LESSON 6: How many orangutans is a healthy number?

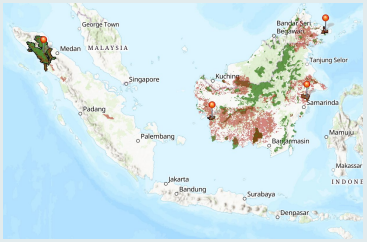
PREVIOUS LESSON

We broadened our thinking beyond palm oil to other locations at which people changed natural ecosystems. We noticed patterns across the cases, which helped us articulate a bigger problem about land use change. We examined before and after images of these systems, which gave us ideas of how to design a better palm farm. We developed criteria and constraints to guide our design decisions. We revisited our Driving Question Board to add new questions and a second driving question for the unit, "How can we use land in ways that work for people and other living things?"

THIS LESSON

INVESTIGATION

2 days



In this lesson, we examine a StoryMap that presents information about the number of orangutans in four protected areas with intact rainforest. We notice that the number of orangutans in each area fluctuates some but is relatively steady. We notice that larger areas seem to have more orangutans. We calculate how many orangutans are in 1 km2 for each park and realize that it is similar across parks, and only about 1-3 orangutans can live in 1 km2. We wonder if that is because of food limitations and consider what we would need in a simulation to test this idea.

NEXT LESSON

We will gather data from a whole-group computer simulation in which individual orangutans compete with each other for two different food sources (figs and termites). We will test the simulation in a variety of environmental conditions (independent variable). We will construct class histograms using data from each simulation to examine how well individual orangutans and the orangutan population overall responds (dependent variables).

BUILDING TOWARD NGSS

MS-LS2-1, MS-LS2-2, MS-LS2-4, MS-LS2-5

WHAT STUDENTS WILL DO

Apply mathematical concepts (ratio) to find patterns in numerical relationships about the number of orangutans that can live in a 1 km^2 area.

WHAT STUDENTS WILL FIGURE OUT

- Populations of organisms are made up of many individuals living in the same area.
- Individual organisms and populations of organisms are dependent upon a certain amount of space.

Lesson 6 • Learning Plan Snapshot

Part	Duration	Summary	Slide	Materials
1	3 min	**NAVIGATION** Review that we need data to figure out what a healthy number of orangutans is.	A	
2	15 min	**INVESTIGATE ORANGUTANS IN PROTECTED AREAS** Explore a StoryMap to find out how many orangutans are in different protected areas in Borneo and Sumatra.	B	Orangutans in Protected Areas StoryMap
3	15 min	**INITIAL IDEAS DISCUSSION ABOUT THE STORYMAP** Introduce the term "population" and share observations and patterns about orangutan populations in four different protected areas.	C–E, O–R	Orangutans in Protected Areas StoryMap, classroom word wall
4	10 min	**CALCULATE THE SPACE ONE ORANGUTAN NEEDS** Focus on what the different park areas mean and calculate how many orangutans are in 1 km^2 in each park.	F–G	calculator, chart paper, markers
5	2 min	**NAVIGATION** Remind students of the revised lesson question and foreground where we are headed in the next class period.	H	
				End of day 1
6	2 min	**NAVIGATION** Review the lesson question and ratio data from the previous class period.	H	
7	15 min	**ANALYZE ORANGUTANS PER AREA DATA** Use the I^2 sensemaking strategy to analyze and interpret the range of orangutans per area across different years at four different parks.	I	*Orangutan Populations in Protected Areas in Indonesia* handout, tape, Orangutans Per Area Chart (made on day 1)
8	10 min	**BUILDING UNDERSTANDINGS DISCUSSION** Make sense of patterns and come to a consensus that 1-3 orangutans can live in 1 km^2.	J–K	*Orangutan Populations in Protected Areas in Indonesia* handout
9	8 min	**ADD TO PROGRESS TRACKERS** Add new ideas to individual Progress Trackers.	L	
10	10 min	**PREDICT WHY ORANGUTANS NEED SO MUCH FOREST AREA** Have students generate ideas about why orangutans need so much forest area and how to test these ideas in a simulation.	M–N	*Orangutan* reference card (from Lesson 1), chart paper
				End of day 2

Lesson 6 • Materials List

	per student	per group	per class
Lesson materials	• Orangutans in Protected Areas StoryMap • science notebook • *Orangutan Populations in Protected Areas in Indonesia* handout • tape • *Orangutan* reference card (from Lesson 1)	• calculator	• classroom word wall • chart paper • markers • Orangutans Per Area Chart (made on day 1)

Materials preparation (30 minutes)

Review teacher guide, slides, and teacher references or keys (if applicable).

