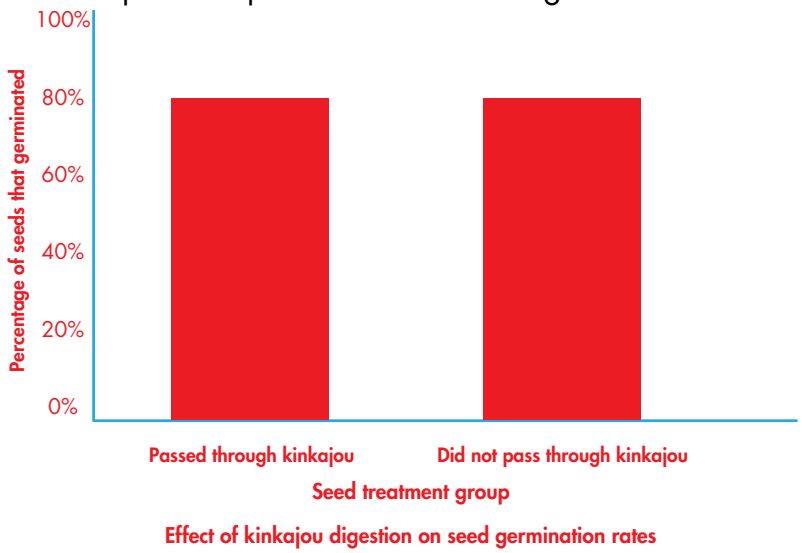
   a. Passed through a kinkajou:

   $\frac{\text{8 seeds germinated}}{\text{10 seeds planted}}$ = 0.8 x100 = 80%

   b. Did not pass through a kinkajou:

   $\frac{\text{8 seeds germinated}}{\text{10 seeds planted}}$ = 0.8 x100 = 80%

5. **Draw** a bar graph to compare the percent of seeds that germinated in each treatment.



6. **Describe** whether or not you think the digestive system of kinkajous breaks down seeds. Use evidence from the experiment.

I do not think the digestive system breaks down seeds. The same number of seeds germinated in the control group and the experimental group.

7. Using your data, predict if kinkajous could help disperse seeds.

I think that kinkajous could help disperse seeds. The seeds survive inside the kinkajou and will move with the kinkajou until they pass through the digestive system.

Activity 3: Do Kinkajous Move Seeds Into Places People Have Disturbed?

Now we know that seeds survive inside kinkajous. Let's explore whether or not kinkajous disperse seeds into new types of habitats. Can they move them into old farmland to help trees regrow there?

