

A closer look at home- Cape Cod and Cyanobacteria

This series of lessons are designed to be the anchor for an Ecology unit at the end of the year. Lessons pull on topics of genetics, photosynthesis, cellular respiration.

Biology - 9-12th

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Stage 1: Desired Results

MA State Standards:

6.3 Use a food web to identify and distinguish producers, consumers, and decomposers, and explain the transfer of energy through trophic levels. Describe how relationships among organisms (predation, parasitism, competition, commensalism, mutualism) add to the complexity of biological communities.

6.4 Explain how water, carbon, and nitrogen cycle between abiotic resources and organic matter in an ecosystem, and how oxygen cycles through photosynthesis and respiration.

Essential Questions: How does genetic variation contribute to the local ecology?

Enduring Understandings: Ecology is the interaction among organisms and between organisms and their environment.

Transfer
At the end of this unit, students will be able to...

Stage 2: Evidence

Formative Assessment ideas:

- Creation of food web
- Participation in class discussions
- Creation of personalized community map
- MCAS questions
- Exit slip

Summative Assessment ideas:

Students may present through written paper, video, powerpoint, song, pamphlet or live demonstration

- Discussion of impacts of cyanobacteria in biotechnology
- Choose one of the questions we proposed on Day 1 and write a response

| Stage 3: Learning Plan | | | | |
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| Lesson Number | Lesson Name | Brief description | Standards (number) | Time |
| 1 | Why can't I go in the water? | <ul style="list-style-type: none"> - List ways that you interact with the natural environment - Participate in gallery walk activity by writing on a sticky note: what you see, what you wonder , - Participate in discussion about gallery walk - Introduce sequence of lessons for next few days - Identify a pond near you - Exit slip | <i>6.4 Explain how water, carbon, and nitrogen cycle between abiotic resources and organic matter in an ecosystem, and how oxygen cycles through photosynthesis and respiration.</i> | 45 mins |
| 2 | My Community Map and food web | <ul style="list-style-type: none"> - Personalized Community mapping activity of a pond that has a bloom - Introduction to food web concepts - Create food web that indicates how cyanobacteria influences the environment - Determine appropriate category for cyanobacteria - Answer past MCAS questions | <i>6.3 Use a food web to identify and distinguish producers, consumers, and decomposers, and explain the transfer of energy through trophic levels. Describe how relationships among organisms (predation, parasitism, competition, commensalism, mutualism) add to the complexity of biological communities.</i> | 45 mins |
| 3 | Cyanobacteria - Friend or Foe? Part 1 | <ul style="list-style-type: none"> - At the end of the lesson, students will be able to articulate the danger of too much cyanobacteria in the ecosystem and be able to explain how cyanobacteria can be beneficial at an appropriate amount. | <i>6.4 Explain how water, carbon, and nitrogen cycle between abiotic resources and organic matter in an ecosystem, and how oxygen cycles through photosynthesis and respiration.</i> | 45 mins |
| 4 | Cyanobacteria - Friend or Foe? Part 2 | <ul style="list-style-type: none"> - At the end of the lesson, students will be able to articulate the danger of too much cyanobacteria in the ecosystem and be able to explain how cyanobacteria can be beneficial at an appropriate amount. | <i>6.4 Explain how water, carbon, and nitrogen cycle between abiotic resources and organic matter in an ecosystem, and how oxygen cycles through photosynthesis and respiration.</i> | 45 mins |

Lesson 1: What can't I go in the water?

| Lesson 1: Overview | |
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| <p><u>Lesson Overview:</u> Students will be introduced to the concept of cyanobacteria and brainstorm questions they want to explore.</p> <p>Lesson fits into the unit since cyanobacteria is a natural part of the ecosystem on Cape Cod and we will be studying concepts related to ecosystems in the next few days.</p> | <p><u>Lesson Objectives:</u> <i>At the end of the lesson, students will be able to articulate the basic issues of cyanobacteria on Cape Cod and generate questions they have about these issues. Students will also identify a pond they would like to further study.</i></p> |
| <p><u>Standards:</u></p> <ul style="list-style-type: none"> • <i>6.4 Explain how water, carbon, and nitrogen cycle between abiotic resources and organic matter in an ecosystem, and how oxygen cycles through photosynthesis and respiration.</i> | <p><u>Timing:</u></p> <ul style="list-style-type: none"> • <i>45 mins-see below for more specific timing</i> |
| <p><u>Materials:</u></p> <ul style="list-style-type: none"> • Gallery walk materials, post it notes • Pond options photos | <p><u>Assessment:</u> <i>Exit slip and participation in discussion</i></p> |

