

Carolina's Certified Version of OpenSciEd® High School
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



Funded by Renowned Philanthropic Organizations



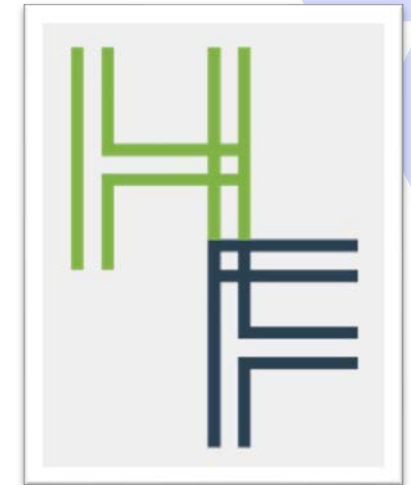
Bill & Melinda Gates Foundation



Carnegie Corporation of New York



Charles and Lynn Schusterman Family Foundation



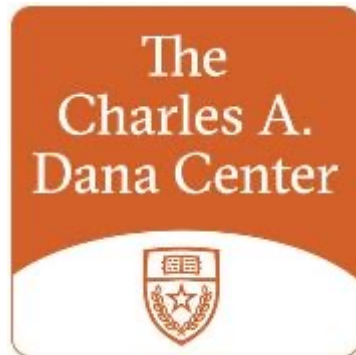
William and Flora Hewlett Foundation



Developed by Leading Education and Research Institutions



BSCS Science Learning Team



Dana Center Team



**NextGen Science Storylines
Northwestern University Team**



**University of Colorado Boulder
University of Colorado Boulder Team**



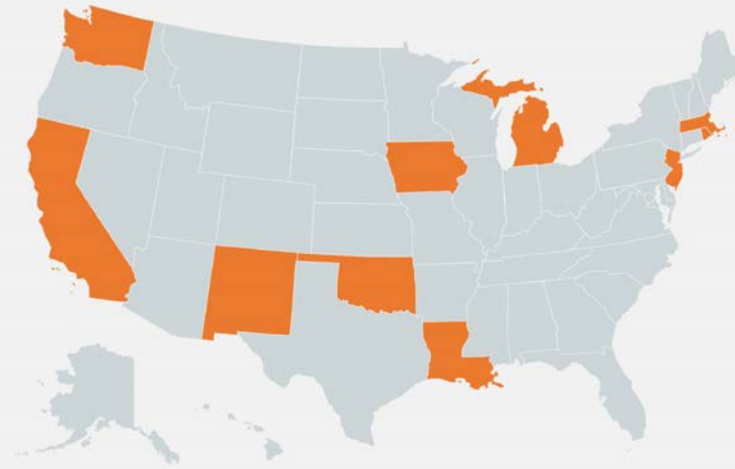
Boston College Team

Field Tested by Teachers and Students Across the Country

OpenSciEd Teachers & Students

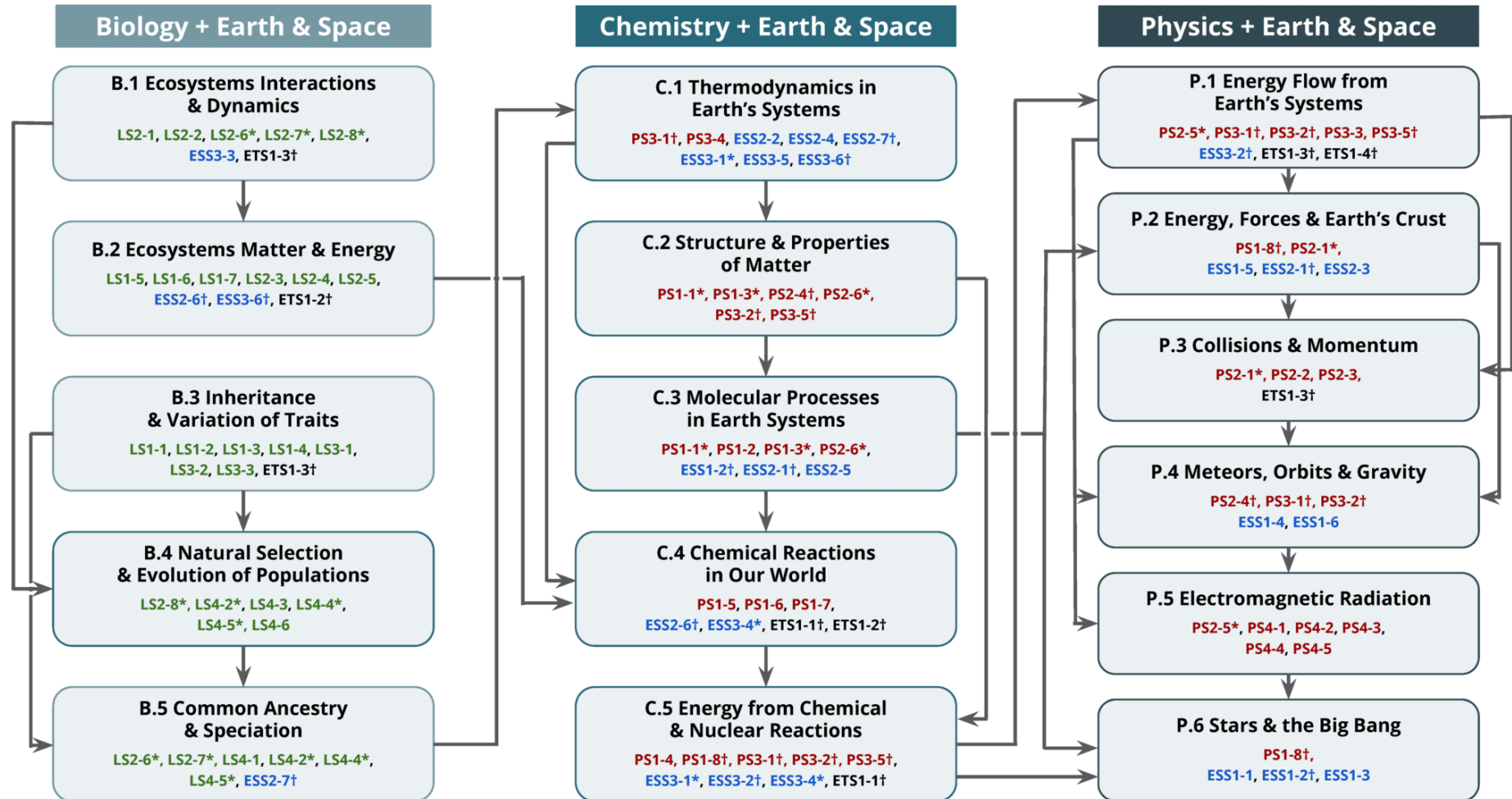
265 field test teachers
and
5800 participating students
in
115 school districts
in
10 states
teach the OpenSciEd units and provide feedback.

