

SCIENCE·3D

TIGER QUEEN

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

In this **Science Mission**, students will explore living and non-living resources in ecosystems. Then they will match individual tigers to images from camera traps and use this information to investigate how tigers change their movements between seasons. They will also explore how day and night cycles influence tigers and other animals in the forest and then track how tiger populations have changed through time. Students will develop and test hypotheses using data that they analyze and graph.



Protecting tigers inside national parks and reserves is very important. To do that, we need to know how many tigers are in the area. We also need to know how much prey is available for them. It is important to know how behaviors of animals and populations change between seasons and how tigers might interact with people near the national parks. Your mission is to help investigate these important questions!

Activity 1: Parts of the Ecosystem

A first step in the investigation is to understand the living (biotic) and non-living (abiotic) factors in the ecosystem.

1. Based on the **Mission Reader** and the **Mission Video**, **complete** Table 1 by listing a total of at least five factors that are important for tigers, their prey, or the plants of Kismet's forest. At least one must be a living resource and one must be a non-living resource.

Students only need to list five, but a set of possibilities is included in Table 1. An alternative to this activity is to give the students the list of factors outlined below and have them choose if each factor is living or non-living and what types or organisms need a resource or are influenced by a particular factor.

Table 1. Biotic (living) and abiotic (non-living) factors important for tigers in Kismet's forest

Resource Number	Resource Name	Living or Non-living?
1	Air, water/rain, nutrients, sunlight, temperature, shelter (rocks or caves)	Non-living
2	Predators, prey/food, shelter (trees), competitors, mates	Living
3		
4		
5		

Activity 2: How Many Tigers in the Forest? When Are They Active?

One of the first things we want to know is how many tigers live in the Nilgiri Biosphere Reserve. Has protecting tigers here helped their population grow? The science team set up camera traps around the forest. They collect images for a period of eight days and nights in the wet season and eight days and nights in the dry season. The camera trap images help scientists and park rangers see how many tigers are in an area and what other animals are around.

Table 2 has data from some of the camera traps in different parts of the forest over the dry season (from December 2018 to May 2019) and the wet season (from June 2019 to November 2019). During the dry season it is hot with very little rain. The vegetation is brown. During the wet season it rains a lot. The vegetation is very green.

The camera traps have collected many pictures of tigers. But, is each picture of a different animal? Probably not. Some pictures may be of the same animal.

How can you tell if a picture is of the same tiger? Look at its stripes! Every tiger has a unique pattern of stripes, like a person's fingerprints. The following pages show all the pictures that were taken at the "Forest 1" site in the dry season and the "Forest 2" site during the wet season. Use these pictures to figure out how many different tigers were photographed.

1. Give the tiger in each picture a name or number. If two pictures are of the same tiger, give them the same identification. Look carefully at the stripe patterns on the tigers in the photos. *Hint: No tiger at Forest 1 was photographed at Forest 2.*

Forest 1 - Dry Season



Tiger Identification Tiger 1



Tiger Identification Tiger 1



Tiger Identification Tiger 2



Tiger Identification Tiger 3



Tiger Identification Tiger 4



Tiger Identification Tiger 5

Forest 2 - Wet Season



Tiger Identification Tiger 6



Tiger Identification Tiger 7



Tiger Identification Tiger 7

2. **Complete** Table 2 using the number of different individual tigers you identified in “Forest 1” and “Forest 2.” Then add the total number of individuals at all locations.

Table 2. Total detections of tigers and total number of unique individuals identified at eight locations in the wet season and dry season

Location	Dry Season		Wet Season	
	Total detections	Total individuals	Total detections	Total individuals
Forest 1	6	5	7	5
Forest 2	3	2	3	2
Forest 3	8	4	6	4
Forest 4	1	1	5	4
Forest 5	6	3	5	5
Forest 6	6	3	8	6
Near Lake 1	18	9	6	5
Near Lake 2	20	8	4	4
Total	68	35	44	35

3. **Describe** whether you think the number of tigers changes in the reserve between the wet season and dry seasons. Use the data in Table 2 to support your answer.