Lesson 1: Activities

| Time | Activity | Teacher is... | Students are... | Modifications Please note these are sample suggestions. All modifications should be unique to your students needs | Materials |
|---------|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|
| 5 mins | Warm up | Ask students to list ways they interact with the natural environment | Generating a list on paper or on their desks | Ask student or provide student with a list of natural resources (light, water, soil, air ect) Ask student to generate a list of ways they use or interact with these resources | Whiteboard marker, paper/pen |
| 3 mins | Share in | Generates a class list on the board and create a class map showcasing the interaction of resources (include past concepts such as photosynthesis, cell respiration) | Sharing answers with the class | | none |
| 2 mins | Teacher explanation | Explain directions of gallery walk "You will now participate in a gallery walk. You may not initially understand what you are seeing so I am providing post notes for you to write down your questions and place them on the different pictures/videos. Use the post it notes to also write down what you see." | Listening | Provide model examples such as "I see that the cyanobacteria is green" "I wonder why there is so much cyanobacteria" | |
| 10 mins | Gallery walk | Assisting where needed | Responding on post it notes "What do you see, what do you wonder" | Same as above | Gallery walk materials |

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| 10 mins | Share in | Let's share out what we have seen, what we wonder" Facilitates class share in and categorizes the see/wonder post its into two columns | Shares responses | Encourage to share out | |
| 2 mins | Teacher explanation | This week we are going to be looking more closely at a common bacteria on Cape Cod called cyanobacteria. Specifically we are going to be diving into how it interacts with our environment and us. For the next 5 minutes I would like for you to find a picture of a pond that you visit or that is near to your home. | Listening | Listening | |
| 5 mins | Pond Location | Assisting where needed | Using internet to search for ponds near their homes | Have pre printed options of ponds for students to choose from | Pond options for students who struggle to research |
| 3 mins | Exit slip | Provide questions to answer: 1. What is one new thing you learned today in regards to cyanobacteria and its relationship to Cape Cod? 2. What is one question you would like to explore even deeper? | Answer questions | Modified questions: 1. How would you describe cyanobacteria? Or have student chose one question to answer | Post its |

Lesson 2: My Community Map

| Lesson 2: Overview | |
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| <p><u>Lesson Overview:</u> Students will create a community map of a pond of their choice.</p> <p>This fits into the overall unit because the map allows students to start to outline the interactions of all the abiotic and biotic factors including cyanobacteria.</p> | <p><u>Lesson Objectives:</u> <i>At the end of the unit, students will be able to describe the major components of a food web and highlight how abiotic and biotic factors interact with one another using specific examples.</i></p> |
| <p>Standards:</p> <ul style="list-style-type: none"> • <i>6.3 Use a food web to identify and distinguish producers, consumers, and decomposers, and explain the transfer of energy through trophic levels. Describe how relationships among organisms (predation, parasitism, competition, commensalism, mutualism) add to the complexity of biological communities.</i> | <p>Timing: <i>45 mins: see below for specific timing</i></p> |
| <p>Materials:</p> <ul style="list-style-type: none"> • Images of various ponds on Cape Cod • Model sketch of pond • Paper/writing utensils • Optional powerpoint | <p>Assessment: sketch drawings and MCAS questions</p> |

| Lesson 2: Activities | | | | | |
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| Time | Activity | Teacher is... | Students are... | Modifications Please note these are sample suggestions. All modifications should be unique to your students needs | Materials |
| 5 mins | Warm Up | <ul style="list-style-type: none"> • Hand out exit slips with feedback • Ask students to share their responses to the answers of yesterday's exit slip with a partner • Any new thoughts/questions come up? | <ul style="list-style-type: none"> • Review teacher feedback • Share responses with a partner | As needed | Exit slips with teacher feedback |
| 2 mins | Intro | <p>Yesterday we started our exploration of cyanobacteria. Today we are going to dive into the concepts of a food web and create personalized food webs based on the pond you identified yesterday.</p> <p>Using your image of your pond please sketch a diagram of the pond. You should include plants and animals and any processes you can think of (photosynthesis for example)</p> <p>Include cyanobacteria!</p> | Listening and taking out pictures from yesterday | Choose from a sample sketch or a provided picture of a pond | Model sketch , pictures of ponds |
| 10 mins | Sketch our your pond | Assist when needed / check to make sure students on task | Sketch out pond and label organisms and processes. Include cyanobacteria | Use sample sketch as a model or add to the sample sketch | Model sketch , pictures of ponds |