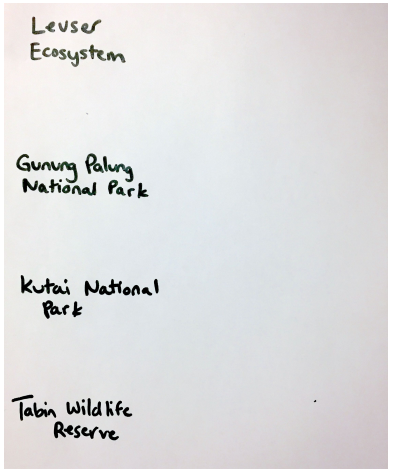
Make copies of handouts and ensure sufficient copies of student references, readings, and procedures are available.

If you have access to computers for students in groups of 2-3, practice opening the *Orangutans in Protected Areas StoryMap* from https://tinyurl.com/orangutanstorymap and review it so that you know how to help students.

If you do not have access to computers, consider the following options or a combination of them:

1. Project the StoryMap for the whole class together.
2. Have students use personal phones to view the StoryMap.
3. Use hardcopy references in the Reference section of the *Student Edition* so that students can look at the same information presented in the StoryMap.
    a. **Slides 0-R** are optional slides that you can use for discussion if you are not using the StoryMap.
    b. *Map of Protected Areas and Orangutan Distribution* and *Orangutans in Four Protected Areas in Indonesia* contain the same information in the StoryMap for students to read.

Make a chart with the names of the four protected areas on it so that it will be easy to fill in during discussion.



Lesson 6 • Where We Are Going and NOT Going

Where We Are Going

At the start of this lesson, students use language about "numbers of orangutans." As students explore the StoryMap, they start to notice different geographic areas within which orangutans live (e.g., four different parks that are very far apart). After this exploration, we explicitly transition from talking about numbers of orangutans to thinking about populations living in specific geographic areas. Moving from thinking about individual organisms to many orangutans is a large conceptual shift.

In the StoryMap, students will observe some data about orangutan populations in the four different geographic areas and notice that the populations fluctuate a little. This idea is introduced in this lesson briefly but will be intentionally developed in Lesson 8 when students can engage with a computer simulation that shows orangutan populations over a much longer period of time.

Students in this grade band are developing an understanding of ratios as a means to compare quantities, as well as to compare a part to a whole. In grade 6 under Common Core, they learn to define and calculate ratios, a skill that they apply in this lesson to figure out how many orangutans live in a given area, as well as to find equivalent ratios and use these comparisons to describe relationships (like the one between the number of orangutans and the size of an area). Using ratios in this specific scenario underscores to students that there is a relationship between orangutans and land area that scales as land area increases, which is an understanding that supports students in figuring out that the number of organisms that can survive in an area depends on the amount and availability of resources (i.e., land). You will need to model how to translate data from a table (like how many orangutans there are) into one side of a ratio whose other side is another value (land area). It is important to emphasize the meaning of the order of this ratio as it related to the question that the class is trying to answer.

Students may also need support in finding equivalent ratios (specifically, unit ratios) in order to find how many orangutans are in 1 unit of area. Teachers can support students by modeling or recalling strategies for finding equivalent ratios, such as bar or block models, ratio tables, and double-tape diagrams. In this case, students may need to see a sample calculation from a classmate or their teacher in order to work through the math required to tabulate data. Calculating these ratios is a secondary skill compared to being able to understand the mathematical meaning of the value of "orangutans per unit area" and use of this data as evidence to draw a scientific conclusion about the relationship between the number of orangutans and the amount of available land.