The 10 OpenSciEd Partner States



California
Iowa
Louisiana
Massachusetts
Michigan
New Jersey
New Mexico
Oklahoma
Rhode Island
Washington

High School Scope & Sequence



*PE built across units †PE built across courses Life Science PE / Physical Science PE / Earth & Space Science PE / Engineering PE

Updated 3/14/2023



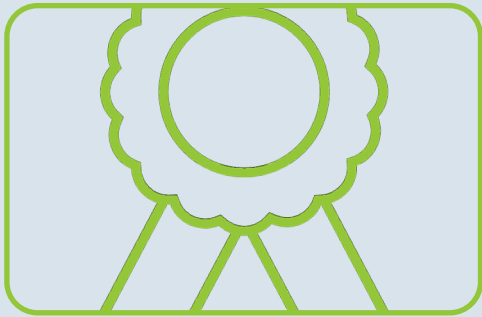
Pathways to Adoption

**OPEN EDUCATIONAL
RESOURCE (OER)**

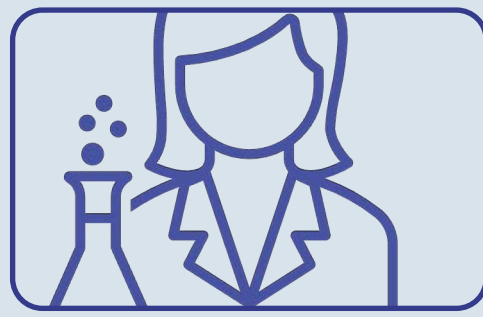
Download the learning
materials freely



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 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

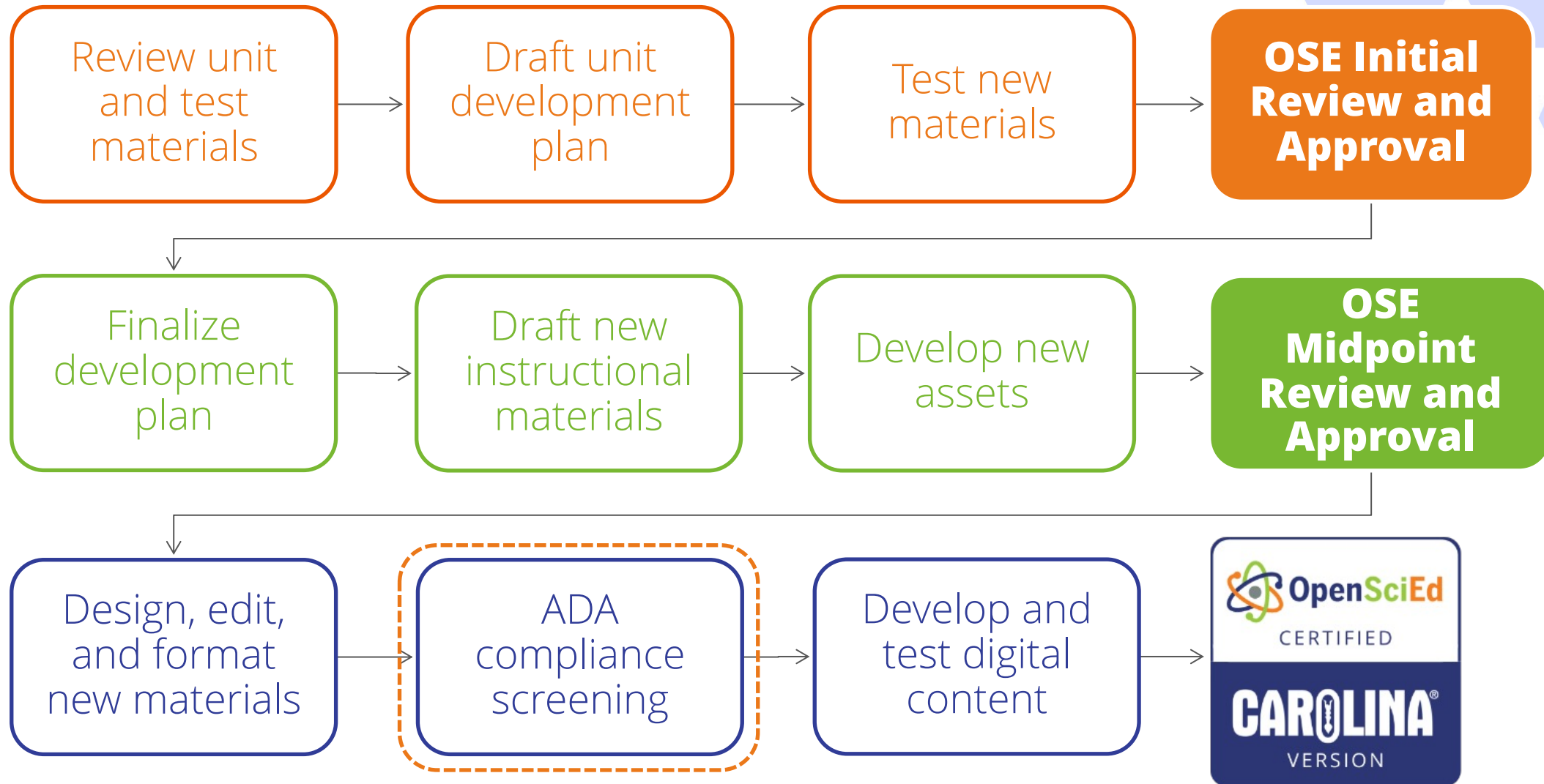
Add Safety Measures

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



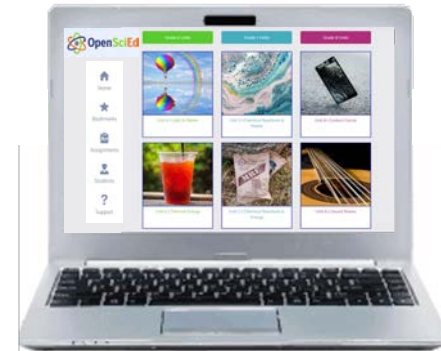
**Redesigned
Print
Materials**



**Simplified
Investigations**



**Enhanced
Digital Content**





Redesigned Print Materials

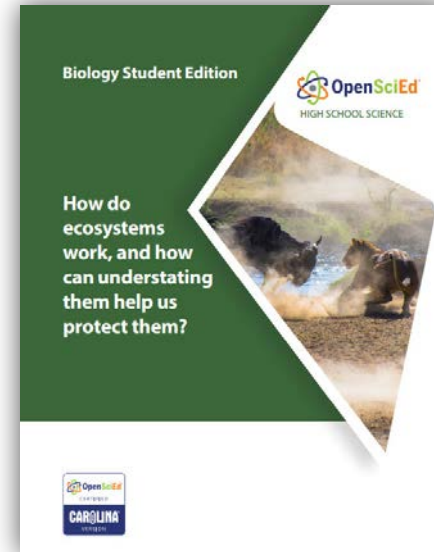


TEACHER EDITION



- Reformatted to traditional portrait format
- Reorganized content with a consistent flow that is simple to follow
- Improved layout, labeling, callouts, and images that are 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 Edition

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?
- How can we plan to address these barriers?

² 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.

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 Edition

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 States 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 notices 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.

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Unit B.1 • Lesson 1 • 12/19/23

Page 28

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 States 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.*



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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 that many other countries are also committing to this initiative. Although we are focused on US data, it is an international movement.

