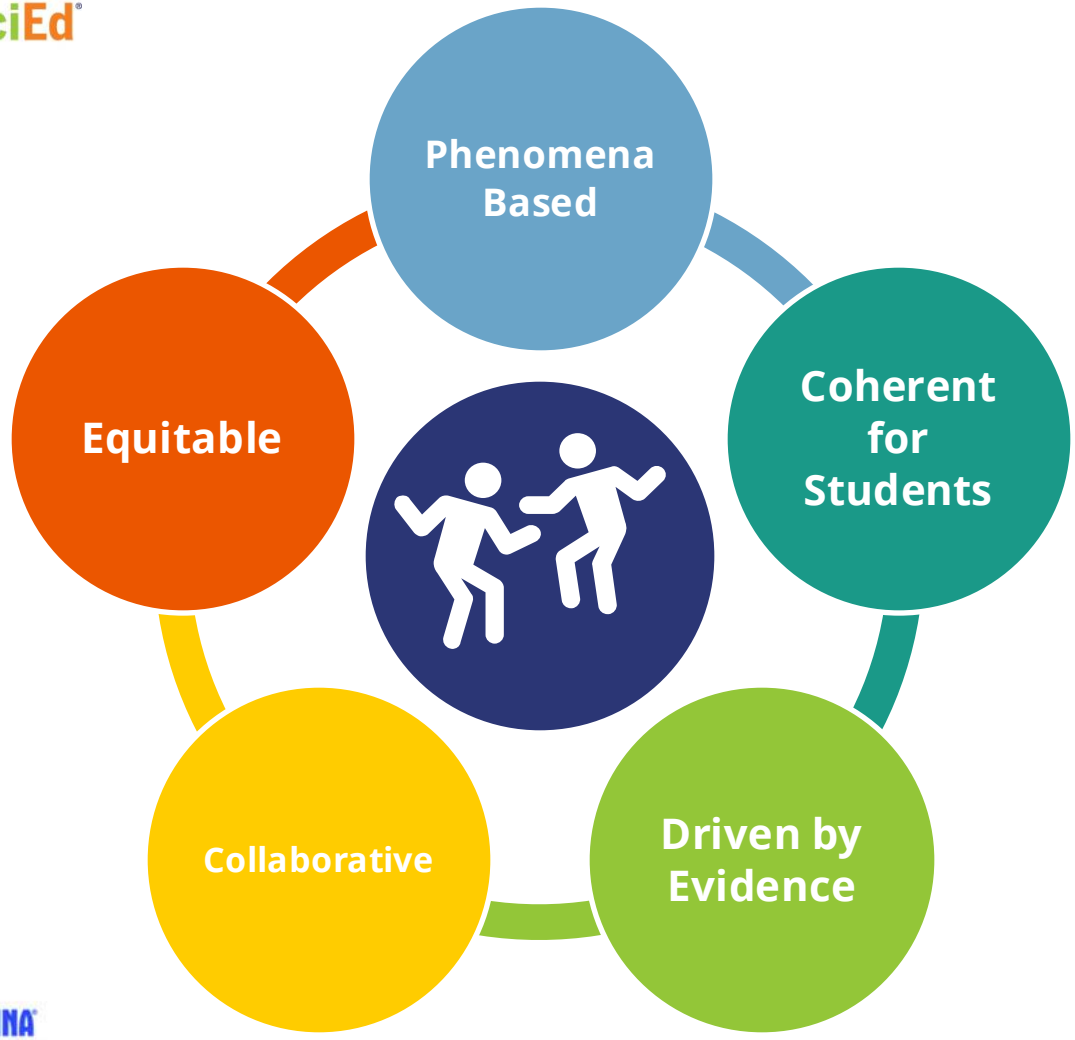
OpenSciEd®

CAROLINA®

High-quality Instructional Materials Just Got Even Better.

Designed and built with students front and center



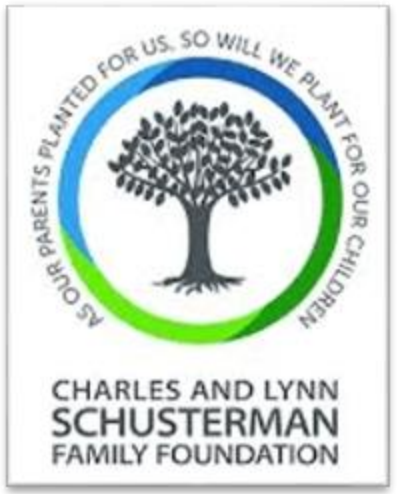
- Exploration is driven by **students'** questions and ideas
- Builds on **students'** prior knowledge and experiences
- **Students** use evidence to revise their thinking
- **Students** figure out ideas as a classroom community

Transforming Science Education

Funded by renowned philanthropic organizations

Bill & Melinda Gates Foundation

Carnegie Corporation of New York



Charles and Lynn Schusterman Family Foundation

William and Flora Hewlett Foundation

Developed by leading education and research institutions

BSCS Science Learning Team

Dana Center Team

Northwestern University Team

University of Colorado Boulder Team

Boston College Team

Transforming Science Education

Field tested by teachers and students across the country

OpenSciEd Teachers & Students

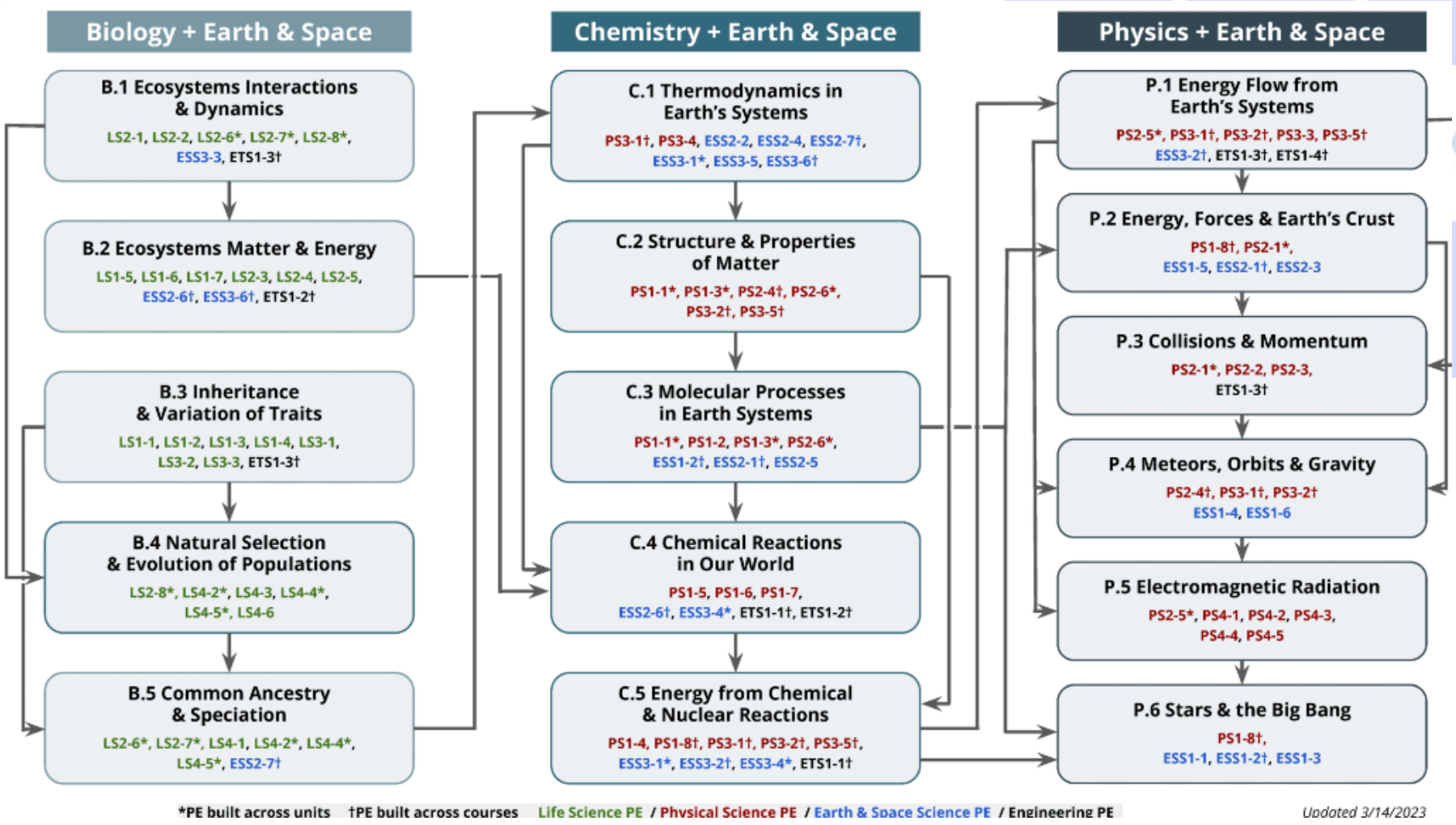
265 field test teachers
and
5800 participating students
in
115 school districts
in
10 states

teach the OpenSciEd units and provide feedback.