Where We Are NOT Going

Students calculate ratios of orangutans per area to compare how many orangutans are in four different protected rainforest areas. We do not use the language "population density" on day 1 of the lesson because we want students to develop a conceptual understanding of what that ratio means. On day 2 of the lesson, population density is introduced to help students more easily make observations of patterns across protected areas; however, using this language is not necessary and will not be revisited during the unit. If students are more comfortable using orangutans per area, that is fine.

LEARNING PLAN for LESSON 6

1 · NAVIGATION

3 min

MATERIALS: None

Review the information needed about orangutans. Project **slide A** and have students briefly turn and talk and then share out with the class. Listen for and draw out the idea that we need information about how many orangutans are in healthy rainforests, as that is where we would anticipate finding "healthy" numbers of orangutans. The healthy rainforest areas are likely in protected areas, like national parks.

Suggested prompts	Sample student responses	Follow-up questions
How are we going to know what makes up a "good" or "healthy" number of orangutans in an area?	*Look at places where there are healthy orangutans and see how many orangutans are there.*	*Where should we look for healthy orangutans? In what kind of ecosystem would we expect to find orangutans that are the most "healthy?"*

Introduce the lesson question. Tell students that this is what we will investigate today and introduce the lesson question: "How many orangutans is a healthy number?"

2 · INVESTIGATE ORANGUTANS IN PROTECTED AREAS

15 min

MATERIALS: Orangutans in Protected Areas StoryMap, science notebook

Prepare to explore the StoryMap. Say, *I have a StoryMap that provides information about where there are protected areas of rainforest, where orangutans live, and information about orangutans in those different protected areas.* Project **slide B** and remind students that the purpose is to examine information about orangutan numbers in locations of intact and protected rainforest. Open the StoryMap from https://tinyurl.com/orangutanstorymap . Review a process for reviewing the StoryMap. Encourage students to read the StoryMap once and then discuss with their partner what information is important to record and how to best organize the information. Then encourage students to read the StoryMap a second time, documenting important information in their science notebooks.

ALTERNATE ACTIVITY

If you do not have enough computers for students to work in groups of 2-3, there are three alternative ways to facilitate this activity: (1) project the StoryMap for the whole class to look at together, (2) have students use personal phones or tablets to view the StoryMap, or (3) use paper versions of the materials. See the preparation section of this lesson for more information.

Explore the StoryMap in partners.✱ Give students time to review the *Orangutans in Protected Areas StoryMap,* in groups of 2-3. The StoryMap is located at https://tinyurl.com/orangutanstorymap and linked in their student procedures. Encourage students to record important information in their notebooks in a way that makes sense to them.

ADDITIONAL GUIDANCE

A StoryMap is an interactive, web-based text that helps students explore a specific geographic story. This StoryMap is a new kind of informational text for students that integrates text, maps, images, and graphs to help students interpret key science ideas.

✱ ATTENDING TO EQUITY

If students are struggling to identify what information to record in their notebooks, remind them of what we are trying to figure out ("How many orangutans is a healthy number?"). Then ask what information would allow us to start to answer this question. Additionally, you could provide a scaffold in the form of a table with the locations and numbers of orangutans for those students who need extra support.

3 · INITIAL IDEAS DISCUSSION ABOUT THE STORYMAP

15 min

MATERIALS: Orangutans in Protected Areas StoryMap, science notebook, classroom word wall

ADDITIONAL GUIDANCE

Consider projecting the StoryMap throughout the discussion as a way of looking at the locations as students share their thinking. Optional **slides O–R** are available to support discussion if you choose not to project the StoryMap during the discussion.

Facilitate an Initial Ideas Discussion. Project **slide C** and bring the class together for an Initial Ideas Discussion. Start the discussion with an open-ended prompt about what students noticed about the number of orangutans.

KEY IDEAS

The purpose of this discussion is to foreground three ideas:

1. We can think about the number of organisms in an area as a population.
2. Population sizes can vary over time.
3. Populations seem to be larger in areas with more space.