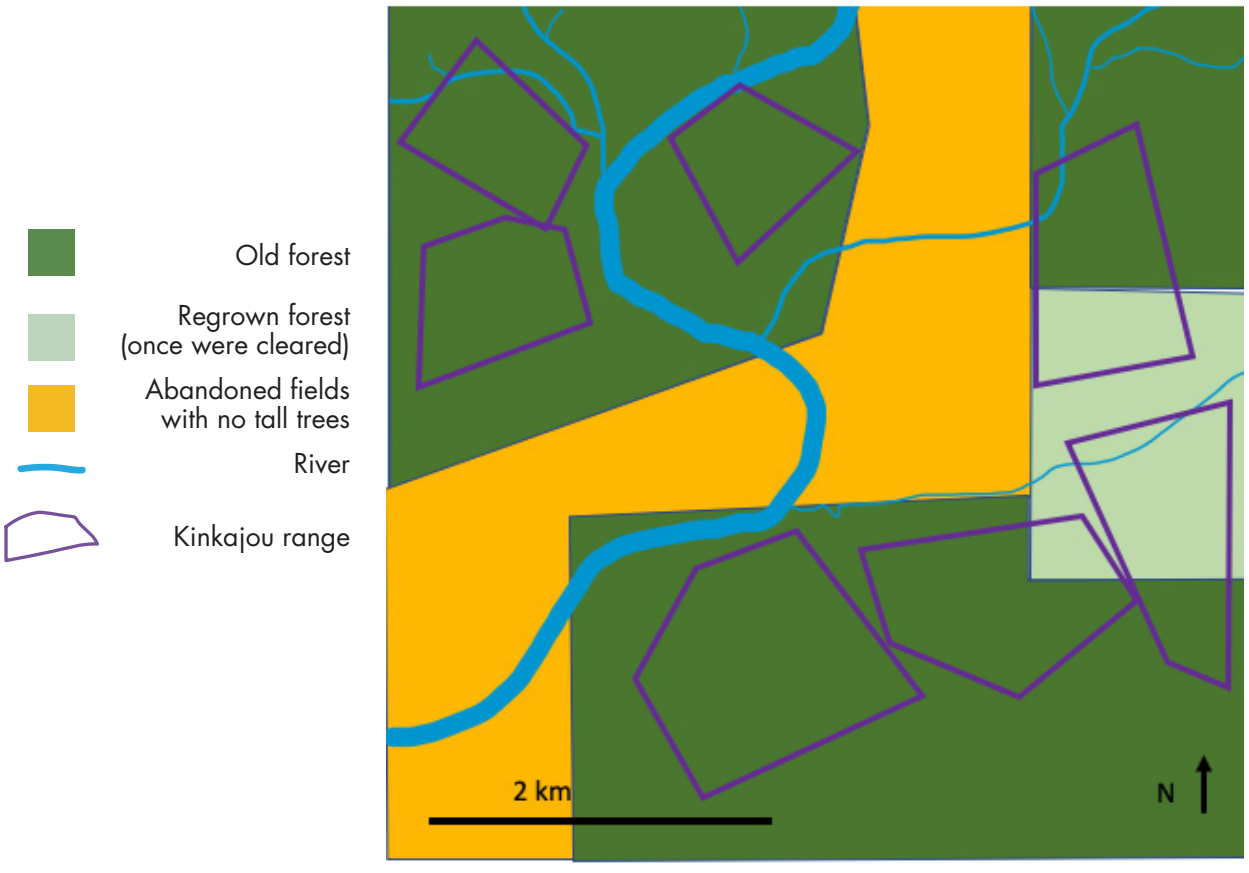


Figure 2. Location of ranges for seven female kinkajous

1. **Describe** the size of area that each female kinkajou moved across. Hint: Look at the size of the scale bar and the ranges. Use evidence from the map.

Answers may vary but should indicate between 0.5 and 1.0 kilometer. That is the distance across many of the ranges shown. No females seemed to move much farther than 1 kilometer.

2. **Describe** the habitats that kinkajous spent time in and the habitats they avoided.

Kinkajous spent time in the old forest and regrown forest. They avoided the abandoned fields with no tall trees.