The 10 OpenSciEd Partner States

OpenSciEd

High School Scope & Sequence



CAROLINA UNLEASH LEARNING

OpenSciEd

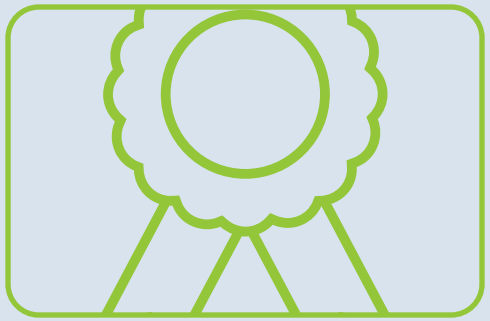
Pathways to Adoption

OPEN EDUCATIONAL RESOURCE (OER)

Download the learning materials freely

OpenSciEd CERTIFIED CAROLINA® VERSION

Carolina and OpenSciEd have partnered to make high-quality instructional materials even better.



High-quality instructional content from OpenSciEd

Materials and development expertise from Carolina

Dedicated service and support from Carolina

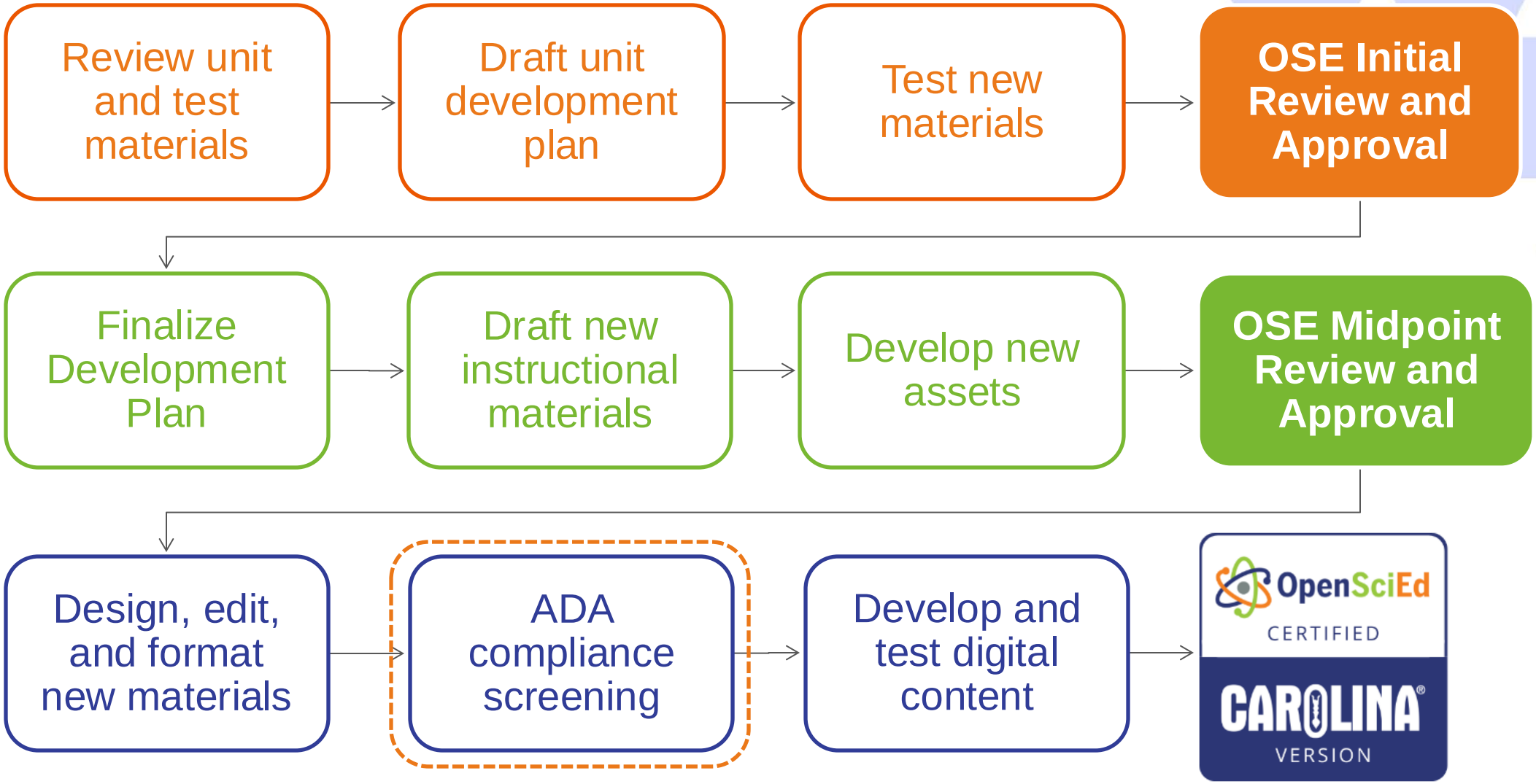
CAROLINA UNLEASH LEARNING

OpenSciEd

Carolina Development Focus

Ease of Use	Redesign the Teacher Guide Reengineer labs and materials Add digital resources and support
Less Prep and Instruction Time	Simplify procedures with new or improved materials Convert some labs to demo or video Add Teacher Prep Videos
Reduce Cost of Kits	Fewer materials Less expensive materials Digital options
Add Safety Measures	Additional Safety Guidance Include PPE in kits Replace and/or reduce some chemicals
Enhance Accessibility	Enhanced ADA features Maintain UDL standards Materials meet adoption standards

Carolina Development Plan

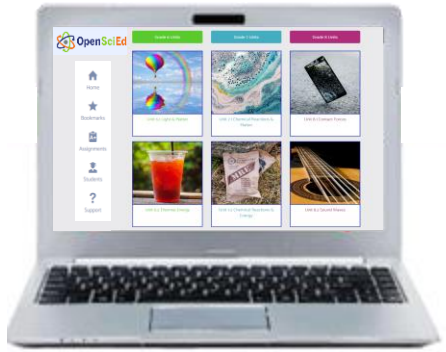


Carolina Certified Version

Redesigned Print Materials

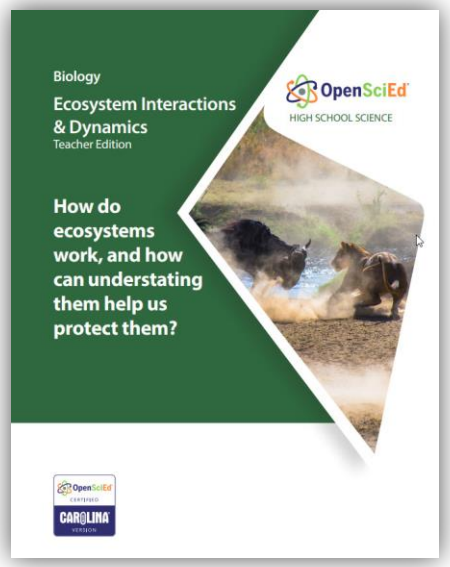
Simplified Investigations

Enhanced Digital Content



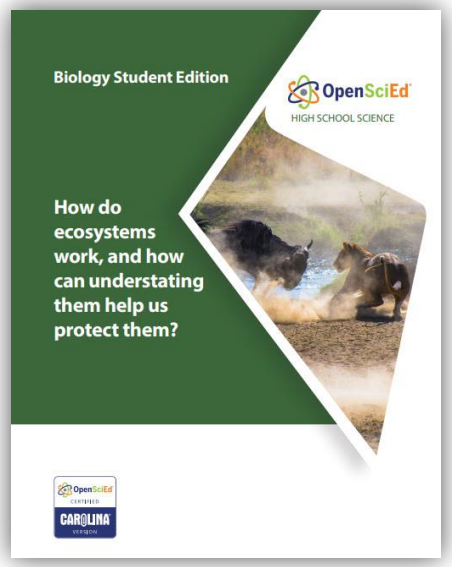
Redesigned Print Materials

TEACHER EDITION



- Reformatted to traditional portrait format
- Reorganized content with a consistent flow that is simple to follow
- Improved layout, labeling, callouts, and images is easy to read
- ADA compliant

STUDENT EDITION



- Bound print versions of all student resources organized **by lesson**
- Includes all handouts, references, and readings
- Student Procedures and Assessments available online
- ADA compliant

Redesigned Teacher Guide

BIOLOGY

3 · CO-CONSTRUCT COMMUNITY AGREEMENTS

10 min

MATERIALS: *Community Agreements*

Consider why we should establish Community Agreements. Before facilitating the first formal discussion of the unit, take some time to prioritize and establish the classroom community. Navigate to this work with community agreements by saying something like, *We have already been working as scientists today as we obtained, evaluated, and communicated information and asked questions. Over the course of the school year, we will engage in these and other science practices together. Those can be difficult tasks, and we will need to practice them together. Scientific work is rarely done alone, and my goal for this class is to have us build a community where we can figure things out together.*

Display **slide G.** Direct students to stop and jot their responses to these prompts in their notebooks:✱

- What are you hoping to get out of this class?
- How can working together help us get farther than we would on our own?
- What barriers may come up that would make it difficult for us to:
  - build a community?
  - accomplish our goals, both as individuals and as a class?
- How can we plan to address these barriers?

Develop community agreements. Distribute *Community Agreements* to each student and give them some individual time to fill in their ideas. Then discuss as a class and build a class set of agreements together.