Listen for these ideas:

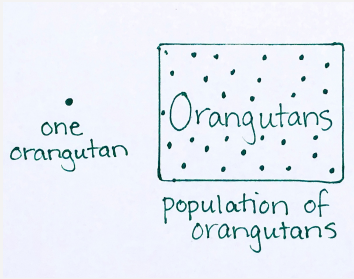
- There is a certain number of orangutans in each different park or reserve.
- The number of orangutans within specific parks sometimes stays the same but sometimes go down or up.
- The number of orangutans in each park is different from the others.
- The Leuser Ecosystem is the biggest park and seems to have way more orangutans than the other smaller parks.

The final idea will prompt a need to calculate a ratio of orangutans per area to figure out if there actually are more orangutans because those areas are larger.

Suggested prompt	Sample student response
What do you notice about the number of orangutans in each area?	*They are changing over time in most locations.* *They are different sizes in different areas.*

Introduce the term "population." Before continuing the discussion, stop and call out the idea that there are specific areas (the protected national parks and wildlife reserves) that have numbers of orangutans within them and that individual orangutans are not moving in between each park. They are their own distinct groups. Introduce the scientific term "population." Emphasize that the four different park areas all have their own populations of orangutans.

Develop a shared representation for the idea of population. Project **slide D** and have students briefly discuss the idea of a population and how to represent this idea with a partner. Then have students share out and develop a class consensus representation. Here is an example representation.



Suggested prompt	Sample student response
How can we represent the idea of a population of orangutans?	*Show a lot of dots to represent a lot of different orangutans.* *Add a circle around the outside to show that it's all in the same place.*
How is a population different from one individual orangutan?	*A population is many different orangutans, not just one orangutan.*

Add "population" to your class word wall or other public vocabulary tracking system (e.g., glossary)**.** Then help students practice using the word throughout the rest of the discussion.

ADDITIONAL GUIDANCE

The introduction of the word "population" has been occasionally used throughout the unit. After looking at examples of four distinct geographic areas in which orangutans live, students should start to have a conceptual understanding that a population is the number of organisms in a specific area. This is why the vocabulary is introduced *after* the StoryMap. By pausing to introduce this term, you provide an opportunity for students to practice using the word "population" as you continue this Initial Ideas Discussion. If students continue to talk about the "number of orangutans," that is OK. You can model the use of the term "population" by restating what the student said and adding the scientific language (e.g., "the number of orangutans in Kutai, or the population of orangutans in Kutai, is the smallest").

Continue the discussion of orangutan populations in four protected areas. Project **slide E** and continue discussing what students noticed in the *Orangutans in Protected Areas StoryMap*. You can project the StoryMap and use it to zoom into areas as students share their ideas.

Suggested prompt	Sample student response
Which area had the largest population? (the most orangutans)? The smallest population (the least)?	*Leuser had the most.* *Kutai had the least.*
What was the approximate population size or number of orangutans in each area?	*It's different in each area. Gunung Palung was around 2500.* *Kutai was 600.* *Tabin was around 1300.* *Leuser varied a lot, between 4,700 and 12,000.*
Why do you think the population of orangutans in an area didn't always remain the same?	*Orangutans are born and die, so it's not always exactly the same.* *Maybe something happened to the orangutans in a year during which there were a lot fewer.*
Why do you think some areas have larger populations of orangutans than others?	*Larger areas had more orangutans. Maybe a bigger area can have more orangutans.*

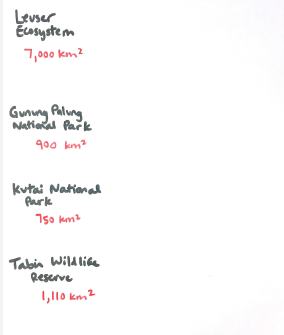
4 · CALCULATE THE SPACE ONE ORANGUTAN NEEDS

10 min

MATERIALS: calculator, chart paper, markers

Review differences in the size of the protected areas. Summarize by saying, *We think that larger protected areas have larger orangutan populations. Let's take a closer look at the sizes of these different protected areas.* Project the *Orangutans in Protected Areas StoryMap* tab and draw students' attention to the sizes of the four different protected areas. Have students share out the size of each area and chart it on a piece of chart paper. Leave space between each area to add more information later.

