Yeasty Beasties

Created by Claire Behning
for the STEM Education Center at WPI's Summer 2022 Research Experience for Teachers program

Subject: Biology
Grade Level: 9
United Nations Sustainable Development Goals:
Goal 13: Take urgent action to combat climate change and its impacts.
Goal 15: Protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverses land degradation and halt biodiversity loss

Overview

Part 1: *"It is the future, and a mysterious crisis is happening in Worcester. In the news and around your city, you see trash and dead matter, such as leaves, trees, and dead animals piling up. Things are getting stinky! Scientists need your help to figure out what could be causing this to happen."*

Part 2: "*Thanks to your hard work we now know what is happening in the environment causing this trash and dead matter to pile up. Your help is needed again to find solutions to fix this problem and make the ecosystem healthy again!"*

Standards & Learning Targets

HS-LS2-5. Use a model that illustrates the roles of photosynthesis, cellular respiration, decomposition, and combustion to explain the cycling of carbon in its various forms among the biosphere, atmosphere, hydrosphere, and geosphere.
*Clarification Statements: • The primary forms of carbon include carbon dioxide, hydrocarbons, waste (dead organic matter), and biomass (organic materials of living organisms). • Examples of models could include simulations and mathematical models. State Assessment Boundary: • The specific chemical steps of respiration, decomposition, and combustion are not expected in state assessment

Vocabulary	**Tier 1**	**Tier 2**	**Tier 3**
	Develop Describe Cycle Living Process	Model Matter Energy Transfer Consumer Producer	Ecosystem Conserve Photosynthesis Cellular respiration Decomposition Decomposer Food web Food chain
What do students	Students will use the following vocabulary words in context: 1. Ecosystem		

need to **KNOW**?	2. Model 3. Cellular respiration 4. Matter 5. Energy Students need to know that matter and energy cycle among living and nonliving parts of an ecosystem and that both matter and energy are conserved through these processes. Students need to know that cellular respiration, photosynthesis, and decomposition are integral processes within the cycling of matter and energy in an ecosystem.
What do students need to **DO**?	1. Develop a model that shows how matter and energy cycle among living and nonliving parts of an ecosystem 2. Describe that matter and energy cycle among living and nonliving parts of an ecosystem and that both matter and energy are conserved through these processes
What will students **CREATE**?	1. Students will create a model to demonstrate the cycling of matter in an ecosystem. 2. Students will write a lab report to report on their methods and findings. 3. Students will create a poster to share their knowledge and finding with others

HS-LS2-7. Analyze direct and indirect effects of human activities on biodiversity and ecosystem health, specifically habitat fragmentation, introduction of non-native or invasive species, overharvesting, pollution, and climate change. Evaluate and refine a solution for reducing the impacts of human activities on biodiversity and ecosystem health.
* Clarification Statement: • Examples of solutions can include captive breeding programs, habitat restoration, pollution mitigation, energy conservation, and ecotourism.

Vocabulary	**Tier 1**	**Tier 2**	**Tier 3**
	Effect Health Activities Human	Analyze Direct Indirect Introduction Evaluate Impacts Refine Solution	Species Overharvesting Biodiversity Ecosystem Habitat Fragmentation Invasive Non-native Pollution

What do students need to **KNOW**?	Students will need to use the following vocabulary words in context: 1. Ecosystem 2. Habitat 3. Pollution 4. Effect 5. Human Students will need to know that humans have direct and indirect effects on biodiversity and ecosystem health. Students will need to know examples of this such as habitat fragmentation, introduction of non-native or invasive species,

	overharvesting, pollution, and climate change. Evaluate and refine a solution for reducing the impacts of human activities on biodiversity and ecosystem health
What do students need to **DO**?	1. Analyze direct and indirect effects of human activities on biodiversity and ecosystem health 2. Evaluate and refine solutions for reducing the impacts of human activities on biodiversity and ecosystem health
What will students **CREATE**?	1. Students will create a solution for reducing the impacts of human activities on biodiversity

ELA Standard: Write informative/explanatory texts (e.g., essays, oral reports, biographical feature articles) to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.

Vocabulary	**Tier 1**	**Tier 2**	**Tier 3**
	Ideas Information Topic Write Text Clearly Accurate	Examine Organization Analysis Selection Effective	Informative Explanatory Biographical Oral

What do students need to **KNOW**?	Students will use the following vocabulary words in context: 1. Analysis 2. Examine 3. Organize 4. Information 5. Idea Students will know how to write in an informative and explanatory style in order to analyze and examine data. Students will know how to organize this information and communicate their ideas using evidence.
What do students need to **DO**?	1. Students will write informative/explanatory texts to examine and convey ideas and information about the concepts they learn in class, their lab and report, as well as through their poster 2. Students will share complex ideas and information with others clearly and accurately, through the effective selection, organization, and analysis of content.
What will students **CREATE**?	1. Students will create a lab report to a write in an informative and explanatory style in order to examine data and convey the scientific method clearly. 2. Students will create a poster to convey information and ideas about a complex real-world problem through effective selection, organization, and analysis of content resources.