ALTERNATE ACTIVITY

When setting up learning community agreements, students should understand how agreements help everyone in the community to know what is expected of them. Here are two approaches to setting up community agreements:

- Co-construct agreements with students (the default approach using *Community Agreements* or something similar). Explain what agreements are and why we need them for productive science talk and classroom culture. Have students co-construct agreements. As the teacher, you can add agreements that may be missing from the list. Be sure to explain to students how you think the agreement you added is helpful so that they are clear about why you are adding it to the list.
- Give students a set of agreements as a starting point (the alternate approach). Share a set of community agreements with students and provide space for students to edit or add to the agreements if they believe something is missing.

Consider the following questions, which can help you determine which approach is best for your situation:

- Do you want students to participate in co-constructing the agreements?
- Do you want the same set of agreements for every section of science you teach?
- Do you want to work with your team teachers to establish a shared set of agreements for students across all your classes?
- What kinds of consequences will you enforce if students do not follow the agreements?

✱ ATTENDING TO EQUITY

Building classroom culture: It is important to use this norm-building time to begin to cultivate an equitable learning community that promotes trusting and caring relationships. The community agreements should reinforce to students the value of (1) the diversity of thought among all classroom community members in pushing our learning forward and (2) providing a safe learning environment that ensures fair participation. In addition, classroom agreements should interrupt cultural norms or stereotypes that could make science experiences feel uncomfortable for some students (e.g., as being someone who is not intelligent enough to think like a scientist, who cannot do the relevant math, who cannot share their thinking). Example community agreements can be found in *Example Community Agreements*. Your version of the agreements should use wording and ideas co-constructed with your class.

4 · FACILITATE AN INITIAL IDEAS DISCUSSION ABOUT CONSERVATION CRITERIA

10 min

MATERIALS: science notebook, whiteboard or chart paper, chart paper markers

Facilitate an Initial Ideas Discussion. ✱ ✱ Display **slide H**. Call on one group to share their list of criteria and publically record it on the whiteboard. Ask each additional group to indicate which criteria they have in common by adding a checkmark next to that criteria and add any new criteria to the list.

✱ STRATEGIES FOR THIS INITIAL IDEAS DISCUSSION

BIOLOGY

Lesson 1 LEARNING PLAN

3 Co-Construct Community Agreements 10 min.

Materials

- *Community Agreements*

Consider why we should establish Community Agreements. Before facilitating the first formal discussion of the unit, take some time to prioritize and establish the classroom community. Navigate to this work with community agreements. **Say,** *We have already been working as scientists today as we obtained, evaluated, and communicated information and asked questions. Over the course of the school year, we will engage in these and other science practices together. Those can be difficult tasks, and we will need to practice them together. Scientific work is rarely done alone, and my goal for this class is to have us build a community where we can figure things out together.*

G **Present slide G.**

Direct students to stop and jot their responses to these prompts in their notebooks:[2]

- What are you hoping to get out of this class?
- How can working together help us get farther than we would on our own?
- What barriers may come up that would make it difficult for us to:
  - build a community?
  - accomplish our goals, both as individuals and as a class?
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Develop community agreements. Distribute *Community Agreements* to each student and give them some individual time to fill in their ideas. Then discuss as a class and build a class set of agreements together.

Reorganized content
Chunked text

Redesigned Teacher Guide

BIOLOGY

LEARNING PLAN for LESSON 1

1 · INTRODUCE PHENOMENON-BASED LEARNING AND THE 30 BY 30 INITIATIVE

12 min

MATERIALS: science notebook, *30 by 30 Initiative*, https://youtu.be/dD3RRX48ods

Introduce phenomenon-based learning. Introduce the idea of phenomena-based learning. Say, *Our work in class this year is going to center on our questions about phenomena--events or things we can observe but not yet completely explain. Each unit will be anchored by a phenomenon, and the questions you all have about it will drive our work in this class for weeks to come as we try to figure them out. This may be different from other classes where someone taught you new ideas right away. As your questions will drive the direction of our work in this class, we are going to spend a few class periods exploring a phenomenon, trying to develop initial explanations about it, and considering other experiences we have had that could be related to it. This will help us pull different ideas and perspectives in and develop questions that reflect what we are all curious about.*

Introduce the 30 by 30 Initiative. Display **slide A**. Say, *In 2021, the US Office of the President issued an executive order setting a goal of conserving 30% of land and water in the United Stated by 2030. This is a movement happening in the US and beyond. Currently, at least 95 other countries have committed to this goal as well.*

ADDITIONAL GUIDANCE

If students experienced *OpenSciEd Unit 7.5: How does changing an ecosystem affect what lives there? (Palm Oil Unit)*, then they are familiar with conservation in the context of orangutans living in protected areas and oil palm farms. Students identified evidence and developed land use plans and PSAs to aid interest holders in decision-making. They also took an action within their community to address a local challenge, such as habitat restoration, monitoring biodiversity, or communicating with interest holders.

The NGSS introduces the idea of conservation in grades 3-5 by specifying how humans can protect Earth's resources and environment (3-LS4.D) and further develops ideas about conservation in middle school (e.g., MS DCI ESS3.C).

If your students do not have prior experience with the concept of conservation, take the time here to add to their personal glossaries with a definition we encounter for conservation such as *preserve or protect a space*. Students will continue to build an understanding of what conservation means through the rest of the unit.

Share additional data. Display **slide B**. Explain to students that a national survey of American voters was conducted, and the majority of voters support the 30 by 30 Initiative. Remind students that many other countries are also committing to this initiative. Although we are focused on US data, it is an international movement.

Introduce Secretary of the Interior, Deb Haaland. Display **slide C**. Explain to students that Secretary Haaland is in charge of the Department of the Interior. The Department of the Interior is responsible for protecting and managing natural resources and cultural heritage in the US.

Set up a Notice and Wonder chart and watch video. Display **slide D**. Direct students to create a T-chart on the first clean page of their science notebooks to record their noticings and wonderings ✱ as they watch a video Secretary Haaland made for Endangered Species Day. The video explains how the 30 by 30 Initiative plans to address issues related to protecting species. Play https://youtu.be/dD3RRX48ods and remind students to keep track of what they notice and wonder in their science notebooks.

ADDITIONAL GUIDANCE

More information can be found about the Department of the Interior at https://www.doi.gov/about and about Secretary Haaland https://www.doi.gov/secretary-deb-haaland

Introduce a reading about the 30 by 30 Initiative. Display **slide E**. Instruct students to record what they notice and wonder in their science notebooks. Distribute *30 by 30 Initiative*. ✱ Give students time to read through the information on their own. Encourage them to mark up the reading using whatever strategy is in place in your classroom.

✱ ATTENDING TO EQUITY

Supporting emergent multilinguals
Students should be encouraged to record their ideas using linguistic (e.g., written words) and nonlinguistic modes (e.g., photographs, drawings, tables, graphs, mathematical equations, measurements). This is especially important for emergent multilingual students because making connections between written words and nonlinguistic representations helps students generate richer explanations of scientific phenomena.

BIOLOGY

Lesson 1 LEARNING PLAN

1 Introduce Phenomenon-Based Learning and the 30 by 30 Initiative 12 min.

Materials
- science notebook,
- *30 by 30 Initiative*
- *Deb Haaland - Secretary of the Interior*

Introduce phenomenon-based learning. Introduce the idea of phenomena-based learning. **Say,** *Our work in class this year is going to center on our questions about phenomena—events or things we can observe but not yet completely explain. Each unit will be anchored by a phenomenon, and the questions you all have about it will drive our work in this class for weeks to come as we try to figure them out. This may be different from other classes where someone taught you new ideas right away. As your questions will drive the direction of our work in this class, we are going to spend a few class periods exploring a phenomenon, trying to develop initial explanations about it, and considering other experiences we have had that could be related to it. This will help us pull different ideas and perspectives in and develop questions that reflect what we are all curious about.*

Introduce the 30 by 30 Initiative.

A **Present slide A.**

Say, *In 2021, the US Office of the President issued an executive order setting a goal of conserving 30% of land and water in the United Stated by 2030. This is a movement happening in the US and beyond. Currently, at least 95 other countries have committed to this goal as well.*

ADDITIONAL GUIDANCE

If students experienced OpenSciEd Unit 7.5: *How does changing an ecosystem affect what lives there?* (Palm Oil Unit), then they are familiar with conservation in the context of orangutans living in protected areas and oil palm farms. Students identified evidence and developed land use plans and PSAs to aid interest holders in decision-making. They also took an action within their community to address a local challenge, such as habitat restoration, monitoring biodiversity, or communicating with interest holders.

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Share additional data.

B **Present slide B.**

Explain to students that a national survey of American voters was conducted, and the majority of voters support the 30 by 30 Initiative. Remind students th
we are focused on US data, it is an interna

Improved labeling
Point-of-use callouts

Simplified Investigations and Materials

"How can we make this lesson easier, reduce cost, and enhance safety?"