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| 10 mins | Intro to concepts | <p>Introduce students to the concepts associated with food web: producers, consumers, and decomposers, and explain the transfer of energy through trophic levels. Describe how relationships among organisms (predation, parasitism, competition, commensalism, mutualism) add to the complexity of biological communities.</p> <p>This can be done via powerpoint, video, flashcards</p> | Take notes | Provide sample pictures/descriptions for each term | |
| 10 mins | Apply concepts | <p>Explain to students that they should try to add the vocabulary just reviewed onto their sketches/pictures</p> | Add vocab: producer, consumer, decomposer, predator, parasite, commensalism, mutualism, parasitism | Provide examples/samples: Tree is a producer/autotroph | Model sketch , |
| 5 mins | Pair Share | <p>When you are done find someone else who is also finished and compare ecosystems</p> <p>-Would you agree with how your partner labeled their ecosystem?</p> <p>Discuss with partner: what vocab word would you assign to cyanobacteria?</p> | Discuss with your partner if you agree or disagree with labeling. Revise as needed | Compare with sample sketch | |
| 5 mins | Exit slip | MCAS practice questions | Answer questions | Provide fewer choice options | MCAS questions |

Lesson 3: Cyanobacteria - Friend or Foe?

| Lesson 3: Overview | |
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| <p><u>Lesson Overview:</u> <i>Students will participate in discussion about the importance of keeping a healthy balance of cyanobacteria.</i></p> <p><i>This lesson fits into the unit because it is important to understand the cycles of resources and the necessity to maintain healthy balances of resources</i></p> | <p><u>Lesson Objectives:</u> <i>At the end of the lesson, students will be able to articulate the danger of too much cyanobacteria in the ecosystem and be able to explain how cyanobacteria can be beneficial at an appropriate amount.</i></p> |
| <p><u>Standards:</u></p> <ul style="list-style-type: none"> ● <i>6.4 Explain how water, carbon, and nitrogen cycle between abiotic resources and organic matter in an ecosystem, and how oxygen cycles through photosynthesis and respiration.</i> | <p><u>Timing:</u></p> <ul style="list-style-type: none"> ● <i>45 mins: see below for specific timing</i> |
| <p><u>Materials:</u></p> <ul style="list-style-type: none"> ● Computer, internet, art supplies, article | <p><u>Assessment:</u> Observation of discussion Campaign</p> |

Lesson 3: Activities

| Time | Activity | Teacher is... | Students are... | Modifications Please note these are sample suggestions. All modifications should be unique to your students needs | Materials |
|---------|----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| 5 mins | Warm up | <p>Explain opening question to respond to:</p> <ul style="list-style-type: none"> - How do organisms respond to their environment? List 2-3 examples from your pond food web sketches | Listen and getting out writing materials | <p>Alternative questions</p> <ol style="list-style-type: none"> 1. How would deer respond to a decrease in the amount of grass? 2. How would plants respond to an increase in carbon dioxide? | Writing materials |
| 3 mins | Share in | <p>Facilitate share in discussion</p> <p>Push discussion further: Do ecosystems stay stagnant? Is there a constant flow of nutrients/resources?</p> | Participating in discussion | As needed | none |
| 2 mins | Teacher explanation | Today we are going to explore how we as humans can help facilitate a healthy balance of cyanobacteria as a model for balancing all resources/organisms | Listen / Get excited | As needed | none |
| 30 mins | Read Article and gather evidence | <p>I am providing the article from Day 1 to help you cultivate your understanding of the problems associated with cyanobacteria.</p> <p>Take evidence from your notes</p> | Read article and annotate independently or with a partner | Read aloud article stopping to check for understanding as needed | Article |

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| | | from Day 1 for understanding of how cyanobacteria is part of the Cape Cod ecosystem. | | | |
| 5 mins | Check in | Tomorrow you will create a marketing campaign that promotes the call for cyanobacteria to be better understood about its importance in our ecosystem. Decide what kind of campaign you want and Create a list of things you will need for your campaign-consider how you want to teach about this topic. | Respond to check in | <p>What did you get done today? Create a to do list of what you need to finish</p> <p>Provide suggestions such as</p> <ul style="list-style-type: none"> - Lessen the use of fertilizers - Promotion of native species - Promotion of alternative lawn species (example: moss) - Promotion of natural lawns | |