Prior Knowledge

Prior to this lesson, students should have a basic understanding of the functions of different organisms in an ecosystem in the context of a food web, including producers, consumers, and decomposers. Students should begin the lesson with an existing basic knowledge of photosynthesis, cellular respiration, and the cycling of matter and energy through an ecosystem.

Materials/Resources

Introduction and Lab Report Portion:

- Videos
- Reading materials
- Powerpoint presentation
- Lab report template
- Laptops for students or print outs

Lab portion:

- Yeast packet (1 packet for each group)
- 12 oz water bottle (3 for each group)
- Balloons (3 for each group
- Spoons (4 for each group)
- Water
- Lemon juice
- Sugar
- Molasses/maple syrup
- Honey
- Vinegar
- Lab instructions and powerpoint

Poster Portion

- Videos
- Poster paper
- Markers
- Powerpoint presentation

Timeline of Activities

Each lesson takes one, 50 minute class period.

Activity	Instructions	Product
Students will complete close reading of a scientific article and apply information learned to answer	1. Starter: 2. Go over objectives	Students will: - Complete a starter

questions about their role in an ecosystem. Introduction of yeast as an organism that will be used through unit.	3. Main Activity: Students complete a close reading in pairs giving background information on yeast and their role as decomposers in an ecosystem. a. Potential Articles to read: Introduction from Yeasty Beasties (add paragraph contextualizing yeasts as decomposers, their role in ecosystems) 4. Exit ticket:	- complete a worksheet with related questions - Complete an exit ticket
Students will watch a video about yeast and cellular respiration then engage in an online interactive to reinforce knowledge	1. Starter 2. Go over objectives 3. Watch yeast/cellular respiration video a. Followed by brief class discussion of major points and understanding questions 4. Online cellular respiration interactive with accompanying questions 5. Exit Ticket	Students will: - Complete a starter - Complete companion questions for online interactive - Complete an exit ticket
Students will watch a video about different variables to reinforce base knowledge of the scientific method. Students will be guided through developing an experiment to test which environment yeast prefer to grow and respire in.	1. Starter 2. Go over objectives 3. Watch variables video (maybe scientific method too?) a. https://www.youtube.com/watch?v=J9kCgWAuB0Y 4. Complete a pre-lab a. Hypothesis b. Questions on yeast background info c. Pick variable d. Experimental design 5. Exit Ticket	Students will: - Complete a starter - Complete pre-lab write up - Design an experiment using the scientific method - Complete an exit ticket
Students will work in groups of 3 to implement their experiments. Kits will be pre-prepared based on each group's material needs.	1. Starter a. Sit in groups (of 3) for lab,Review pre-lab procedures 2. Set up experiment a. Students will implement plans of trying different solutions for yeast growth	Students will: - Complete a starter - Execute a wet lab experiment designed through use of the scientific method

Students will record data in pre-made/guided tables.	(sugar, salt, vinegar, molasses) b. take initial measurements c. record data 3. Exit Ticket a. Cleaning up from experiment	- Complete an exit ticket
Students will extend their knowledge of how yeast respire and live. They will brainstorm what yeast eat and be exposed to new discoveries about what yeast metabolize such as oil and carbon dioxide. Students will apply this new information to discuss how this can be used in the world-> global warming.	1. Starter 2. Go over objectives 3. Post Lab activity a. Debrief lab b. Content review/discussion about what yeast 'eat' i. What did they like to 'eat' most in the lab? 4. Question- what else might yeast 'eat'?-> Discussion 5. Show video of bioremediation yeast that metabolize oil 6. Have either discussion/worksheet for groups about how these yeast could be used a. Global warming context	Students will: - Complete a starter - Complete a group worksheet for yeast extension in global warming - Complete an exit ticket
Students will begin the write up of their experiment. They will work on the title, purpose, hypothesis.	1. Starter 2. Go over objectives 3. Introduce lab report 4. Go over lab report part A a. Begin with modeling then work in groups b. Everyone submits their own c. Title, Purpose, Hypothesis 5. Exit Ticket	Students will: - Complete a starter - Create a lab report - Understand and be able to write a title, purpose, and hypothesis - Complete an exit ticket
Students will work on the write up of their experiment. They will work on the materials and procedure.	1. Starter 2. Go over objectives 3. Go over lab report part B a. Materials list, procedure 4. Exit Ticket	Students will: - Complete a starter - Create a lab report - Understand and be able to write a materials and procedures section - Complete an exit ticket