- All materials are tested to ensure safety, quality, and accuracy of investigations
- Some materials have been changed to simplify lab setups
- High-quality videos or teacher demonstrations are available to save time or address safety concerns (e.g., open flame)

B.1 Ecosystem Interactions & Dynamics

OER Resources:

- Resize and print Gameboard
- Print and cut out Event Cards
- Print and cut out game tokens

✓ Prepared materials
✓ Cut prep time
✓ Better storage option

Enhanced Assessment

Question types include:

- **Multiple choice**
- **Evidence-supported response** – A scenario or question that provides 3 correct or partially correct responses. Students choose the best response and then support their choice with evidence.
- **Scenario-based free response**

OSE B.1 Lesson 3: What do the differences in bone marrow health between live and dead wildebeest indicate?

A. Nutritional differences impact survival against predation. (Correct)
B. Environmental temperature changes are the main cause of death.
C. Age differences solely determine wildebeest's survival chances.
D. Anthrax is the only factor influencing bone marrow health.

Instructional Routines

Each step is driven by student questions about the phenomenon.

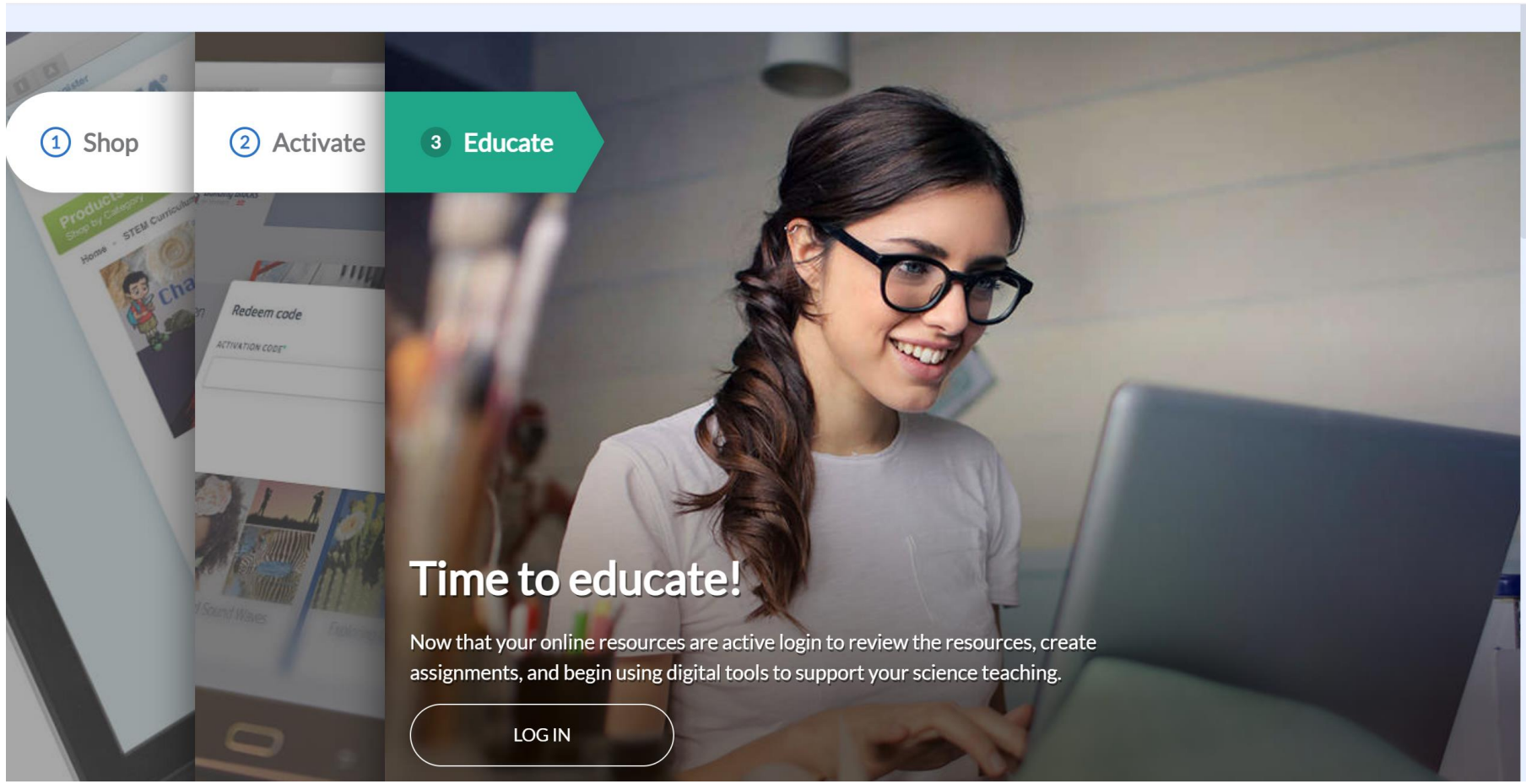
Anchoring Phenomenon Routine	How do we kick off investigations in a unit?
Navigation Routine	How do we work with students to motivate the next step in an investigation?
Investigation Routine	How do we help students use practices to figure out pieces of the science ideas?
Putting the Pieces Together Routine	How do we help student put together pieces of the disciplinary core ideas and crosscutting concepts?
Problematizing Routine	How do we push students to go deeper and revise their science ideas?

OpenSciEd Storyline Instructional Model

CAROLINA UNLEASH LEARNING

OpenSciEd

Enhanced Digital Content



Print and Digital Materials

Compatible with most learning management systems:

Clever (1,320 Schools)

ONEROSTER (250 Schools)

carolina science ONLINE (12,903 Schools)

ClassLink (370 Schools)

Google Classroom (1,628 Schools)

Microsoft

Blackboard

schoology

brightspace

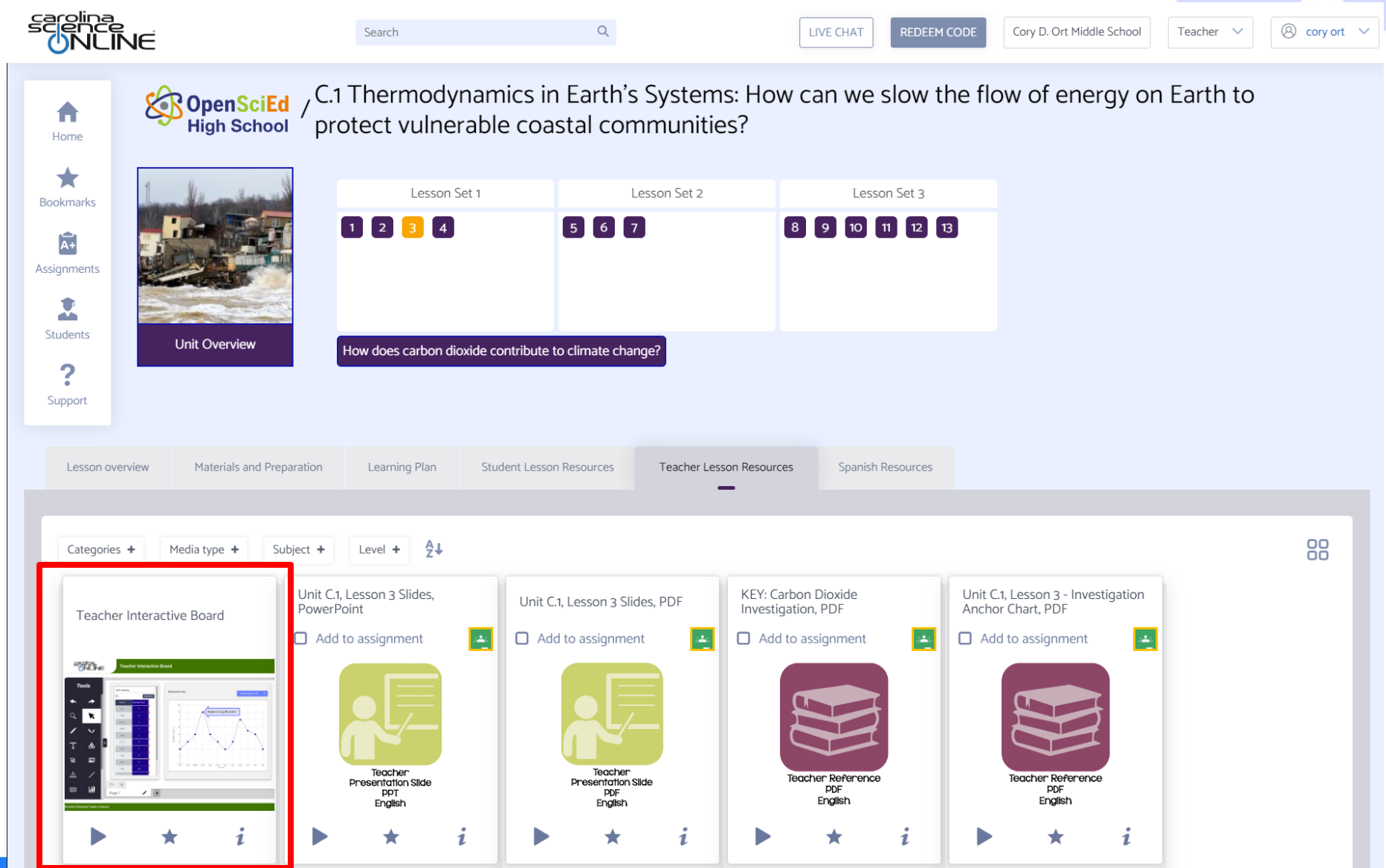
Google Classroom

CANVAS

OpenSciEd CERTIFIED CAROLINA VERSION

OpenSciEd

Enhanced Digital Content



CAROLINA UNLEASH LEARNING

OpenSciEd

Unit Storyline

Unit Storyline

Lesson Set 1: How do populations interact with components of ecosystems?