6

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Improved labeling
Point-of-use callouts



Simplified Investigations and Materials

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

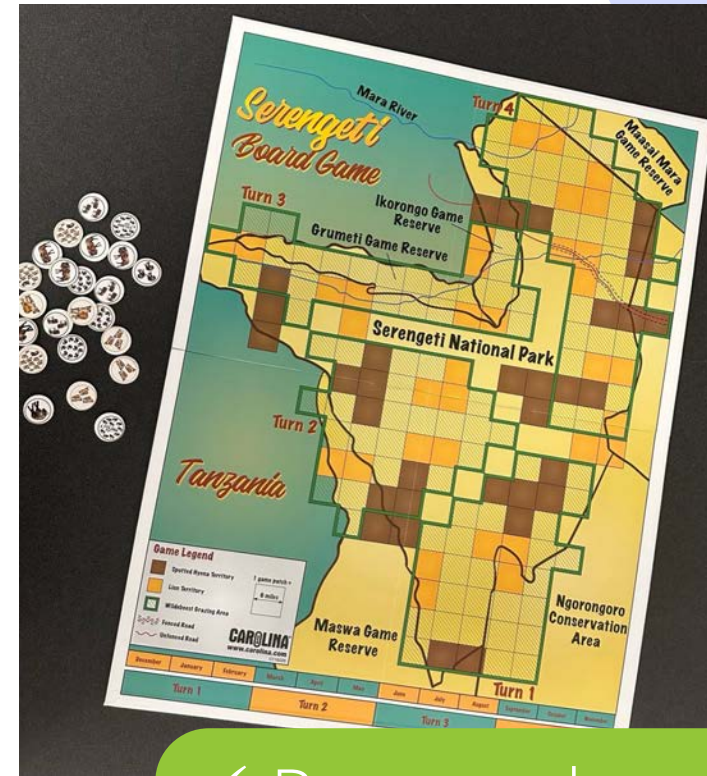
- All materials are tested to ensure safety, quality, and accuracy of investigations
- Some materials have been changed to simplify lab setups
- High-quality videos or teacher demonstrations are available to save time or address safety concerns (e.g., open flame)



B.1 Ecosystem Interactions & Dynamics

OER Resources:

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



Carolina
Resources:

- ✓ Prepared materials
- ✓ Cut prep time
- ✓ Better storage option

Enhanced Assessment

Question types include:

- **Multiple choice**

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.



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and educators.



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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, then support their choice with evidence.

OSE B.1 Lesson 3: What is the significance of bone marrow data in understanding wildebeest migration? Explain your answer with examples.

1. Bone marrow data provides the strongest evidence for what causes wildebeest migration, showing a clear difference between the health of living and dead wildebeest.
2. Bone marrow data is slightly helpful, but it mainly highlights the differences in age among the wildebeest population.
3. Bone marrow data shows no notable differences and is therefore insignificant in understanding wildebeest migration.



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, then support their choice with evidence.
- **Scenario-based free response**

OSE B.1 Lesson 3: Your class is comparing and contrasting different data displays related to wildebeest migration. Some groups have organized their data into charts focusing on nutritional health, while others have emphasized predator data or environmental conditions.

1. What similarities and differences can you find between data displays focusing on nutritional health versus those focusing on predator data?
2. How can contrasting data displays help you draw more comprehensive conclusions about wildebeest migration?
3. What criteria should be used to determine what information is included in the final class data display?