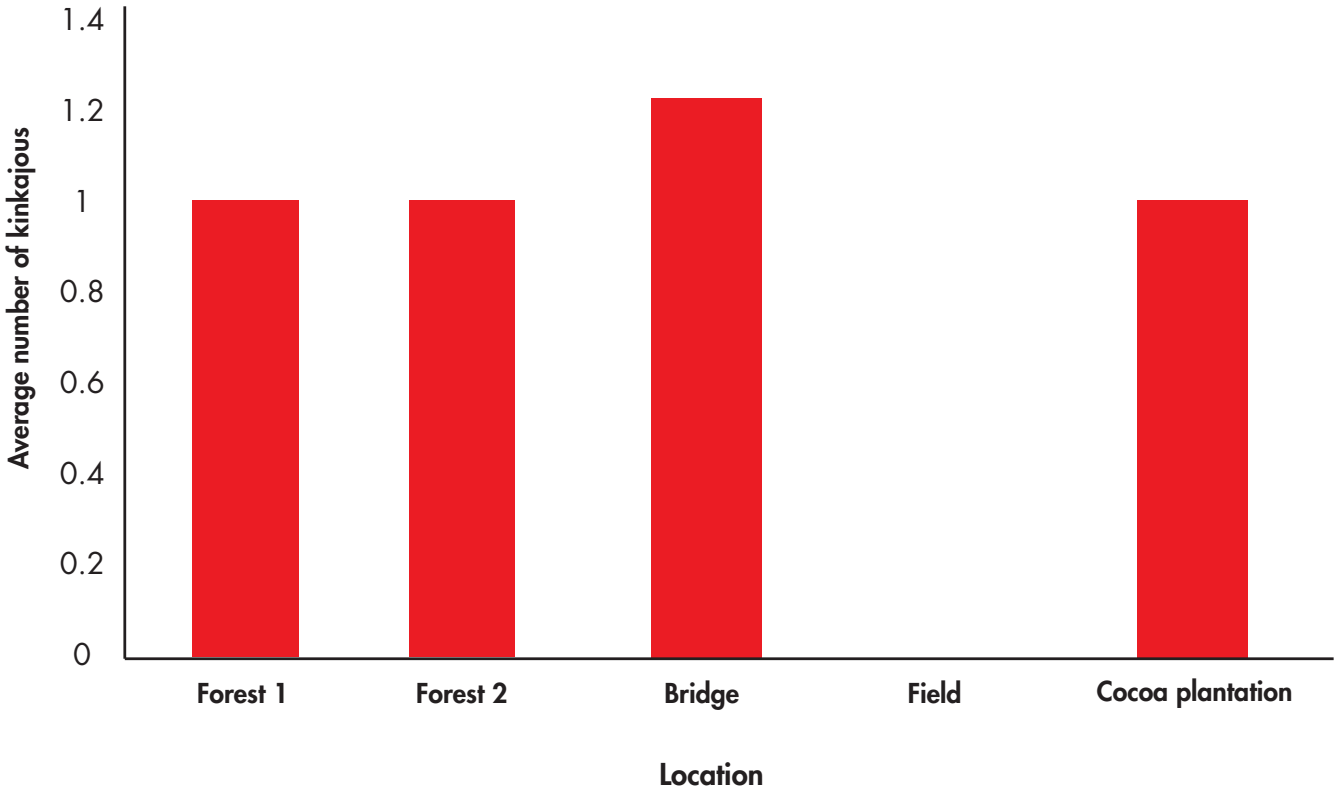
Dr. Bernal and his team have set out traps in the forest at Tirimbina, on the bridge between two forest patches, and in a cocoa plantation. The cocoa plantation has tall trees as well as cocoa plants. It doesn't have the understory that is found in the forest. They also set traps in a tree in the middle of an abandoned field. Each night they set two traps in each habitat. The data in Table 2 shows how many traps caught kinkajous on each of ten nights.

3. **Calculate** the average number of kinkajous each night. Hint: Add up all of the kinkajous caught and divide by the number of nights that traps were set (10).

Table 2. Number of kinkajous caught each night in various habitats

Night number	Forest 1	Forest 2	Bridge	Cocoa plantation	Field
1	2	1	2	1	0
2	0	0	0	1	0
3	1	1	2	0	0
4	1	1	1	1	0
5	2	2	1	1	0
6	0	1	1	0	0
7	0	1	1	2	0
8	2	1	1	1	0
9	1	0	2	1	0
10	1	2	1	2	0
Average	1	1	1.2	1	0

4. **Draw** a graph of the average number of kinkajous in each location. Give the graph a caption.



Number of kinkajous caught at each location

5. **Compare and contrast** the average number of kinkajous in each habitat.

There were the same number of kinkajous caught in the forest locations and the cocoa plantation. There were more kinkajous caught on the bridge. No kinkajous were caught in traps in the field.

Extend the lesson: Have students investigate Table 2. Have them construct an argument around why it was important that traps were set on more than one night. They should express that the number of animals caught was different across the different nights.

6. **Construct** an argument about whether kinkajous might disperse seeds into abandoned fields for regrowth. Use your graph and the map to support your answer.

I don't think that the kinkajous would take seeds into the abandoned fields. No kinkajous went into the abandoned field according to the map. Also, no kinkajous were caught in the tree in the middle of a field.

7. **Construct** an argument about whether kinkajous might carry seeds away from the parent plant where they ate fruits. Use your graph and the map to support your answer. (Hint: Kinkajous on the bridge were probably moving from one forest patch to the other. Another hint: Do kinkajou ranges cross rivers in the map?)

Answers may vary. Correct answer will express that kinkajous disperse seeds. The seeds survive in kinkajous as they move within a 1-kilometer range. The map shows they will move across rivers (small rivers that trees may cross), and that the traps caught kinkajous moving from one forest to another.

8. The cocoa plantation has trees for the plantation and some natural trees to provide habitat. Make an argument whether this has provided habitat for kinkajous. Use data to support your argument.

Yes, the plantation has helped provide kinkajous with a habitat. The same number of kinkajous were caught in the forest and in the cocoa plantation.