LESSON 1

Why do ecosystems need protection, and how are they protected?

Anchoring Phenomenon 4 days

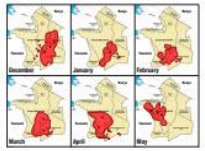
Phenomenon or design problem	What we do and figure out	How we represent it
Lands and waters are protected in different ways based on different criteria. 	We hear about a plan called the 30 by 30 Initiative designed to preserve land and water in the US and beyond. We brainstorm a list of criteria that motivate conservation. We look at examples of conservation and develop initial models of what happened in these places over time. We build a Driving Question Board and generate ideas for investigation. We figure out: • In the US and other countries, there is a plan to conserve 30% of lands and waters by 2030. • Humans have different reasons for conserving lands and waters. • Each system is composed of unique components and interactions that are affected by human interactions. • We can look at ecosystems that have been protected to understand how to protect systems in the future.	 National Park Service

Navigation to Next Lesson: We figured out that people conserve places, lands, and waters for many different reasons and in many different ways. We wonder how we can use what we figured out about multiple ecosystems to understand how to conserve lands and waters across the US.

LESSON 2

What can other cases of conservation help us understand about ecosystems and conservation?

Investigation 2 days

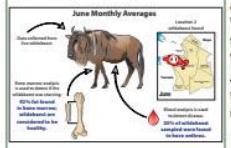
Phenomenon or design problem	What we do and figure out	How we represent it
Serengeti National Park was created to protect the great animal migration route and has a history of complicated human interactions. 	We watch a video and look at maps of the Serengeti ecosystem and read about the history of its conservation. We collect more information in a scavenger hunt. We create a consensus model and short explanation of why Serengeti National Park and surrounding reserves were created. We figure out: • The Serengeti is a unique ecosystem with high biodiversity, a unique large mammal migration, and endemic and endangered species. • The great migration is unique, and the park was established in part to protect it. • The great migration is dangerous, but the animals do it anyway. • As a protected space, human decision-making about the Serengeti ecosystem has been motivated by many different points of view and priorities.	

Navigation to Next Lesson: We figure out that Serengeti National Park and surrounding reserves were created to protect the migration of the wildebeest. We wonder why wildebeest go through such a long, dangerous migration.

LESSON 3

Why do the animals in the Serengeti migrate?

Investigation 2 days

Phenomenon or design problem	What we do and figure out	
Wildebeest field data can be organized to find patterns to explain their migration. 	We reflect on wildebeest migration and brainstorm why wildebeest migrate. We hear from a scientist about what he figured out from studying wildebeest. We look closer at wildebeest field data and organize it to look for patterns to explain wildebeest migration. We communicate what we figure out on data displays and co-construct a classroom consensus model to explain what we figured out about wildebeest migration. We figure out: • Some wildebeest are killed by predators, but most wildebeest die of starvation. • Food is the main factor that motivates the migration pattern.	

Navigation to Next Lesson: We figure out that there is evidence that the wildebeest migration is caused by food. We have a lot of questions about this connection between food and wildebeest moving from location to location.

LESSON 4

How is food driving the wildebeest migration?

Investigation 3 days

Phenomenon or design problem	What we do and figure out	How we represent it
Factors such as rain affect wildebeest migration in the Serengeti.  Daniel Rosengren	We decide to investigate how food drives the migration. We hear from a scientist that rain is a good way to understand food, because it is a limiting factor that affects how much grass there can be. We figure out: • There is a wet and a dry season in the Serengeti. • Rain is related to location some of the time. • Other factors limit wildebeest location at different times of the year.	

Navigation to Next Lesson: We figure out what limiting factors are driving wildebeest migration, which makes us wonder about the large wildebeest population and how it can be so big.

Unit Storyline

Unit Storyline

Lesson Set 1: How do populations interact with components of ecosystems?

LESSON 1

Why do ecosystems need protection, and how are they protected?

Anchoring Phenomenon 4 days

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Navigation to Next Lesson: We figured out that people conserve places, lands, and waters for many different reasons and in many different ways. We wonder how we can use what we figured out about multiple ecosystems to understand how to conserve lands and waters across the US.

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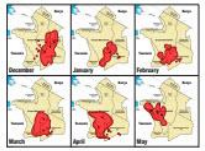
Serengeti National Park was created to protect the great animal migration route and has a history of complicated human interactions. 	We watch a video and look at maps of the Serengeti ecosystem and read about the history of its conservation. We collect more information in a scavenger hunt. We create a consensus model and short explanation of why Serengeti National Park and surrounding reserves were created. We figure out: • The Serengeti is a unique ecosystem with high biodiversity, a unique large mammal migration, and endemic and endangered species. • The great migration is unique, and the park was established in part to protect it. • The great migration is dangerous, but the animals do it anyway. • As a protected space, human decision-making about the Serengeti ecosystem has been motivated by many different points of view and priorities.	

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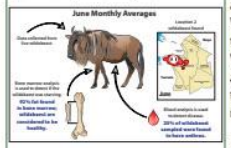
Wildebeest field data can be organized to find patterns to explain their migration. 	We reflect on wildebeest migration and brainstorm why wildebeest migrate. We hear from a scientist about what he figured out from studying wildebeest. We look closer at wildebeest field data and organize it to look for patterns to explain wildebeest migration. We communicate what we figure out on data displays and co-construct a classroom consensus model to explain what we figured out about wildebeest migration. We figure out: • Some wildebeest are killed by predators, but most wildebeest die of starvation. • Food is the main factor that motivates the migration pattern.	

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Navigation to Next Lesson: We figure out what limiting factors are driving wildebeest migration, which makes us wonder about the large wildebeest population and how it can be so big.

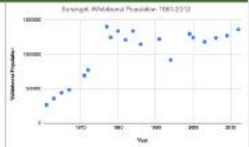
Unit Storyline

Unit B.1 UNIT STORYLINE

LESSON 5

How does food affect the population size?

Investigation 2 days

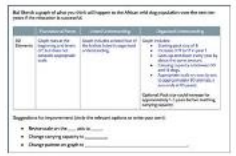
Phenomenon or design problem	What we do and figure out	How we represent it
The population of wildebeest is large when there is a lot of access to food (grass).  Anthony R.E. Sinclair	We decide to use a kinesthetic model to simulate what is happening with food and wildebeest in the Serengeti. We make sense of the data we collect to determine that the amount of food regulates how many wildebeest can survive. We conclude that more food is available because the wildebeest migrate. We figure out: • Food availability is the main limiting factor that regulates the wildebeest population; when they run out of food they move or die. • Migration increases the carrying capacity of the Serengeti ecosystem for wildebeest.	 Data Source: Hopcraft, G. et al. (2015)

Navigation to Next Lesson: We figure out more food is available to wildebeest when they migrate. We wonder if we can apply everything we have figured out so far back to our conservation profiles.

LESSON 6

Can we apply what we figured out about limiting factors and carrying capacity to a new scenario?

Putting Pieces Together 2 days

Phenomenon or design problem	What we do and figure out	How we represent it
Scientists want to reintroduce African wild dogs from South Africa to a new national park in Malawi.  Andy Morffew, CC BY-2.0	We apply the concepts of limiting factors and carrying capacity to a new scenario as we learn how to complete transfer tasks. We revisit the Driving Question Board to determine what else we need to know about the Serengeti ecosystem to learn how ecosystems work and protect them. We figure out: • Space, food, and predation can be limiting factors for wild dogs. • Data about limiting factors can be used to determine carrying capacity. • Liwonde National Park can support one pack of African wild dogs. • We need more information about the role of predators in the Serengeti ecosystem.	

Navigation to Next Lesson: We determine that we understand some of the limiting factors for the wildebeest, but we do not completely understand the role of their predators in the Serengeti ecosystem.

Navigate

Turn and Talk

- What did we figure out about how wildebeest are affected by food availability?
- What did the transfer task about the African wild dogs make us wonder about the Serengeti?
- What are some ways we could investigate changes in populations and predators when we cannot be there in real time?

Be prepared to share your ideas with the whole class.

Modeling as a Practice

With Your Class

- How have you developed or used models in the past?
- How did the models help you make sense of what you were figuring out?
- What are the parts of the models that you have included?

What Is Agent-Based Modeling?

Agent-based models are based on computer simulations of complex systems.

They include:

- An environment.
- Agents.
- Rules that describe how the agents interact with the environment.
- Rules that describe how the agents interact with each other.