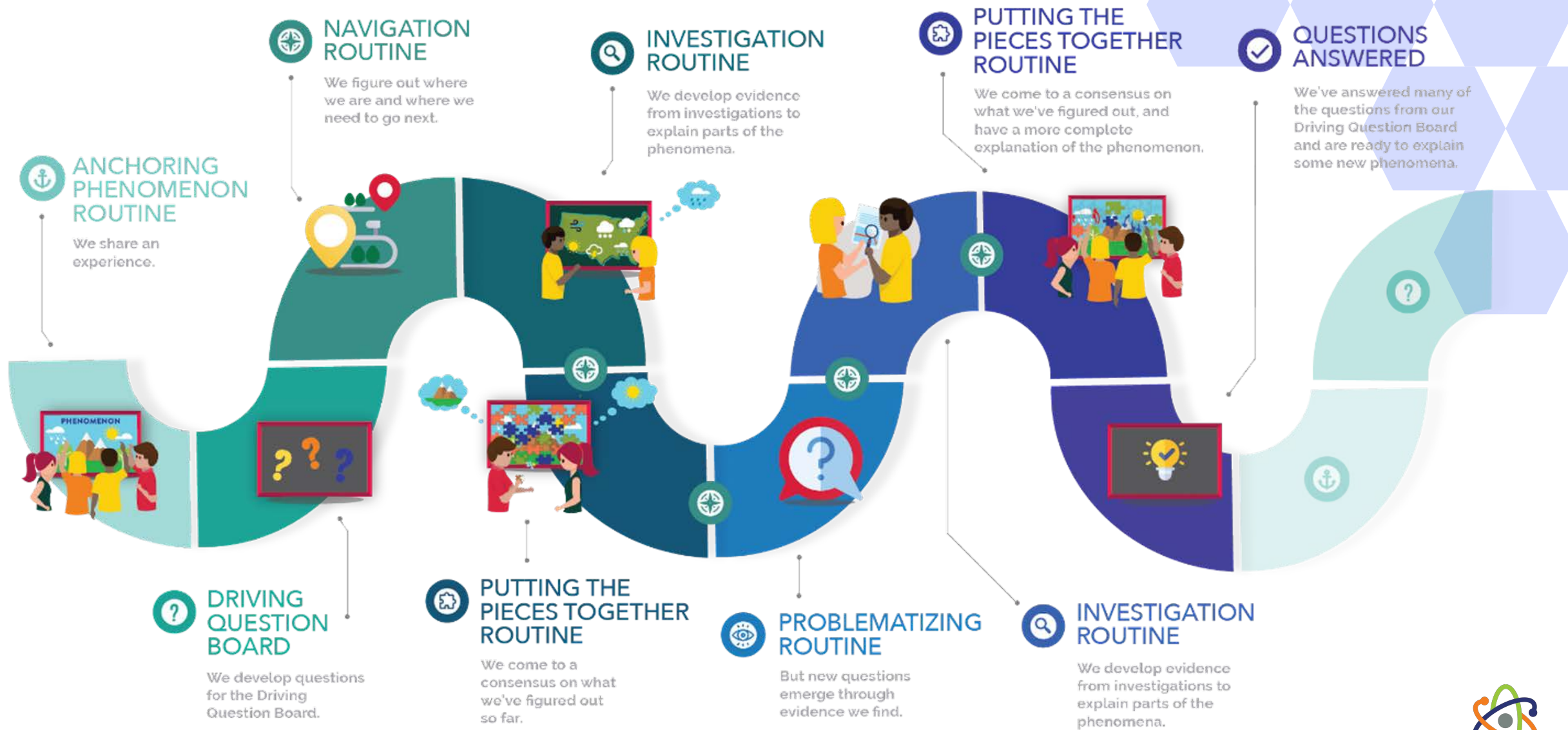


Instructional Routines

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





Enhanced Digital Content

SUPPORT

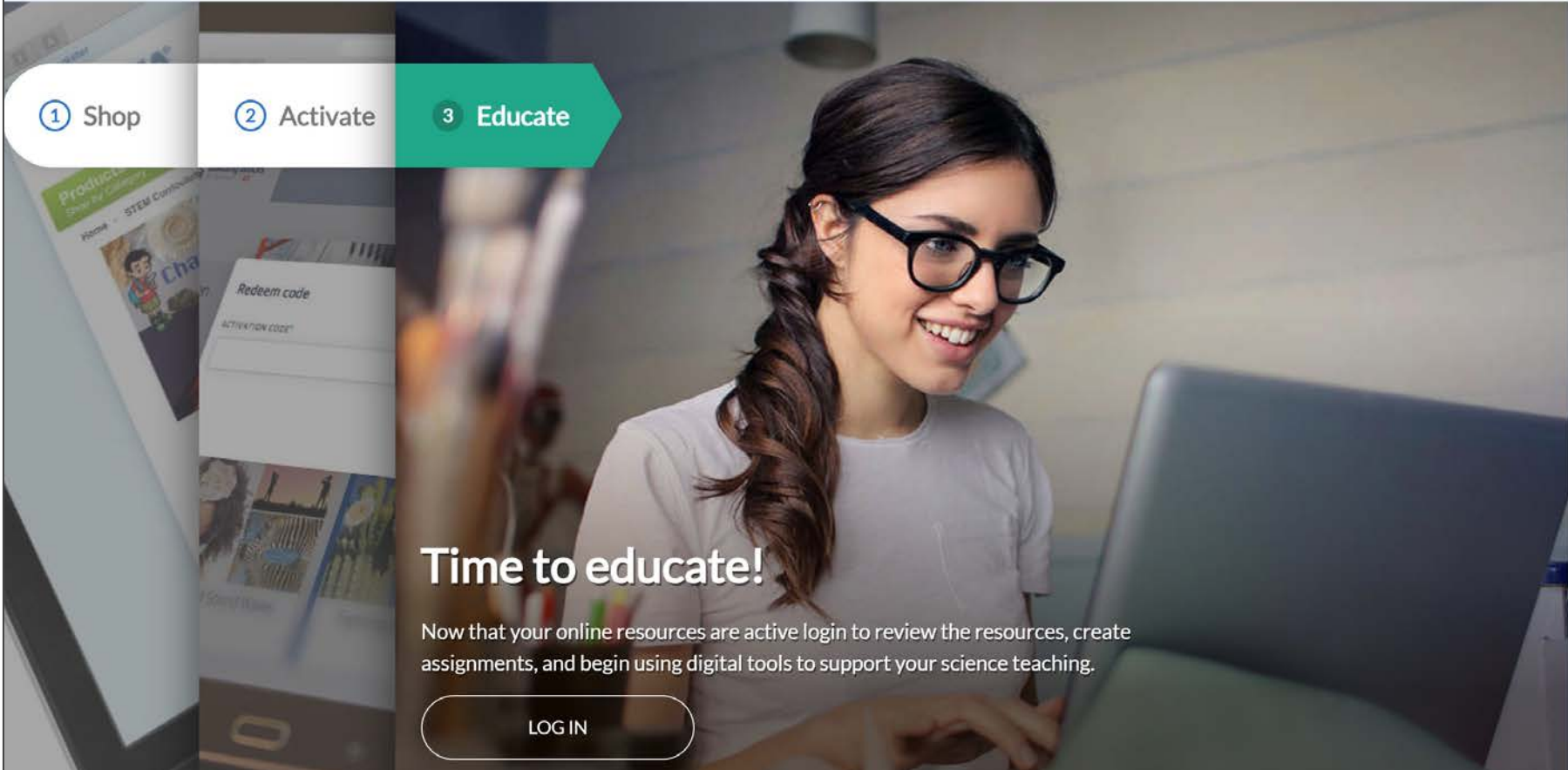
Teacher login

Student login

1 Shop

2 Activate

3 Educate



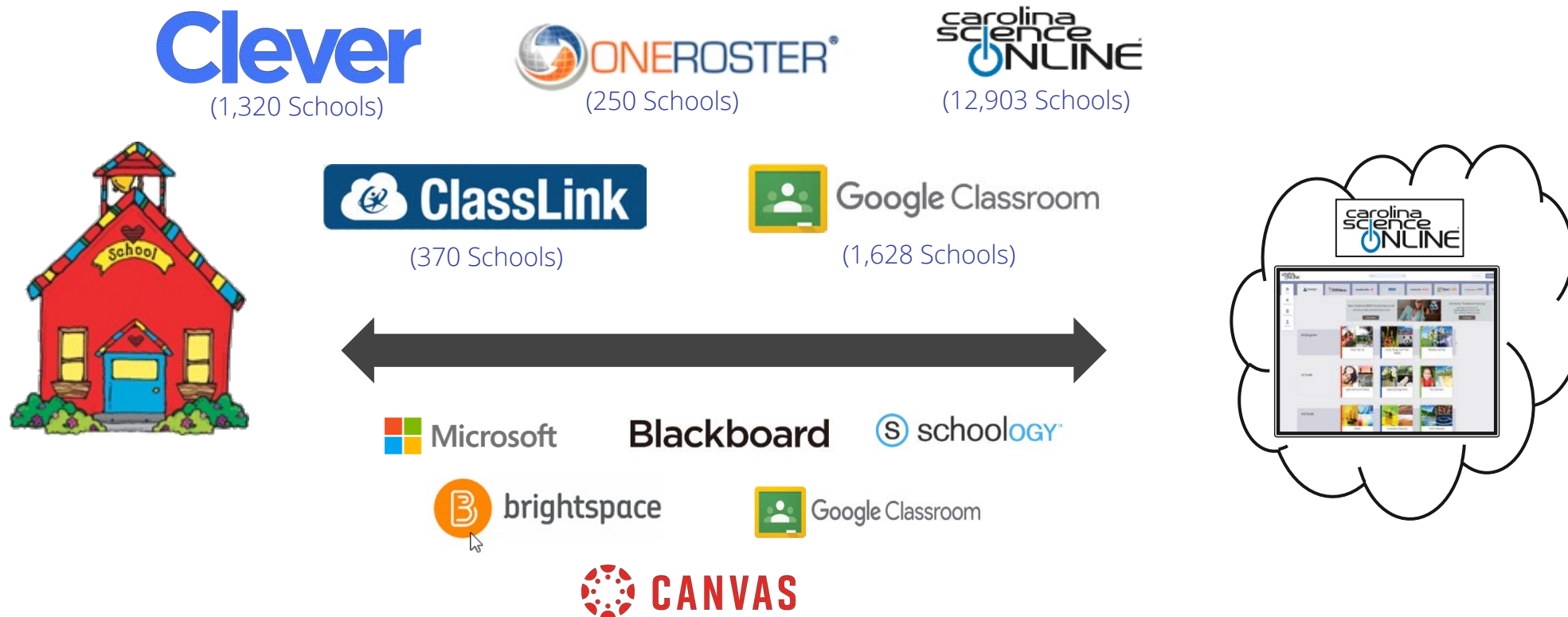
Time to educate!

Now that your online resources are active login to review the resources, create assignments, and begin using digital tools to support your science teaching.