Discuss what these areas mean. The purpose of this discussion is to help students understand the idea of area in general and differences in the sizes of these four areas.



Suggested prompt	Sample student response
The units of the sizes are km^2. Let's break that apart. What is a kilometer?	*Like a mile but shorter.* *Not sure.*
What does a square kilometer mean?	*A km^2 is an area.* *Two kilometers make a box.* *That is made up of two length units squared.*

ADDITIONAL GUIDANCE

Help students understand how big these areas are by relating each area to places with which students are familiar (cities, states, parks, etc.). A quick Google search should give you the local information students will need. Some examples are:

- 186 football fields is 1 km^2,
- the state of Delaware is 6,500 km^2,
- Los Angeles is 1,300 km^2, and
- New York City is 780 km^2.

Note that km^2 will be the standard area unit in this unit as opposed to hectare and acre.

Revisit the lesson question and reframe it to explore a ratio of orangutans per area. Say, *It's hard to determine what a "healthy" number of orangutans is because the areas are so different. We think the protected areas that are larger have more orangutans than smaller areas. But that may just be because there is more space for them to live. So is the Leuser Ecosystem orangutan population larger because the area is just bigger? How can we standardize the area so that we could compare? All of the park areas are measured in kilometers squared. I wonder about how many orangutans we'd find in just 1 km^2 in each of these parks. Would it be similar?* Project **slide F** and have students share some ideas.

✱ SUPPORTING STUDENTS IN ENGAGING IN USING MATHEMATICAL AND COMPUTATIONAL THINKING

Students may also need support in finding equivalent ratios (specifically, unit ratios) in order to find how many orangutans are in 1 unit of area. Teachers can support students by modeling or recalling strategies for finding equivalent ratios, such as bar or block models, ratio tables, and double-tape diagrams. In this case, students may need to see a sample calculation from a classmate or their teacher in order to work through the math required to tabulate data. Calculating these ratios is a secondary skill compared to being able to understand the mathematical meaning of the value of "orangutans per unit area" and use of this data as evidence to draw a scientific conclusion about the relationship between the number of orangutans and the amount of available land.

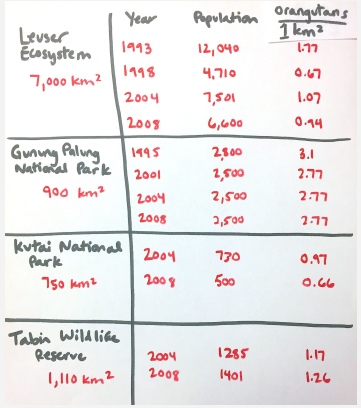
Suggested prompt	Sample student response
How many orangutans do you think we would find in 1 km^2 in each of these parks?	*Accept all ideas and probe for reasoning.*
How could we determine that?	*Not sure.* *Divide the number of orangutans by the amount of space for each area?*

Revise the lesson question. Say, *Let's change our lesson question to reflect this issue with area.* Change the lesson question to: "How many orangutans in 1 km^2 is a healthy number?"

Introduce the idea of calculating a ratio of orangutans per area. Project **slide G** and, if students have not already brought up the idea, introduce the idea of dividing the number of orangutans by the total area as a way to compare the different populations to see if they are about the same. Use the Leuser Ecosystem in 1993 as an example. Emphasize that this could help students to compare the number of orangutans in each protected area and see if there is a "healthy" range.

Chart the population sizes on the board. Ask for student volunteers to share the population information in each year and add this information in a chart you have started.

Calculate a ratio of orangutans per area for each year and location.✱ Divide students into small groups and have each group use a calculator to calculate a ratio of orangutans per area for one or two years in one location. Then have groups add their data to a class chart. Title the chart "Orangutans Per Area Chart" and save it to use the following day. See an example chart to the right.