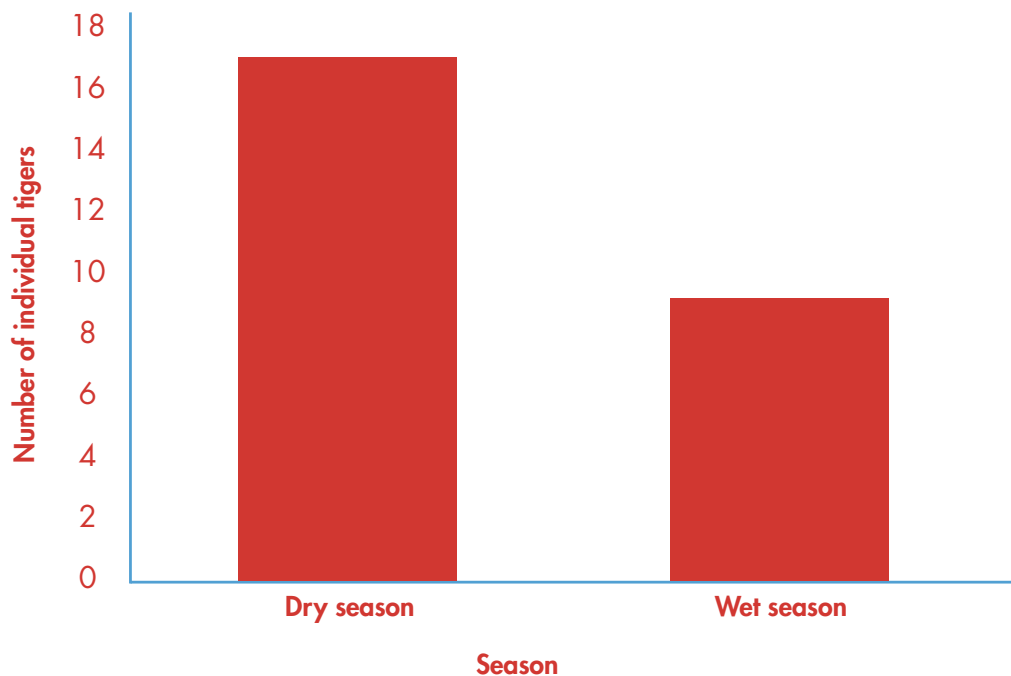
The number of unique individuals was the same in the wet and dry seasons, so I don't think there is a difference in the total number of tigers in the reserve between the seasons.

4. **Calculate** the total number of tigers seen in the two 'Near Lake' locations in the dry season and in the wet season. Show your work.

Dry season: $9 + 8 = 17$

Wet season: $5 + 4 = 9$

5. **Draw** a bar graph of the total number of individual tigers seen at the 'Near Lake' locations in the dry season and wet season. Label the axes and write a figure caption.



Number of individual tigers seen near the lake in the dry season and the wet season

6. **Describe** whether there were changes in how often tigers used the 'Near Lake' locations between the seasons. Use data to support your answers.

I think tigers use the near lake habitat more in the dry season than the wet season. Tigers were detected more often near the lake in the dry season (38) than the wet season (10).

There were more individual tigers seen near the lake in the dry season (17) than the wet season (9).

7. **Construct** a possible explanation for this pattern.

Accept reasonable answers, but students might say that there could be more prey near the lake in the dry season. Accept other logical answers that make sense. Make sure students understand they just need to form a testable prediction, even if their predictions are wrong.

8. **Describe** how you might test your hypothesis from question 7.

Accept reasonable answers. Students might say they would measure the abundance of prey in the forest and near the lake in the two seasons. *Note: This is what they will do later in the activity!*