LOG IN

Print and Digital Materials

Compatible with most learning management systems:





Enhanced Digital Content

carolina science ONLINE

Search

LIVE CHAT REDEEM CODE Cory D. Ort Middle School Teacher cory ort

OpenSciEd High School / C.1 Thermodynamics in Earth's Systems: How can we slow the flow of energy on Earth to protect vulnerable coastal communities?

Home Bookmarks Assignments Students Support

Unit Overview

Lesson Set 1 Lesson Set 2 Lesson Set 3

1 2 3 4 5 6 7 8 9 10 11 12 13

How does carbon dioxide contribute to climate change?

Lesson overview Materials and Preparation Learning Plan Student Lesson Resources Teacher Lesson Resources Spanish Resources

Categories + Media type + Subject + Level + A-Z

Teacher Interactive Board

Unit C.1, Lesson 3 Slides, PowerPoint

Unit C.1, Lesson 3 Slides, PDF

KEY: Carbon Dioxide Investigation, PDF

Unit C.1, Lesson 3 - Investigation Anchor Chart, PDF

Add to assignment

Teacher Presentation Slide ppt English

Teacher Presentation Slide PDF English

Teacher Reference PDF English

Teacher Reference PDF English

Unit Storyline

UNIT STORYLINE

Unit B.1

Unit Storyline

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

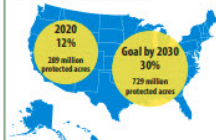
LESSON 1

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

Anchoring Phenomenon 4 days

Phenomenon or design problem

Lands and waters are protected in different ways based on different criteria.



What we do and figure out

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.

How we represent it



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.

Unit B.1

UNIT STORYLINE

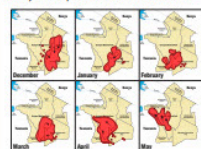
LESSON 2

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

Investigation 2 days

Phenomenon or design problem

Serengeti National Park was created to protect the great animal migration route and has a history of complicated human interactions.



What we do and figure out

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.

UNIT STORYLINE

Unit B.1

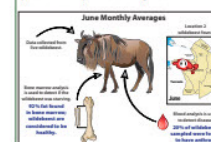
LESSON 3

Why do the animals in the Serengeti migrate?

Investigation 2 days

Phenomenon or design problem

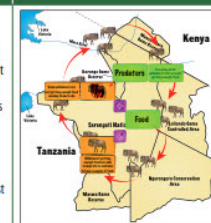
Wildebeest field data can be organized to find patterns to explain their migration.



What we do and figure out

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

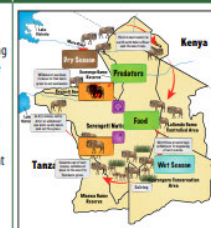
Factors such as rain affect wildebeest migration in the Serengeti.



What we do and figure out

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

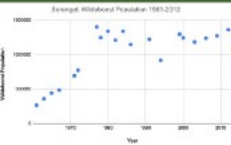
Unit B.1

UNIT STORYLINE

LESSON 5

How does food affect the population size?

Investigation 2 days

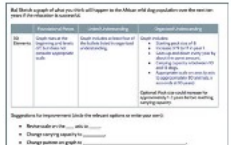
Phenomenon or design problem	What we do and figure out	How we represent it
The population of wildebeest is large when there is a lot of access to food (grass).  Anthony B.F. Sinclair	We decide to use a kinesthetic model to simulate what is happening with food and wildebeest in the Serengeti. We make 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.	 Serengeti Wildebeest Population: 1963-2012 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 MacTew, 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.	 Driving Question Board (DQB) for Lesson 6

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.

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Unit B.1 Ecosystem Interactions & Dynamics

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

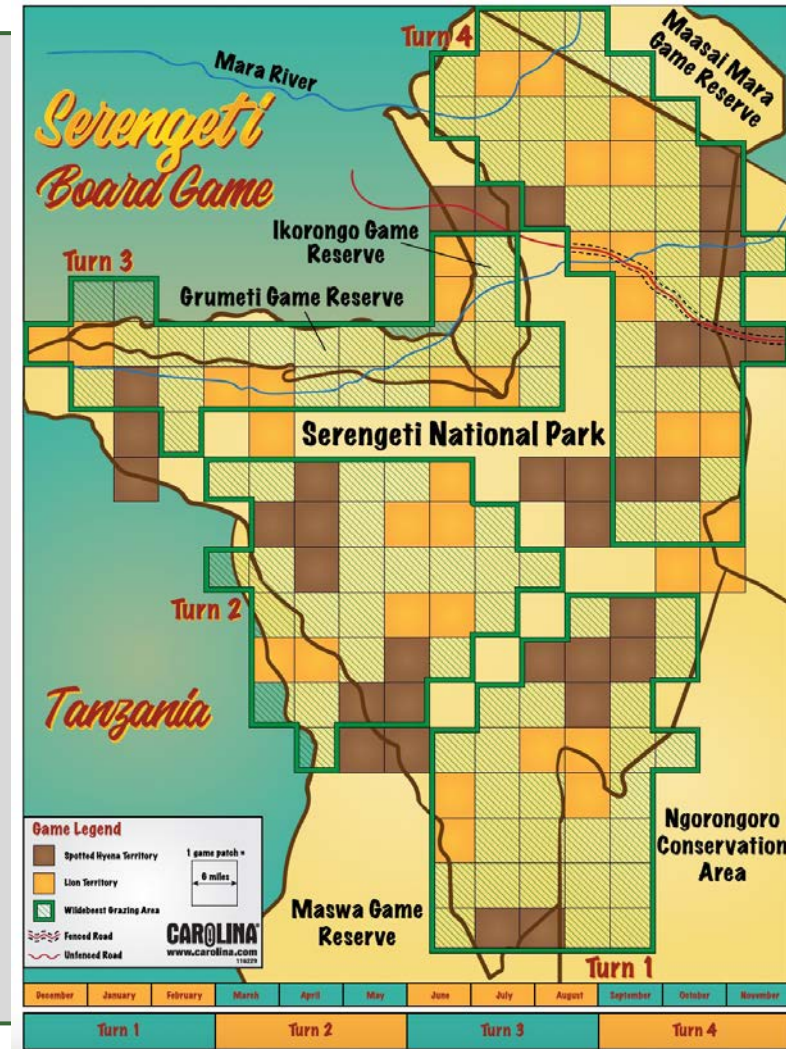
Identify the Parts of Our Model

- 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 Wildebeest

Part 1: Agent Background



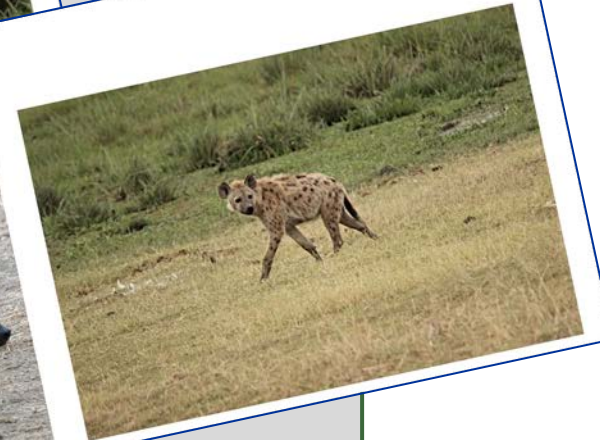
Meet Your Lion

Part 1: Agent Background



Meet Your Hyena

Part 1: Agent Background



Meet Your Agent: Initial Conditions



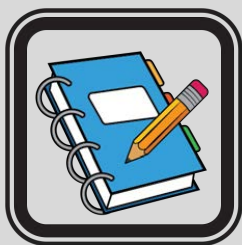
With a Group

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.