	Year	Population	Orangutans / 1 km^2
Leuser Ecosystem 7,000 km^2	1993	12,040	1.77
	1998	4,710	0.67
	2004	7,501	1.07
	2008	6,600	0.94
Gunung Palung National Park 900 km^2	1995	2,800	3.1
	2001	2,500	2.77
	2004	2,500	2.77
	2008	2,500	2.77
Kutai National Park 750 km^2	2004	720	0.97
	2008	500	0.66
Tabin Wildlife Reserve 1,110 km^2	2004	1285	1.17
	2008	1401	1.26

5 · NAVIGATION

2 min

MATERIALS: None

Remind students of the new lesson question. Display **slide H**. Remind students that we revised the lesson question and that we will analyze the data we just calculated to answer it tomorrow. ✱

✱ SUPPORTING STUDENTS IN ENGAGING IN ASKING QUESTIONS AND DEFINING PROBLEMS

Use this as an opportunity to remind students that, in science, we pose questions that make sense to us, but as we gather more evidence, we may need to revise those questions so that we can answer them.

End of day 1

6 · NAVIGATION

2 min

MATERIALS: None

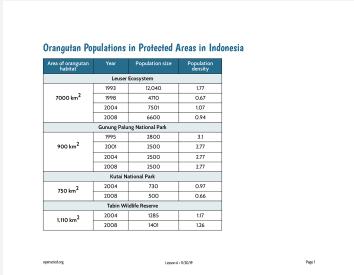
Remind students of the new lesson question. Display **slide H** again. Remind students that we revised the lesson question so that we could include the idea of area in assessing what a healthy number of orangutans is in a standardized area, 1 km^2. Remind students that, the previous day, we calculated these ratios for all of the different locations and times, and now we will have a chance to analyze those data to answer this question.

7 · ANALYZE ORANGUTANS PER AREA DATA

15 min

MATERIALS: *Orangutan Populations in Protected Areas in Indonesia* handout, science notebook, tape, Orangutans Per Area Chart (made on day 1)

Introduce and prepare for the I^2 sensemaking strategy. Say, *I made a handout of the data we gathered yesterday so that we can mark it up.* Project **slide I** to students and remind them how to use the I^2 strategy to analyze and interpret data.✱ Arrange students in groups of three. Hand out to each student a copy of *Orangutan Populations in Protected Areas in Indonesia.* Students can tape the handout in their science notebooks.

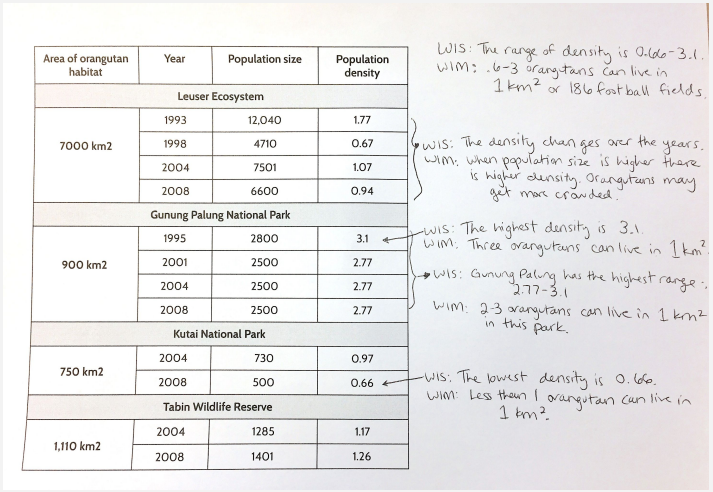

Orangutan Populations in Protected Areas in Indonesia

Area of orangutan habitat	Year	Population size	Population density
Leuser Ecosystem			
7000 km^2	1993	12,040	1.77
	1998	4710	0.67
	2004	7501	1.07
	2008	6600	0.94
Gunung Palung National Park			
900 km^2	1995	2800	3.1
	2001	2500	2.77
	2004	2500	2.77
	2008	2500	2.77
Kutai National Park			
750 km^2	2004	730	0.97
	2008	500	0.66
Tabin Wildlife Reserve			
1,110 km^2	2004	1285	1.17
	2008	1401	1.26

Introduce the vocabulary "population density." Now that students have done the calculations and understand the concept of orangutans per area, introduce the vocabulary "population density" or the total population divided by the land area. Show students that the "orangutans per area" that they calculated has a name, and it is called "population density." Population density is introduced here to help students make WIS statements more easily. However, if students want to continue using the language of "orangutans per area," that is fine. Population density will not be used later in the unit.

