RESET | Algal Bloom

AN AEOP EFFORT aeop

Authors

Leanne Thele
Tiska Rodgers

SUBJECT/GRADE LEVEL

Biology
Environmental Science

9-12

Materials

- Algae (*Microcystis* sp.)
- Algae (*Nannocloropsis* sp.)
- Algae food for *Nannocloropsis* sp.
- Salt water for *Nannocloropsis sp.*
- Pipettes
- pipettor
- Sechi stick
- UV colorimeter
- Cuvettes
- Chromatography paper
- Culture flasks
- Multiple wavelengths of light bulbs
- Multiple types of fertilizers
- Air pump
- Air tubing
- Aquarium stones
- Air pump splitter
- Several small aquariums
- Microscope
- Deep well microscope slides
- Filter paper
- Collection tubes
- Microcentrifuge
- Microcentrifuge tubes
- Algae identification cards

STANDARDS

Next Generation Science Standards

- HS-LS2-5: Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
- HS-LS2-7: Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*
- HS-ESS3-4: Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.*
- HS-ESS3-5: Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.
- HS-ESS3-6: Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.
- HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

Mathematics Standards | Common Core State Standards

- CCSS.MATH.CONTENT.HSA.CED.A.2
    - Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- CCSS.MATH.CONTENT.HSF.LE.A.1
    - Distinguish between situations that can be modeled with linear functions and with exponential functions.
- CCSS.MATH.CONTENT.HSS.ID.B.6.A
    - Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.

English Language Arts Standards | Common Core State

- CCSS.ELA-LITERACY.SL.11-12.1.A: Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.

LESSON OBJECTIVE(S)

Students will describe actions that can be taken to reduce the impact of harmful algal blooms by calculating the rate of algal growth to predict how oxygen levels will decrease after a given time and determine the best algal species to use for biofuel.

CAREER CONNECTION(S)

Mentor Background: Victor Medina (Research Environmental Engineer at Army Engineer Research & Development Center) My career has been primarily in environmental research. My work is largely applied, on the edge of research and full scale application. I have had the opportunity to work on a wide range of problems, and because of this, I have developed a broad perspective that has allowed me to better develop my work to actual usable solutions.

STEM Careers: Biologist, Environmental Chemist, Environmental Engineer, Chemist, Epidemiologist, Health Educator, Toxicologist

ENGAGEMENT

Brief Description: Students will be shown a map and host a discussion of dead zones. Then watch the short video clip Happening Now: Dead Zone in the Gulf 2020 | Ocean Today (noaa.gov) followed by What Makes Harmful Algal Blooms as the phenomena for this unit followed by a pre-assessment and article reading.

Procedures:

- Students will be shown a map of the 2020 Gulf of Mexico Dead Zone. They will talk together to decide what could be causing this dead zone in the Gulf of Mexico. The teacher will then ask the class for their ideas. She will then play the video:Happening Now: Dead Zone in the Gulf 2020 | Ocean Today (noaa.gov)
- Students will then watch the chemistry behind Harmful algal blooms with a short video clip. This video clip explains why the chemistry of the algal blooms affects humans and other organisms.
- Then the students will take a pre- assessment over harmful algal blooms.
- Lastly, they will then read an article titled: "Toxic Shorelines" The Science of Algal Blooms." and discuss with others if their original ideas with the map were valid. Students will draw lines through ideas that no longer are valid and circle ideas that are possible.

EXPLORATION

Brief Description: Students will be asked: "Are algae all the same?" Students will be given phytobacteria/algae cards and play the algae identification game. Students will be given cards containing nutrition facts and asked to identify the algae. Students will be given a dichotomous key and pictures. Students will then use the given information to identify algae.

Procedures:

- Students will be asked: "What is algae?" The instructor will then create a list on the board using information given by the students. If additional guidance is needed the following questions could also be asked: "What do you know about algae? Is algae all the same? Where is algae found? What is algae used for? What do algae need to survive?" This discussion should be no more than 10 minutes long.
- Students will be given cards containing nutrition facts and asked to identify the algae. (extension: include cards from non food items as well) Students will then be tasked to find 5-10 additional products that contain algae and share it on a google jamboard. Each group will have its own page in the jamboard file. Students will then be asked to explore each group's jamboard pages to discover similarities/differences or any surprises that they find. It should take 15-20 to complete this activity.
- Students will then be given phytobacteria/algae cards and will play an identification game. It should take 15 minutes to complete this activity. Card game teacher instructions
- Students will then be given a dichotomous key and pictures. They will be asked to identify the salt water algae that they will be growing in the initial experiment. This should take no more than 10 minutes.

EXPLANATION

Brief Description: Students will grow *Nannochloropsis* using a guided lab activity sheet. Students will then complete a guided microscopy lab using the *Nannochloropsis* algae.

Procedures:

- Students will complete a guided lab experiment to grow *Nannochloropsis*. Students will be divided into groups of two and be assigned a number from one to three. Students will then add different levels of algae and nutrients to their culture flasks depending on the number that they were assigned. Students will place their culture flasks into the mini greenhouse. If a mini greenhouse is not available then the flasks can be placed on a sunny windowsill.
- Students will make qualitative and quantitative observations each day for a week. Students will use a secchi stick to determine algae density starting on the initial day and each subsequent day for a week.
- Students will use a disposable pipet to collect an algae sample from the original algae culture and place a drop onto a deep well slide. Students will then complete a guided microscopy lab using the original sample of *Nannochloropsis*.

ELABORATION

Brief Description:

Students will be given the prompt " The algae is going to be used for biofuel, you need to create an economical biodegradable fuel that can be replaced rapidly without causing damage to the environment. Students will choose the independent/dependent variable of their choice to study and take data daily for 2 weeks using this brainstorming worksheet.

Procedures:

- Using the prompt "The algae is going to be used for biofuel, you need to create an economical biodegradable fuel that can be replaced rapidly without causing damage to the environment." students will begin with their group to design a lab experiment where they choose the independent and dependent variable to solve the problem.
- Students will take data for 2 weeks for their lab experiment design and write a formal lab report.
- Then students will design a digital poster explaining their results and present those results for peer review to the class.

EVALUATION

Brief Description:

Students will be given a data table comparing three types of algal blooms from the same species. They will then use the data in the data table to decide which species would be the least harmful and the most harmful in each scenario and use data to back up their decisions.

Procedures:

- Students will be given a data table to compare 3 types of algal blooms.
- Students will use the data to decide in several scenarios which algal bloom would be the most harmful of the least harmful and why. They will present data from the data table as evidence to back up each decision. Students with IEPs or ESL could use this site to enter their data so that it will determine the best and worst pond for them.
- Students will submit this in a google form (doc) as a formal assessment of the unit.

REFERENCES

https://serc.carleton.edu/microbelife/topics/redtide/education.html
https://www.marine.usf.edu/pjocean/packets/sp01/sp01u3p2.pdf

https://chnep.wateratlas.usf.edu/upload/documents/Red%20Tide%20Activity%201.pdf
https://www.acschemmatters-digital.org/acschemmatters/april_2018?pg=15#pg15
algae-in-bottle_experiment_description (d32ogoqmya1dw8.cloudfront.net

https://cees.iupui.edu/algal-bloom