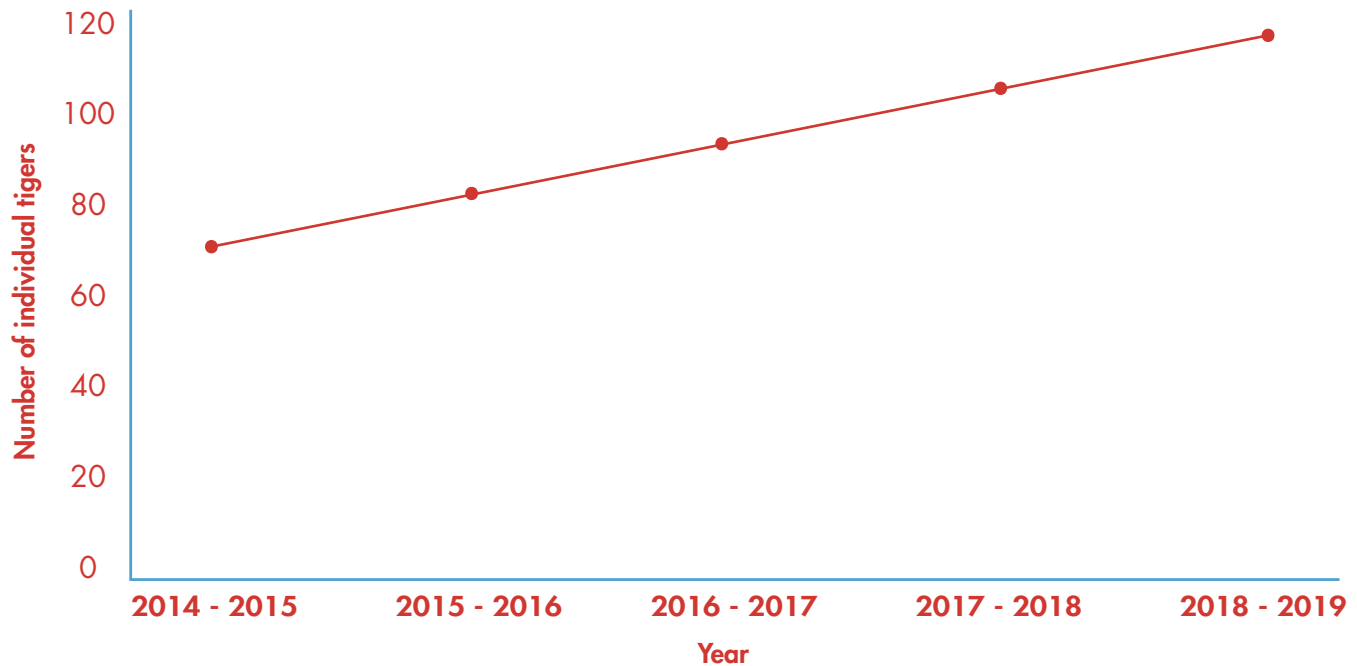
Extend the Lesson: Have students determine the total number of detections seen in the dry season and wet season. Have them construct possible explanations for why there are the same number of tigers in the two seasons but more detections overall in the dry season. The answer appears to be that tigers are actually moving more during this season, possibly to find prey. Have students think about how they might test their ideas for why the differences between seasons in apparent movement exist.

The data you helped collect for 2018 to 2019 is part of a monitoring project that has been going on for over five years. Table 3 shows the number of individual tigers in the reserve each year since 2014.

Table 3. Total number of unique individual tigers identified from cameras over five years

Year	Total number of individual tigers observed
2014 to 2015	72
2015 to 2016	80
2016 to 2017	90
2017 to 2018	98
2018 to 2019	110

9. **Draw** a line graph of the change in the tiger population through time. Label the axes and write a figure caption.



Change in tiger population over time

10. **Describe** whether you think the Nilgiri Biosphere Reserve is helping to protect tigers. Use evidence from your graph to support your answer.

Yes, it appears that the reserve is protecting tigers. The number of tigers has gone up every
year.

11. **Describe** if you think that the tiger population was limited by resources in the 2014 to 2015 year. Use evidence from your graph to support your answer.

I do not think that the tiger population was limited by resources. If they were limited by
resources, the population should not have grown in the next years.

Activity 3: Cycles in the Forest

How do Earth's rotation and orbit affect Kismet's forest? The rotation of Earth causes the cycles of daytime and nighttime. The orbit affects the seasons. We already found out that the number of tigers in the Nilgiri Biosphere Reserve is similar in the dry season and the wet season. But, what about their prey?

1. **Predict** whether prey numbers should be similar or different in the dry season and wet season based on the number of tigers.

I think that prey numbers are similar between dry seasons and wet seasons because there has to be enough to support the same number of tigers in the two seasons. Accept other logical answers that make sense. Make sure students understand they just need to form a testable prediction, even if their predictions are wrong.