Students will work on the write up of their experiment. They will work on data measurements and data analysis.	1. Starter 2. Go over objectives 3. Go over lab report part C a. Data measurements and data analysis b. Draw a model of cycling of carbon through ecosystem 4. Exit Ticket	Students will: - Complete a starter - Create a lab report - Understand and be able to create tables and graphs to analyze data and measurements. - -Understand how to write about data. - Complete an exit ticket
Students will work on the write up of their experiment. They will work on the conclusion.	1. Starter 2. Go over objectives 3. Go over lab report part D a. Conclusion 4. Exit Ticket	Students will: - Complete a starter - Create a lab report - Understand and be able to write a conclusion - Be able to talk about the meaning of the results of their experiment - Complete an exit ticket
Students will work on the write up of their experiment. They will work on revising the full report and adding in an extension of applying their knowledge about global warming and yeast.	1. Starter 2. Go over objectives 3. go over lab report, if completed work on lesson extension a. Add element of the extension from post lab activity to report at the end b. Revise	Students will: - Complete a starter - Create a lab report - Understand and be able to write a full lab report. - Complete an exit ticket
Students will be introduced to a "real world problem" in which decomposition isn't happening. Students will use the schema of a brainstorming template to apply their findings	1. Starter 2. Objectives 3. Go over "problem" - in the future, trash and dead matter is piling up, why isn't decomposition happening? Work in groups to problem-solve and discover possible explanations & solutions	- Complete a starter - Complete a brainstorming template - Complete an exit ticket

from the lab to solve this problem.	a. Use brain-storming template 4. Exit ticket	
Students will view a video and complete a worksheet/notes about real world situations which lack decomposers (oil spills, plastic pollution, etc.) Students will be introduced to poster assignment.	5. Starter 6. Objectives 7. Start with video or reading giving more information about conditions and decomposer/example of real life lack of decomposers 8. Explain requirements for what must be on the poster 9. Exit ticket	- Complete a starter - Complete Notes or worksheet with information about decomposers - Complete an exit ticket
Students will be organized into groups to work on the first part of their poster. Using their notes, knowledge from videos and close readings, as well as their lab report. Students will use CER strategies to explain the problem of "why trash is piling up, and where are the decomposers?"	10. Starter 11. Objectives 12. Work in groups on "Why is this happening?" section of poster a. Use CER, cite lab results as evidence 13. Exit ticket	- Complete a starter - Complete "Why" section of group poster - Complete an exit ticket
Students will return to the same groups from yesterday to complete the second part of the poster. Students will apply their knowledge from the lab work, close readings, and videos within a CER template to propose & defend possible solutions.	14. Starter 15. Objectives 16. Work in groups on "Possible Solutions" section of poster a. Use CER, cite lab results as evidence 17. Exit ticket	- Complete a starter - Complete "problem solving Section of group poster - Complete an exit ticket
Students will display posters and participate in a gallery walk to give feedback to and learn from peers. Students will reflect on what makes a poster/argument convincing and how they could improve their own poster.	a. Starter b. Objectives c. Gallery walk of posters i. Must write at least 3 comments and have 3 questions d. Exit Ticket i. Which poster was most convincing? Why? ii. How would you change your poster after seeing everyone else's?	- Complete a starter - A completed poster including explanations and problem solving will be presented to class through a gallery walk - Complete an exit ticket

Culturally Responsive Teaching Strategies

Purposefully Structured Instruction	*Break down all portions of the lesson, especially lab procedures, lab report, and brainstorming sessions, into smaller tiered steps. This provides students with scaffolding for all levels to access material.*
Modeling and exemplars provided	*Modeling, providing exemplars and doing "think alouds" make expectations clear for what products students are expected to complete and make the thinking process visible and demystified for students*
Pre-teach and re-teach vocabulary via direct instruction	*Daily direct vocabulary instruction and review built into starters and exit tickets helps make academic vocabulary and texts accessible to all students and supports ELL vocabulary acquisition*
Visuals and graphics	*Visuals and graphics incorporated into lessons (eg. embedded into close reading text, videos, online interactives, lab work, posters, starters, etc.) support student understanding of vocabulary, text, and concepts*
Graphic organizers with sentence frames	*Graphic organizers and sentence frames support all students to be able to find the language to express and organize their thoughts*
Small group and partner work	*Small group and partner work support all learners to participate in the collaborative learning process*
Culturally relevant/real-world problem	*Assigning a visible, real-world problem (trash piling up and not decomposing) to which students can relate and localizing it to Worcester makes the lesson relatable and relevant for students, draws on their lived experiences*
BIPOC representation in lesson materials	*Selecting lesson materials which include images, photographs, and videos showing BIPOC people of various genders doing and discussing science promotes an inclusive & welcoming classroom environment*

Career Connections

To connect this activity to STEM careers we will reference potential careers throughout the lesson as they are applicable. When discussing the real-world problem, we will mention that "a team of scientists" needs their help. We could specify that those scientists are biochemists or ecologists. Next, during their brainstorming and solution developing sessions for the real-world problem, we can mention that they are helping or working as a team of engineers.

- Environmental Engineer
- Chemical Engineer

- Biochemist
- Ecologist
- Biologist

Assessment

Project Rubric