Wilbebeest	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 wilbebeest tokens touching another wilbebeest 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

General Game Instructions

Setting up the game:

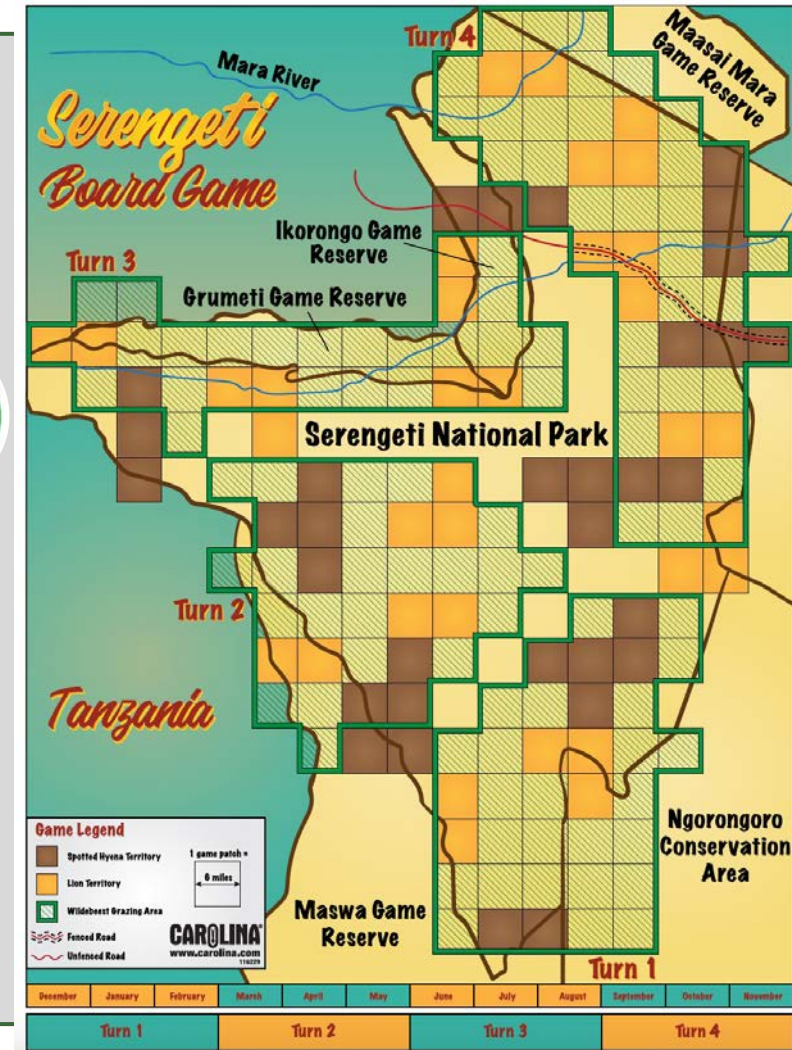
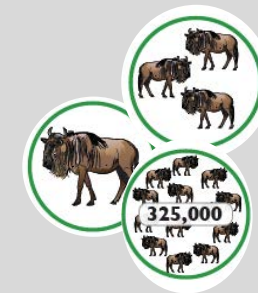
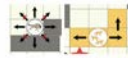
All of the agents can place their tokens down on the game board at one time.
1 token per square

Instructions for each turn:

Wildebeest play first, lions go second, and spotted hyenas are last.

Tokens cannot move diagonally. They can only move up and down, left or right.

Tokens can not be placed on top of each other.



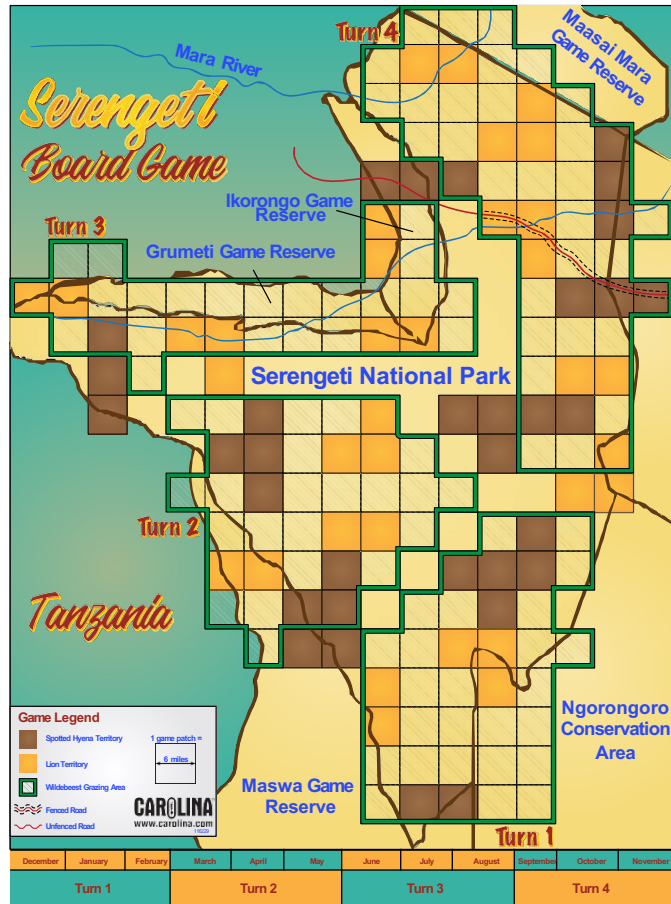
The Serengeti Game Instructions: Game Overview

1. The Serengeti Board Game is designed for 3 players (or 3 teams if more than 3 people are 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 4 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 4 turns or seasons of the year (winter, spring, summer, fall).

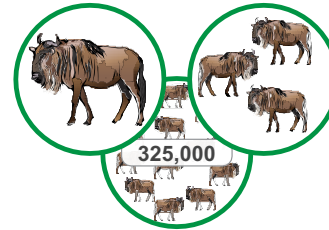
Serengeti Game Instructions • OSE Ecosystems Interactions & Dynamics • ©Carolina Biological Supply Company • 116233

Game Setup: Serengeti Game Materials

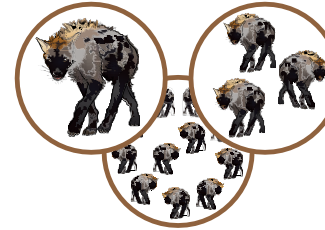
Serengeti Game Board



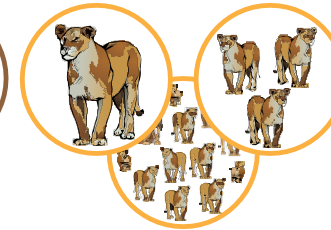
22 Wildebeest Tokens



22 Hyena Tokens



28 Lion Tokens



16 Event Cards

Shuffled and text down



6 Dice

3 red and 3 white



Game Data Collection Handout

Form titled "Serengeti Game Data Collection" with fields for Name and Date.