Let's investigate how the time of day and seasons affect Kismet's prey. That will let us know when tigers might hunt. The graphs in Figure 1 and Figure 2 show the average numbers of each species observed at ten forest locations over eight days at each site. These are the different species:



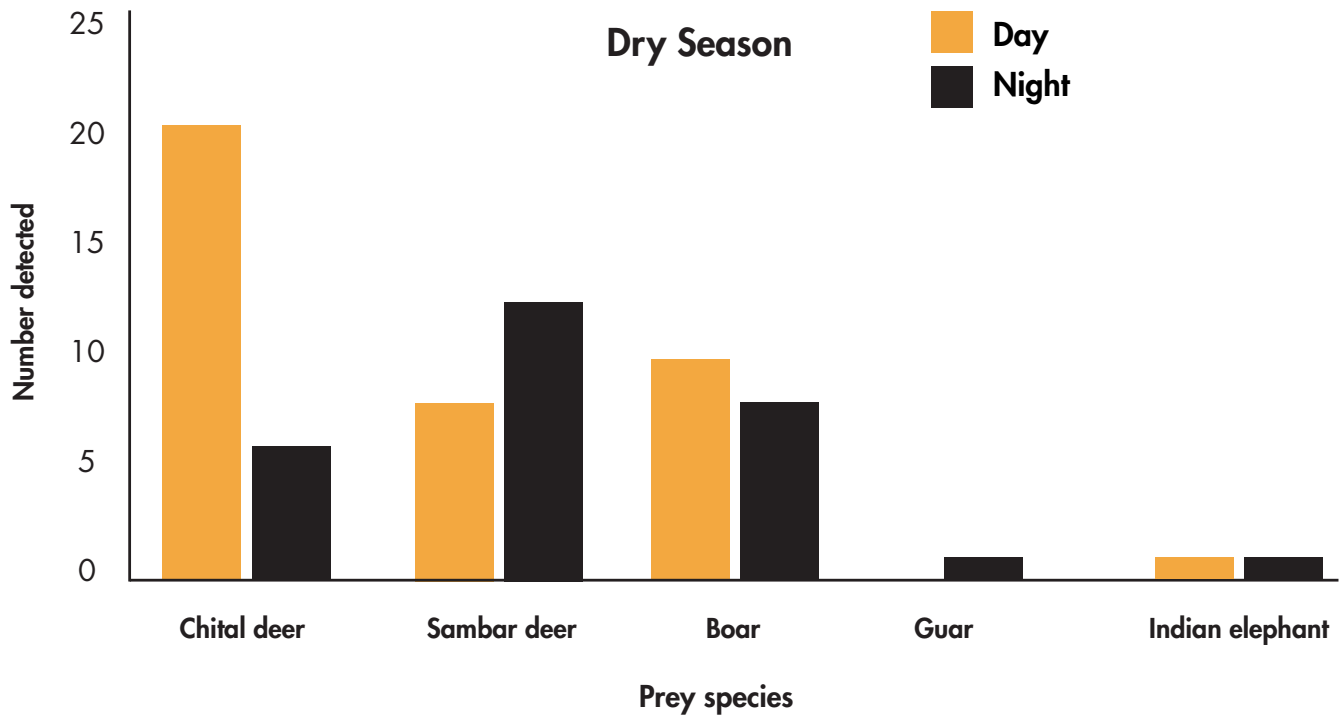


Figure 1. Detections of potential tiger prey in the forest during the day and at night in the dry season