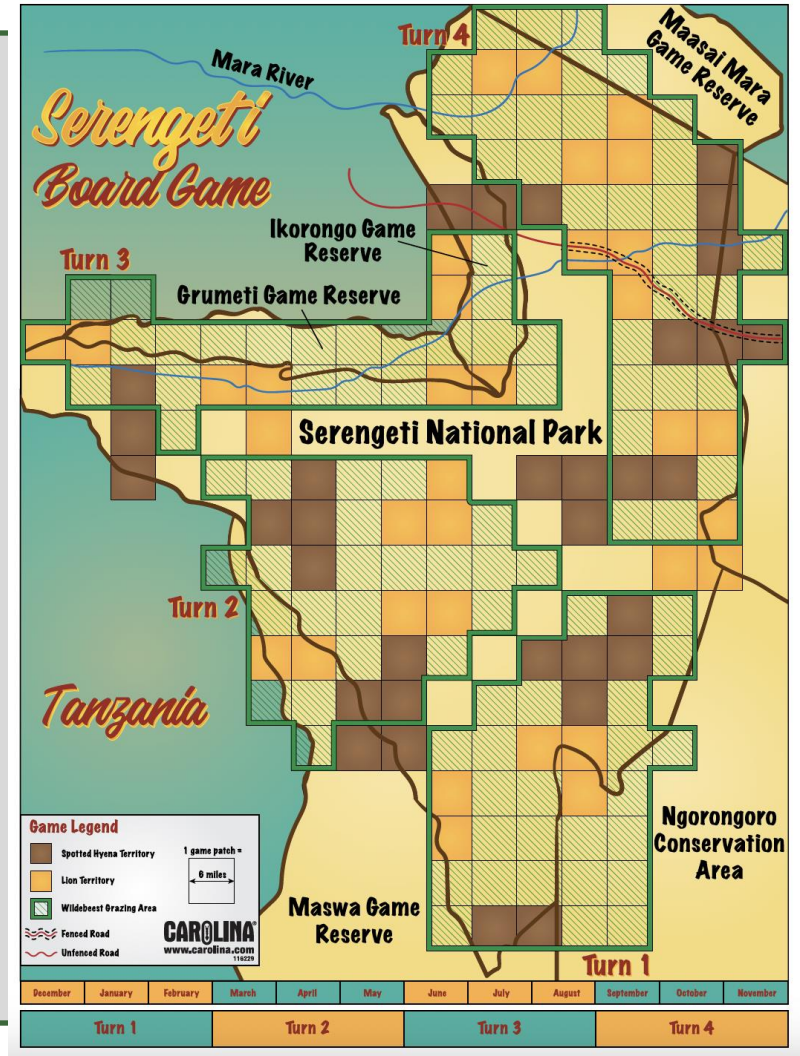
Identify the Parts of Our Model

- What components would the game include if it helped us explain how predators interact with wildebeest in the Serengeti?
- How would some of the components interact with each other?
- How can the model/game help us answer our question?
- If we are going to play this game, what are our next steps?

The Serengeti Board Game

Investigation question:

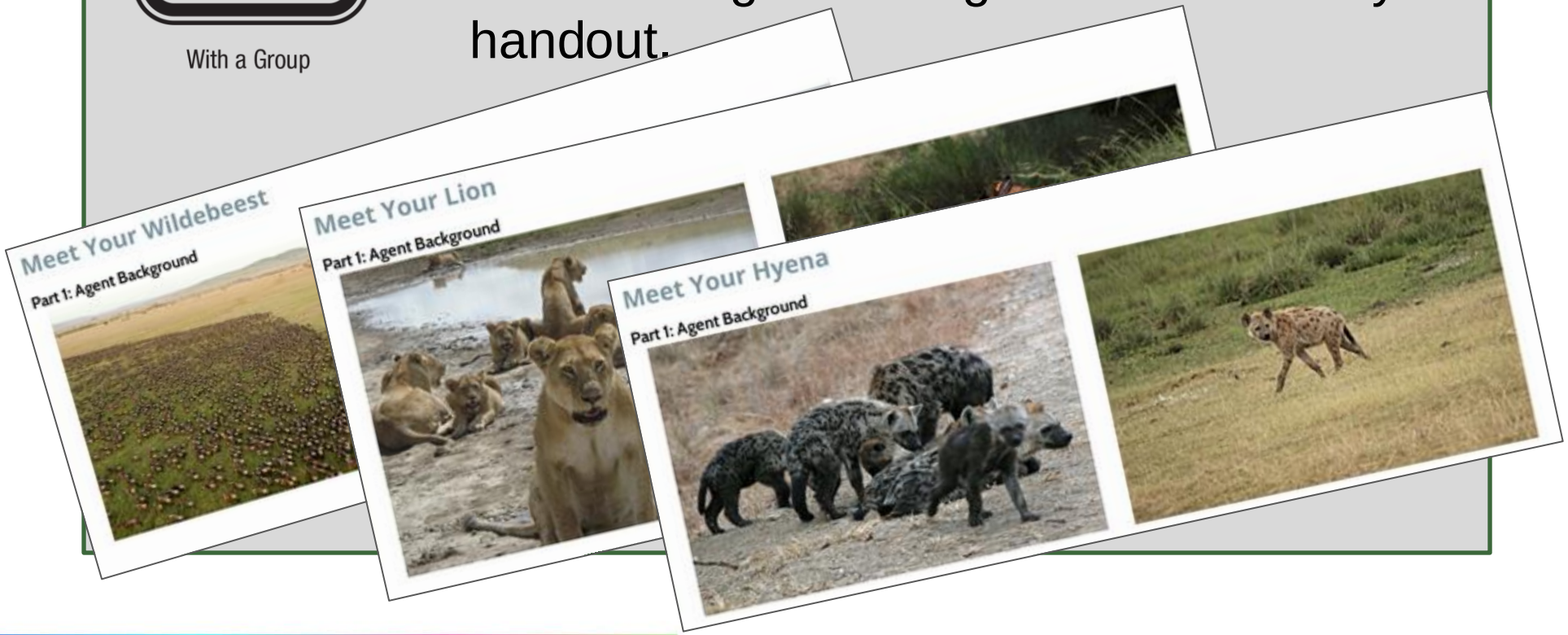
How do predators interact with wildebeest in the Serengeti?



Meet the Agents in the Serengeti Board Game

With a Group

- Choose an agent: lion, spotted hyena, or wildebeest.
- Read the Agent Background section in your handout.



Meet Your Agent: Initial Conditions

With a Group

Use the Agent Background to identify the behaviors connected to the initial conditions.

Table 1. Initial conditions.

Wildebeest	Initial Conditions	Connected Behaviors
	Look at the game board to decide where to put your tokens. For each turn, there is an area outlined on the game board that shows where the most nutritious grasses are. The wildebeest must stay within these areas. It is okay for wildebeest tokens to be placed within lion or spotted hyena territories. Add 22 tokens to the game board, including: • 12 individual tokens • 6 small group tokens • 4 herd tokens	

Connect the Factors that Led to the Rules

Science Notebook

Review the **rules** for your agent, refer back to the Agent Background, and identify the **connected behaviors** that led to the rules.

Wildebeest	Rule	Connected Behavior
Move	At the start of each turn move all of your tokens to the next turn's green outlined area. Check your tokens. Are all of the wildebeest tokens touching another wildebeest token on at least one side? If not, move your tokens so they are touching.	
Interact with Predators	When a predator attacks, you engage with them by rolling 1-3 dice depending on the token being attacked. Herd = 3 dice Small group = 2 dice	

Navigate

With a Group

Predict one way your agent will interact with another agent when you play the game.

Science Notebook

Record your question in your notebook so you can refer to it later.

Navigate

Turn and Talk

- What did we figure out yesterday?
- What question did you suggest as our investigation question?

Be prepared to share your ideas with the whole class.