Record your investigation question here:

Example Question: How do lions and hyenas interact?

Turn # 2

Circle and connect the agents that interacted.	Write a quick note about the outcome of the interaction.	What was successful? Circle one.	Population Change
	An individual lion attacked an individual wildebeest and ate it.	☒ Lion	- 1 wildebeest
	An individual hyena attacked an individual wildebeest and ate it.	☒ Hyena	- 1 wildebeest
	A small group of hyenas attacked an individual lion and ate it.	☒ Hyena	- 1 lion
Population changes due to predator-prey interactions.			- 1 hyena
Population changes due to event cards.			- 2 wildebeest, - 1 hyena
Total Population Change			

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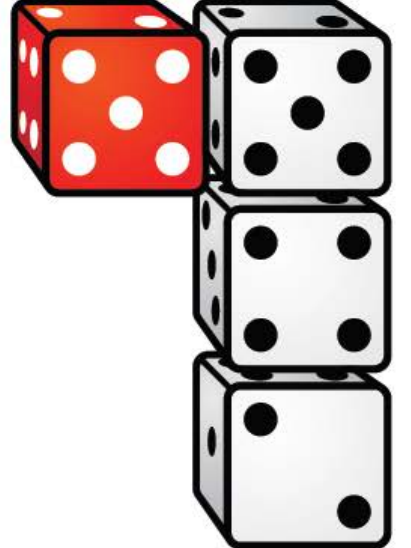
How to Roll the Dice in a Hunt

Example Hunt 2 - Individual predator vs. herd of wildebeest



1st Roll

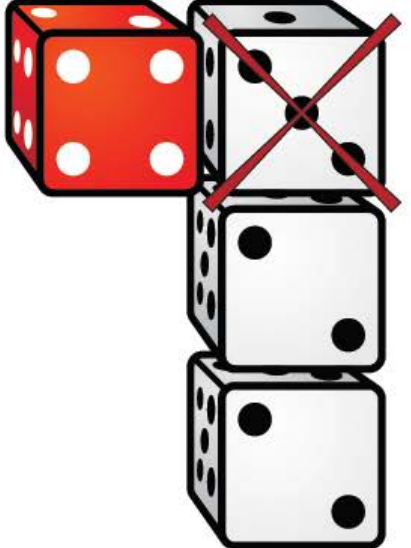
 Predator  Prey



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

2nd Roll

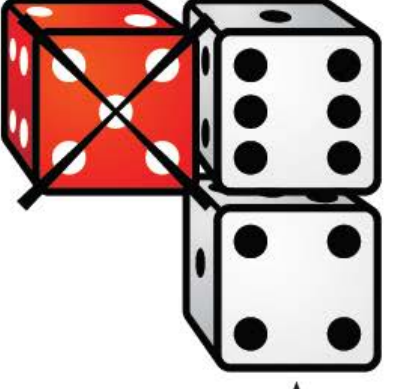
 Predator  Prey



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

3rd Roll

 Predator  Prey



Prey wins

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.

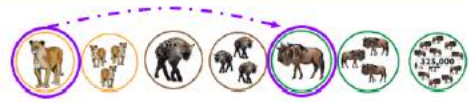
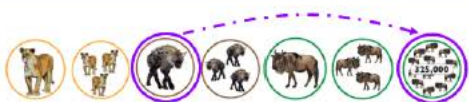


Data Collection

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

General Game Instructions

Setting up the game:

All of the agents can place their tokens down on the game board at one time.
1 token per square

Instructions for each turn:

Wildebeest play first, lions go second, and spotted hyenas are last.

Tokens cannot move diagonally. They can only move up and down, left or right.

Tokens can not be placed on top of each other.



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 Game Play



With a Group

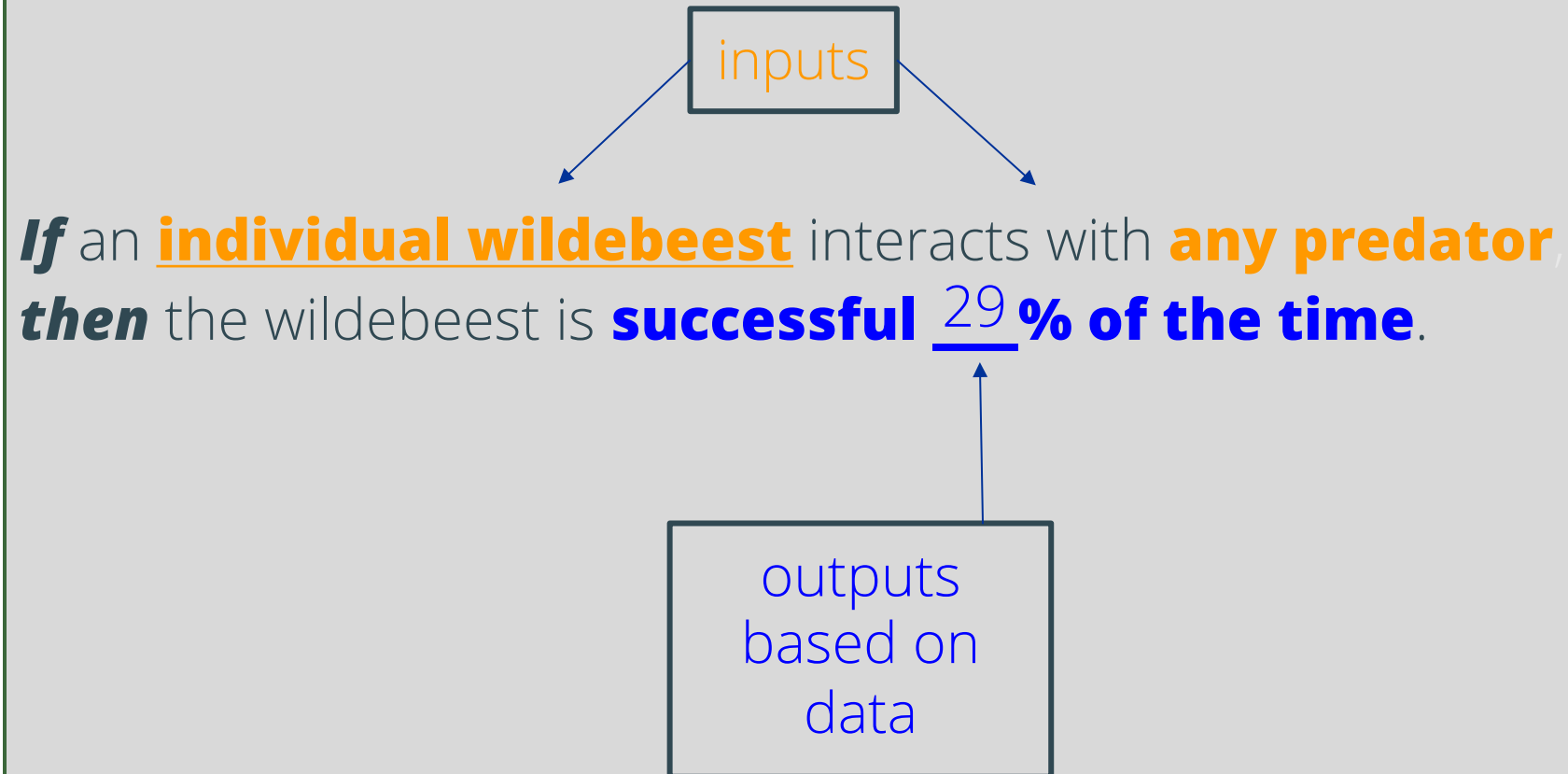
Complete your **Data Analysis** handout individually and then share your ideas with your game group.