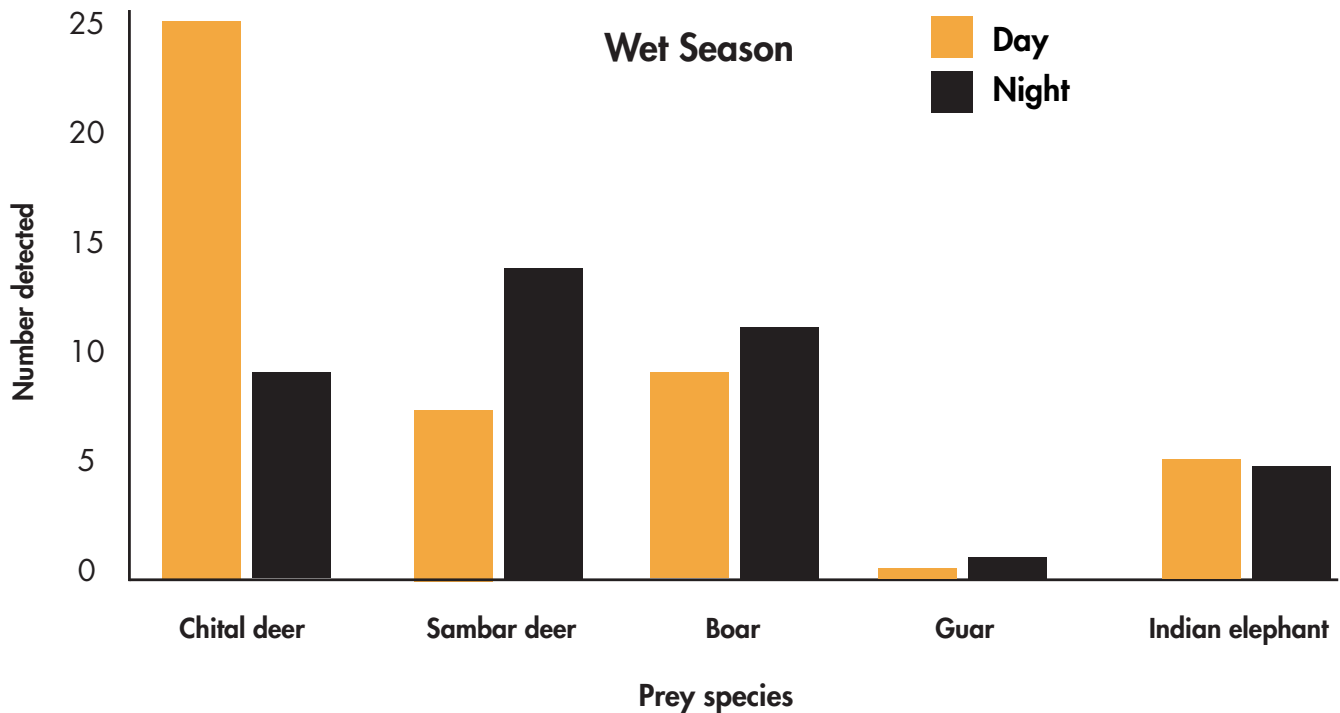


Figure 2. Detections of potential tiger prey in the forest during the day and at night in the wet season

2. **Describe** whether there are large changes in the types and numbers of prey available to tigers between the dry season and the wet season. Do these data support or reject your hypothesis from question 1?

It looks like the amount of prey is fairly similar. There may be a slightly higher number of detections in the wet season for chital and Indian elephants. This supports my hypothesis that the amount of prey is similar in the two seasons. *Note: Student answers may vary and should be consistent with the data and the hypotheses that they made.*

3. **List** the species that are mostly active at night, or *nocturnal*.

Sambar deer, gaur

4. **List** the species that are mostly active during the day, or *diurnal*.

Chital deer

5. **List** the species that are active during the day and during the night.

Indian elephant, boar, students may also list 'gaur'

Table 4 shows the total number of Indian elephants and chital deer at camera traps near the lake in the dry and wet seasons.

6. **Complete** Table 4 by calculating total number of detections near the lake for each species in each season.

Table 4. Changes in the abundance of chital deer and Indian elephants near the lake between seasons

Location	Chital deer		Indian elephant	
	Dry season	Wet season	Dry season	Wet season
Near Lake 1	23	12	8	2
Near Lake 2	27	8	7	4
Near Lake 3	32	9	9	5
Near Lake 4	41	11	12	3
Near Lake 5	36	14	13	7
Total	159	54	49	21

Extend the Lesson: Have students draw a bar graph of the data in Table 4 if you would like them to have more practice creating graphs.

7. **Describe** how the number of Indian elephants and chital deer changes near the lake across seasons.

More elephants and chital deer use areas near the lake in the dry season than the wet season.

8. **Propose** a reason why you see this pattern.

There is probably less water in the forest in the dry season so the animals have to move to the lake.

9. **Describe** whether the pattern you observed supports or rejects your hypothesis for changes in tiger detections that you made for question 7 in Activity 2.

Answers should be consistent with their hypotheses. An example answer is:

Yes, it supports my hypothesis of more prey being near the lake in the dry season.

Tigers will actually try to hunt young elephants at the water!