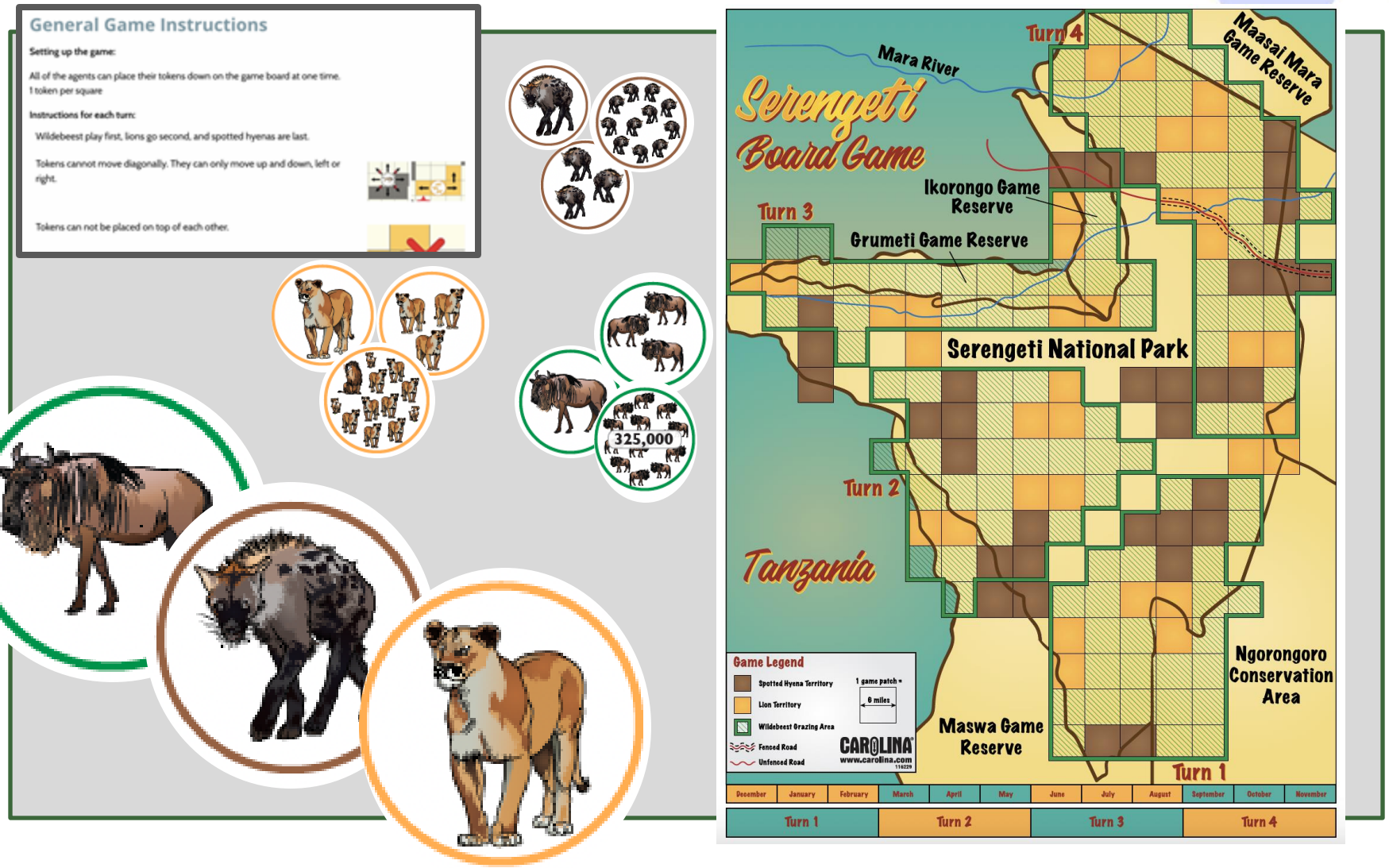
Preparing for Game Play

With Your Class

Which community agreement(s) apply?

Respectful Our classroom is a safe space to share.	
Equitable Everyone's participation and ideas are valuable.	
Committed to Our Community We learn together.	
Moving Our Science Thinking Forward We work together to figure things out.	

Setup of Serengeti Board Game



The Serengeti Game Instructions

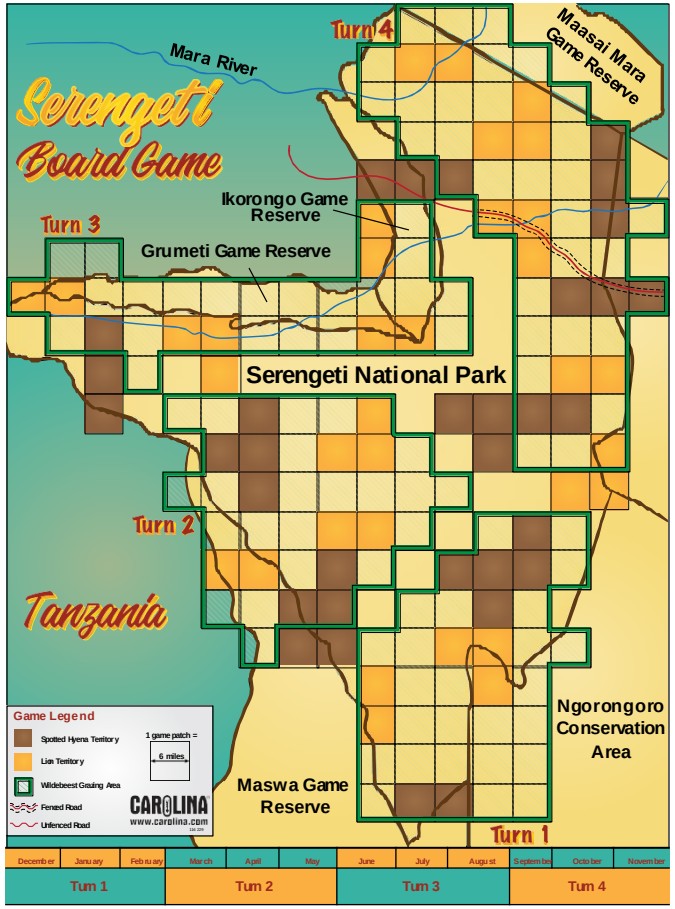
Game Overview

1. The Serengeti Board Game is designed for 3 players (or 3 teams if there are more than 3 people playing the game). This game has no winning or losing; the purpose is to simulate wildebeest population change due to predator-prey interactions and migration patterns.
2. Each player in the game takes on the role of one of the agents - lion, hyena, or wildebeest.
3. The game consists of four turns (or seasons). Each turn has 4 events:
   a. Wildebeest migrate to new seasonal location. (This does not happen in the first turn.)
   b. Each player pulls an Event Card (in this order: wildebeest → hyena → lion) and follows the directions.
   c. Hyenas hunt wildebeest using the dice to determine the results.
   d. Lions hunt wildebeest using the dice to determine the results.
4. Gameplay ends after completing all four turns or seasons of the year (winter, spring, summer, fall).

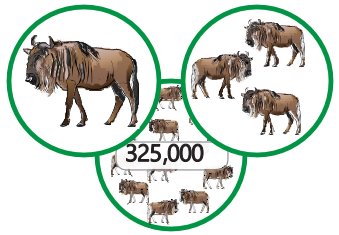
Game Set Up

Serengeti Game Materials

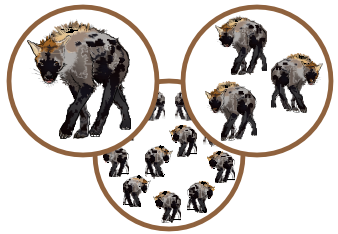
Serengeti Game Board



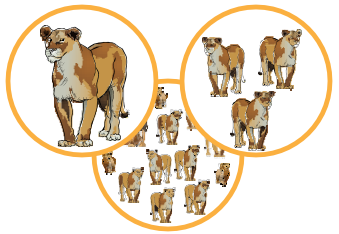
22 Wildebeest Tokens



22 Hyena Tokens



28 Lion Tokens

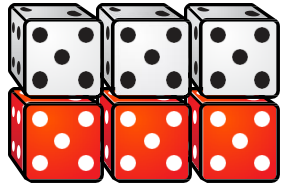


16 Event Cards

Shuffled and Text Down

6 Dice

3 red and 3 white



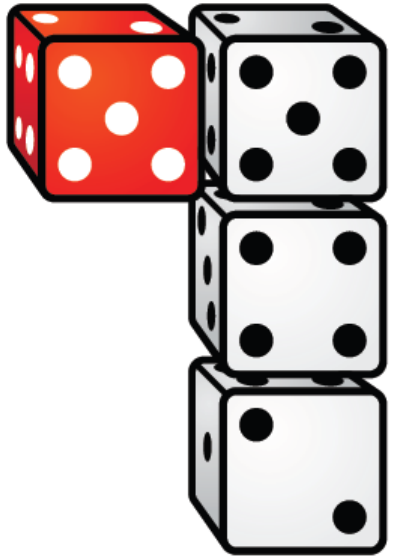
Game Data Collection Handout

How to Roll the Dice in a Hunt

Example Hunt 2 - Individual predator vs. herd of wildebeest

1st Roll

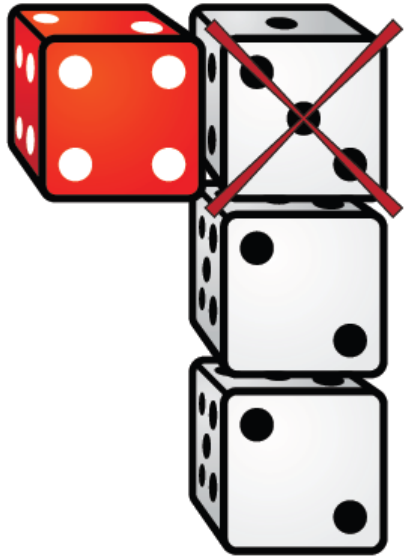
Predator Prey



The two highest dice are tied. Since the predator only has one dice, all die are rolled again.

2nd Roll

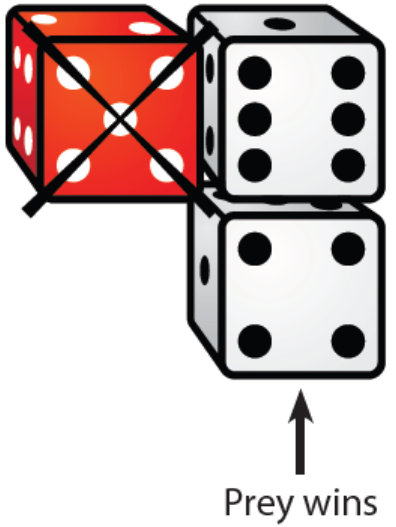
Predator Prey



The predator's die is higher than the prey's highest. One predator's die is eliminated.

3rd Roll

Predator Prey



The predator's die is lower than the prey's and removed, leaving no predator dice remaining.