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

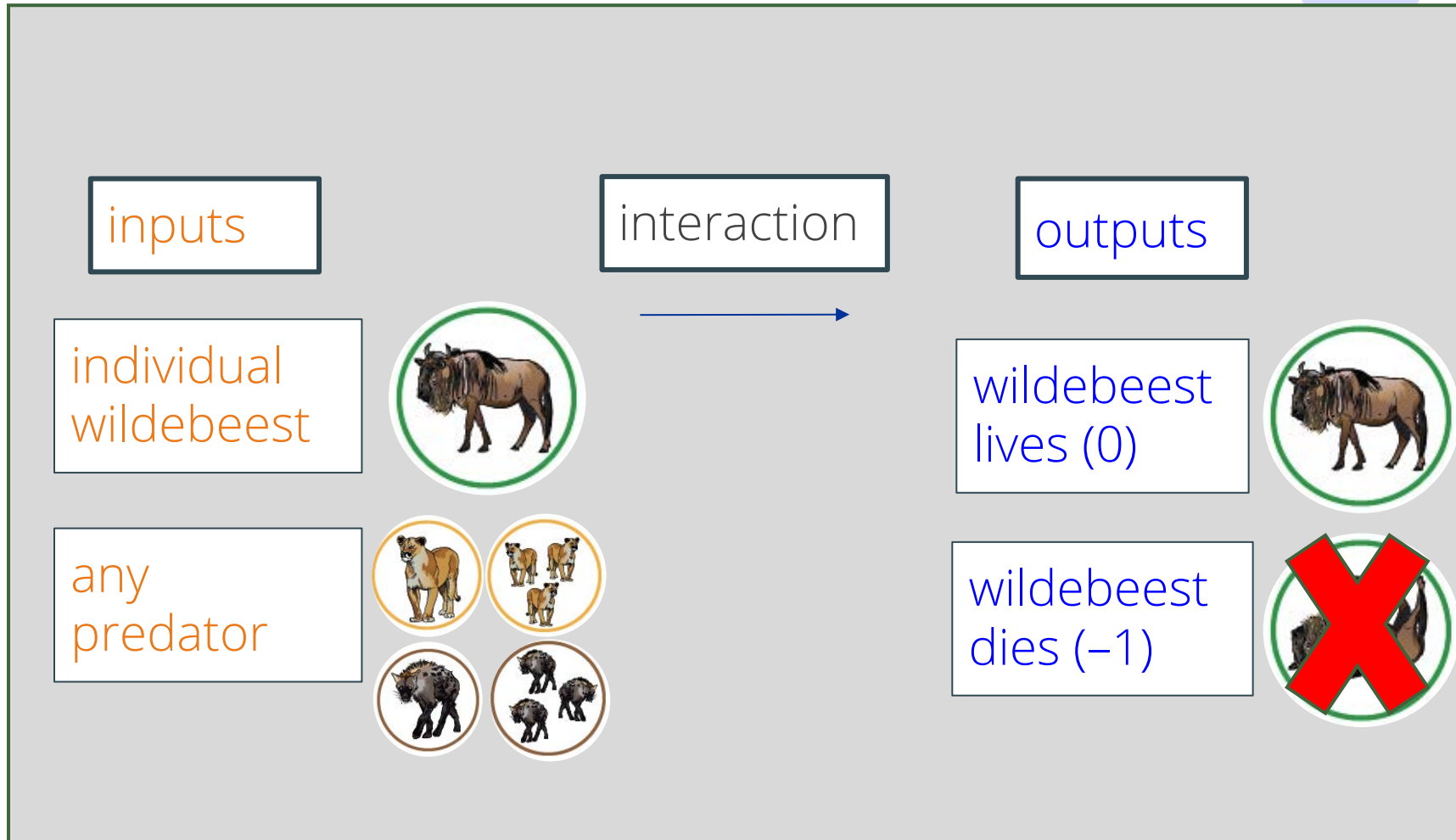
$$\% \text{ time successful} = \frac{\# \text{ times successful}}{\text{total \# of interactions}} \times 100$$

Writing Algorithms

Write an ***if-then*** statement in words:

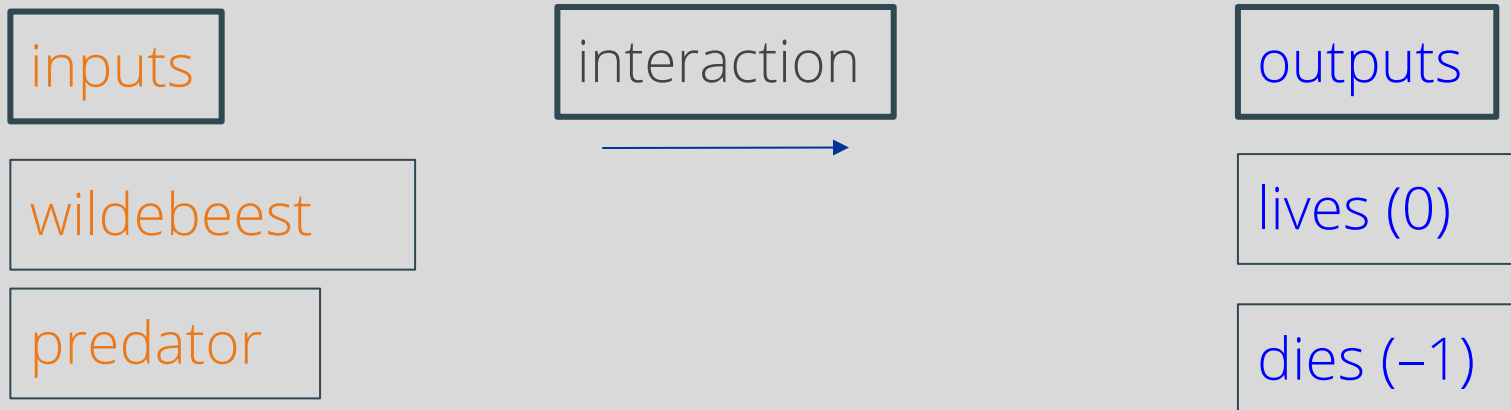


Develop a System Model



Writing Numeric Algorithms

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



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)

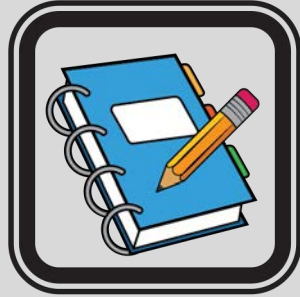
Building Understandings Discussion



Scientists Circle

- What accounted for differences in the outcomes during interactions between predators and prey?
- When an agent was successful, how could its 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.

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