Make observations of the graph using "What I see" statements. Prompt students to write "What I see" (WIS) statements in their small groups. Remind students to write directly on the data tables, drawing arrows to their observations. After about 4–5 minutes, bring students together to discuss their observations of the data (e.g., "What patterns did you notice? Did anybody else notice something similar?"). Focus the discussion on the range of orangutans to area ratios.

Interpret observations using "What it means" statements. Have students write "What it means" (WIM) statements next to each of their "What I see" statements. These statements are students' initial explanations of what they think is happening to cause the change in data. Give groups 4–5 minutes to work on their interpretations then have several groups share some of their interpretations aloud. Probe deeper into a few of the interpretations, specifically about the range of orangutans to area ratios and what they mean.



✱ SUPPORTING STUDENTS IN ENGAGING IN ANALYZING AND INTERPRETING DATA

Students will use the Identify and Interpret (I^2) sensemaking strategy to analyze the data table. Consider modeling one observation (WIS) and one interpretation (WIM) with your students before they begin small-group work. This strategy helps students break down an information-rich data set into smaller pieces to interpret, which will allow them to use the data to provide evidence for a phenomenon.

8 · BUILDING UNDERSTANDINGS DISCUSSION

10 min

MATERIALS: *Orangutan Populations in Protected Areas in Indonesia* handout, science notebook

Make sense of the patterns in the data. Project **slide J.** Facilitate a Building Understandings Discussion in which students share their interpretations of the ratio data and make claims about how many orangutans in 1 km^2 is a healthy number. ✱ This discussion can piggyback off of the sharing of "What it means" statements but with the intention of steering the students toward noticing certain patterns if they have not yet emerged during discussion.

KEY IDEAS

Purpose of this discussion: Help students estimate a range of how many orangutans can live in 1 km^2.

Listen for these ideas:

- The range of orangutans in 1 km^2 is between .66 and 3.
- There is a maximum number of about 3 orangutans in 1 km^2.
- In three cases, there is around 1 orangutan in 1 km^2.
- The range fluctuates a little over time.

Suggested prompt	Sample student response
What patterns did you notice about the range of orangutans that can live in 1 km^2?	*In most places it's a little under or over 1 orangutan per km^2. The maximum was 3 in one of the parks, but that was less normal than the others. It fluctuates a little.*
Do you think that 20 or more orangutans could live in that same 1 km^2 space? Why?	*Probably not. They would get really crowded.*

Discuss the lesson question in small groups. Project **slide K**. Bring students together to discuss the new overarching lesson question: "How many orangutans in 1 km^2 is a healthy number?" They should also discuss a related question: "Why is it important to think about the number of orangutans per area (or per km^2)?" Have students discuss these questions with a partner first and then share their ideas with the whole class. For the original lesson question, have students discuss why we could not answer that question. Listen for:

- ideas about how populations are different sizes in different areas so we change the question to account for area and
- that 1-3 orangutans in 1 km^2 seems about normal for intact rainforests.

9 · ADD TO PROGRESS TRACKERS

8 min

MATERIALS: science notebook

Update individual Progress Trackers for reflection. Explain to students that we want to take some individual time to capture what we have figured out from the StoryMap and these data analyses about our questions: "How many orangutans is a healthy number? How many orangutans in 1 km^2 is a healthy number?"

Have students turn to the Progress Tracker section in their notebooks. Use **slide L** to guide students in drawing a line before the last entry from Lesson 4 and to complete the 2 columns, filling in both lesson questions and their responses.

Give students 3–5 minutes to quietly update their Progress Trackers using words and drawings to show what they have figured out. Ask students to draw a line underneath their responses when they are done. Prompt students to use evidence from the StoryMaps and data that we calculated as a class.

ASSESSMENT OPPORTUNITY	Use the Building Understandings Discussion and Progress Tracker entry for formative assessment. If students are struggling to understand the concept of the ratio of orangutans per area, model the ways in which students can represent ratios (including as fractions, as numbers separated by a colon, etc.), emphasizing the importance of preserving the order of the quantities and labeling them in calculations. Consider drawing a square (labeling the area), populating that square with a certain number of orangutans, then modeling how to represent a ratio of number of orangutans to land area. You can also model how to translate data from a table (like how many orangutans there are) into one side of a ratio whose other side is another value (land area). It is important, in this step, to emphasize the meaning of the order of this ratio as it relates to the question the class is trying to answer.