Instructions for Each Turn

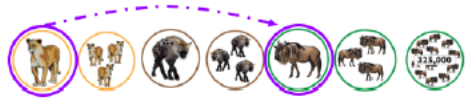
- Draw Event Card
- Hyenas hunt, followed by lions.
- Make sure you know how to roll the dice in a hunt.
- Record your observations in your Data Table.

Data Collection

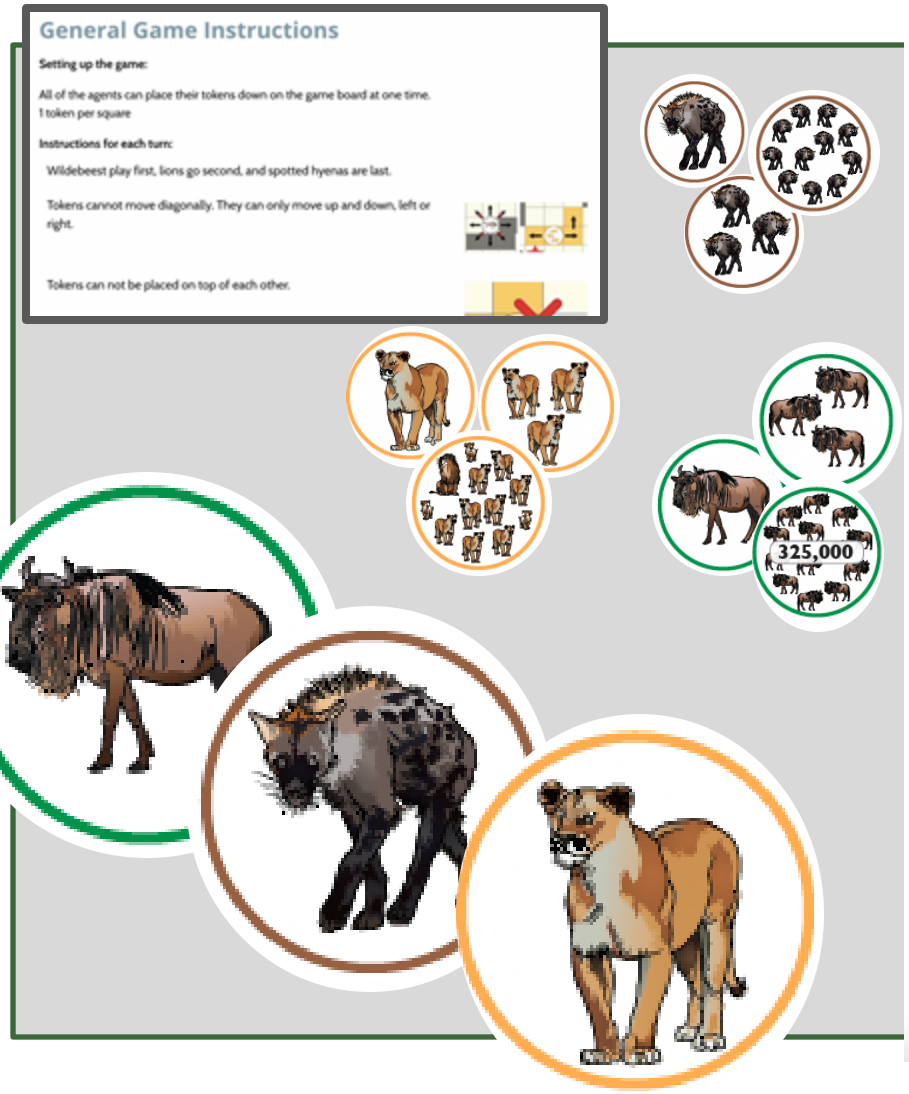
Serengeti Game Data Collection

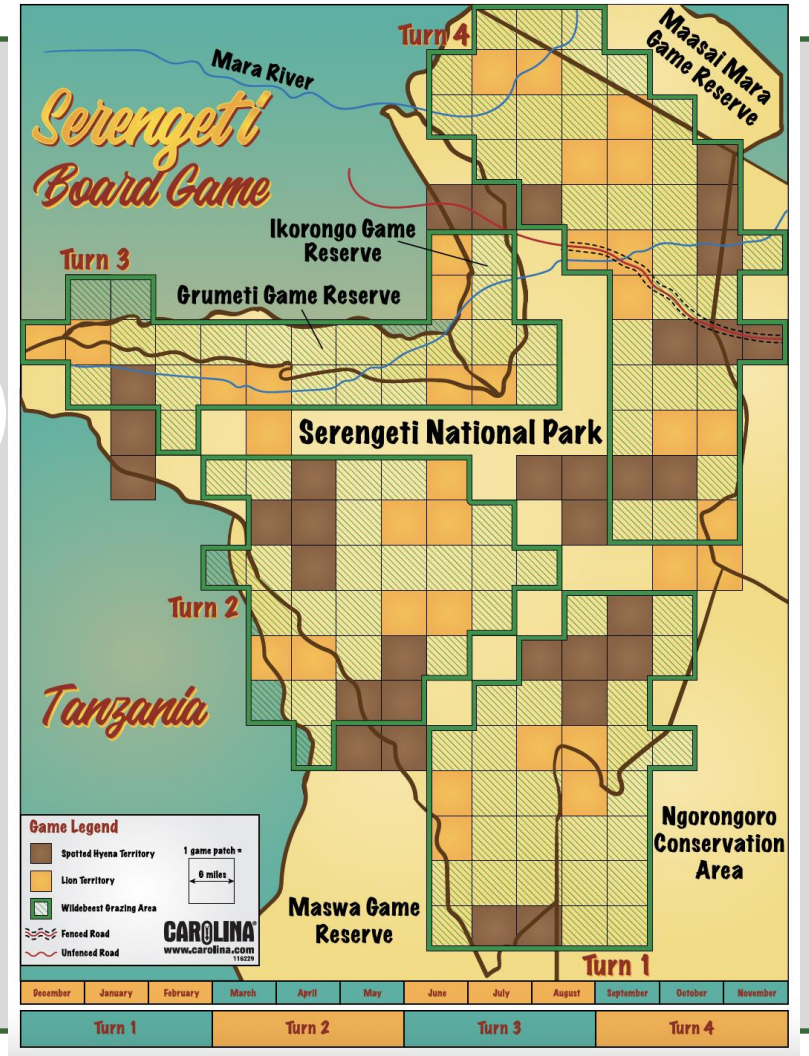
Record your investigation question here:

Example Data

Turn # 2			
Circle and connect the agents that interacted.	Write a quick note about the outcome of the interaction.	**Who was successful? Circle one.**	**Population Change** Circle your agent. Wildebeest, Lion, Spotted Hyena **Record losses/gains.**
	An individual lion attacked an individual wildebeest and won with a single roll of the dice.	Predator / Prey	– 1 wildebeest
	An individual hyena attacked a herd of wildebeest and lost after three single rolls of the dice.	Predator / Prey	none
	A small group of hyenas attacked an individual wildebeest and won with a single roll of the dice.	Predator / Prey	– 1 wildebeest
	Population changes due to predator–prey interactions.		– 2 wildebeest
	Population changes due to Event Cards.		– 1 hyena
	Total Population Change		– 2 wildebeest, – 1 hyena

Play the Serengeti Board Game





Navigate

Exit Ticket

How will the data you collected help you answer your investigation question?

Navigate

Turn and Talk

What was your main takeaway from playing the game?

How will the data collected help you answer your investigation question?

How can we make sense of the data?

Be prepared to share your ideas with the whole class.

Image credits: Spotted hyena, PanWoyteczek, lions, amanderson2, wildebeests, Daniel Rosengren

Analyze Data of Gameplay

With a Group

Complete your *Data Analysis* handout individually and then share your ideas with your game group.

Group Size	Number of interactions	Number of successful interactions	% of time successful
Individual	*7*	*2*	*29%*

% time successful = $\frac{\text{\# times successful}}{\text{total \# of interactions}} \times 100$

Writing Algorithms

Write an *if–then* statement in words:

If an **individual wildebeest** interacts with **any predator**,
then the wildebeest is **successful** 29 **% of the time**.

outputs based on data

Develop a System Model

inputs	interaction	outputs
individual wildebeest 	→	wildebeest lives (0) 
any predator 	→	wildebeest dies (–1) 

Writing Numeric Algorithms

If an **individual wildebeest** interacts with **any predator**, *then* the wildebeest is **successful 29% of the time**.

inputs	interaction	outputs
wildebeest	→	lives (0)
predator		dies (–1)

If **wildebeest = 1** and **predator = 1 and 2**, *then* wildebeest 0 (.29)

OR

If **wildebeest = 1** and **predator = 1 and 2**, *then* wildebeest –1 (.71)

Building Understandings Discussion

Scientists Circle

- What accounted for differences in the outcomes during interactions between predators and prey?
- When an agent was successful, how could their success impact the rest of the group?
- Did evidence from other agents' algorithms support similar or different conclusions?
- What kinds of limitations did you discover in the model?

Add to the Personal Glossary

Science Notebook

What idea have we co-constructed that we want to have consensus on?

Personal Glossary

Navigate

Turn and Talk

Now that we have figured out that group behavior increases survival for wildebeest and their predators, what new questions do you have about the Serengeti system?

How can we investigate those components?

Be prepared to share these with the whole class.

Licensing Information