10 · PREDICT WHY ORANGUTANS NEED SO MUCH FOREST AREA

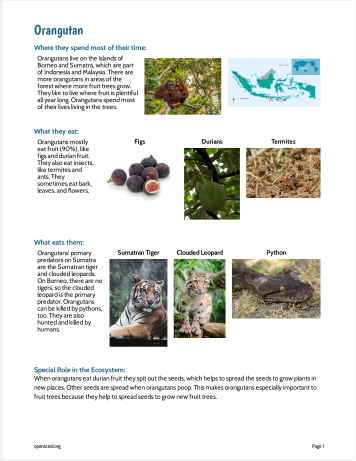
10 min

MATERIALS: *Orangutan* reference card (from Lesson 1), chart paper

Discuss why orangutans need so much forest area. Project **slide M** and emphasize that 1 km^2 is a lot of space. In pairs, prompt students to predict why orangutans need so much forest space. Then have students share their ideas with the class. Chart ideas on the board. Listen for students bringing up ideas about food and draw those ideas out.

Suggested prompt	Sample student response
1-3 orangutans in 1 km^2 is really big. That's only 1-3 orangutans in a space that is 186 football fields. Why do we think orangutans need so much forest space?	*Maybe they need a lot of food, there's only so many homes they can live in, or they fight with each other.*
Why would they need so much forest space if they fought with each other?	*Maybe they would need more space to avoid each other.*
Why would they need so much forest space to get food?	*Maybe the food is spread out, and they need to go a long way to get enough food. Maybe there's not very much food in the forest.*

Discuss how we could test the food idea in a simulation. Project **slide N**. Tell students that tomorrow they will have a chance to test this idea using a computer simulation. Have students discuss what they would want in a simulation first with their partner and then as a class. Students may want to reference the information about orangutans, reading *Orangutan* reference card as a reminder about what foods orangutans eat.



Orangutan

Where they spend most of their time:

Orangutans live on the islands of Borneo and Sumatra, which are part of Indonesia and Malaysia. There are more orangutans in areas of the forest where more fruit trees grow. They like to live where fruit is plentiful all year long. Orangutans spend most of their lives living in the trees.

What they eat:

Orangutans mostly eat fruit (90%), like figs and durian fruit. They also eat insects, like termites and ants. They sometimes eat bark, leaves, and flowers.

Figs | Durians | Termites

What eats them:

Orangutans' primary predators on Sumatra are the Sumatran tiger and clouded leopards. On Borneo, there are no tigers, so the clouded leopard is the primary predator. Orangutans can be killed by pythons, too. They are also hunted and killed by humans.

Sumatran Tiger | Clouded Leopard | Python

Special Role in the Ecosystem:

When orangutans eat durian fruit they spit out the seeds, which helps to spread the seeds to grow plants in new places. Other seeds are spread when orangutans poop. This makes orangutans especially important to fruit trees because they help to spread seeds to grow new fruit trees.

openeddog

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Suggested prompt	Sample student response
If we were going to test the idea that orangutans need so much space to get the food they need in a simulation, what would we need to have in the simulation?	*Different types of food that orangutans eat—figs and termites.* *A set amount of space.* *Orangutans.* *A way to spread out the food in the space.*

Record class ideas on a chart paper to help students remember these ideas at the start of Lesson 7.

Additional Lesson 6 Teacher Guidance

SUPPORTING STUDENTS IN MAKING CONNECTIONS IN MATH

CCSS.MATH.CONTENT.6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.

CCSS.MATH.CONTENT.6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.

On day 1, after realizing that four different protected areas have very different orangutan population sizes and areas, students use ratio concepts to calculate the number of orangutans per area of the four protected areas.

On day 2, students analyze patterns in orangutans per area ratios across four parks to understand how many orangutans 1 km^2 can support.