Lesson 4: Create your Campaign

| Lesson 3: Overview | |
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| <p><u>Lesson Overview:</u> <i>Students will create a marketing campaign to raise the public's awareness of cyanobacteria.</i></p> | <p>Lesson Objectives: <i>At the end of the lesson, students will be able to articulate the danger of too much cyanobacteria in the ecosystem and be able to explain how cyanobacteria can be beneficial at an appropriate amount.</i></p> |
| <p>Standards:</p> <ul style="list-style-type: none"> 6.4 Explain how water, carbon, and nitrogen cycle between abiotic resources and organic matter in an ecosystem, and how oxygen cycles through photosynthesis and respiration. | <p>Timing:</p> <ul style="list-style-type: none"> 45 mins: see below for specific timing |
| <p>Materials:</p> <ul style="list-style-type: none"> Computer, internet, art supplies, article | <p>Assessment: Campaign</p> |

| Lesson 4: Activities | | | | | |
|---------------------------------------------------|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| Time | Activity | Teacher is... | Students are... | Modifications Please note these are sample suggestions. All modifications should be unique to your students needs | Materials |
| 5 mins | Warm up | You should have an idea of what kind of campaign you want. Check in with your list of things to do and create a budget timeline for today. | Check in with their to do list and create a timeline | Provide sample | Writing materials |
| 40 mins (Can provide more time if needed) | Work time | You will now have time to create a marketing campaign that promotes the need for cyanobacteria in our ecosystems but also the need to keep it at a healthy balance so that humans can continue to interact with the environment safely. | Generate ideas and create a short campaign *Students could present their campaigns to one another or to the wider community | Provide suggestions such as <ul style="list-style-type: none"> - Lessen the use of fertilizers - Promotion of native species - Promotion of alternative lawn species (example: moss) - Promotion of natural lawns | Art supplies |
| 5 mins | Wrap up | Discuss with students if they want to present to one another or to the greater community | Students vote! | | |

Performance Assessment (if applicable)

- Participate in debate within the classroom about how cyanobacteria should be monitored and cleaned up including financial responsibility
- Present campaign from Lesson 3 and present to town government and discuss solutions to ongoing cyanobacteria issue
- Conduct a experiment using safe and similar bacteria to test various solutions to inhibit growth

Summative Assessment ideas:

Students may present through written paper, video, powerpoint, song, pamphlet or live demonstration

- Discussion of impacts of cyanobacteria in biotechnology
- Choose one of the questions we proposed on Day 1 and write a response
- Discussion: How does genetic variation contribute to ecological succession? Choose cyanobacteria or another organism as an example.

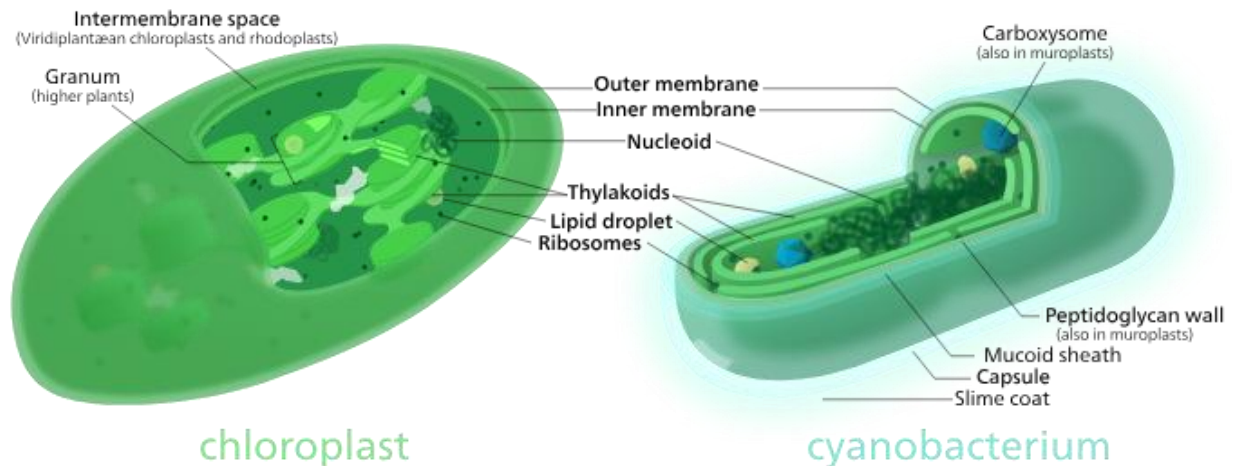
Resources

Resources to support teacher learning - *help teachers to develop background content knowledge for this unit.*

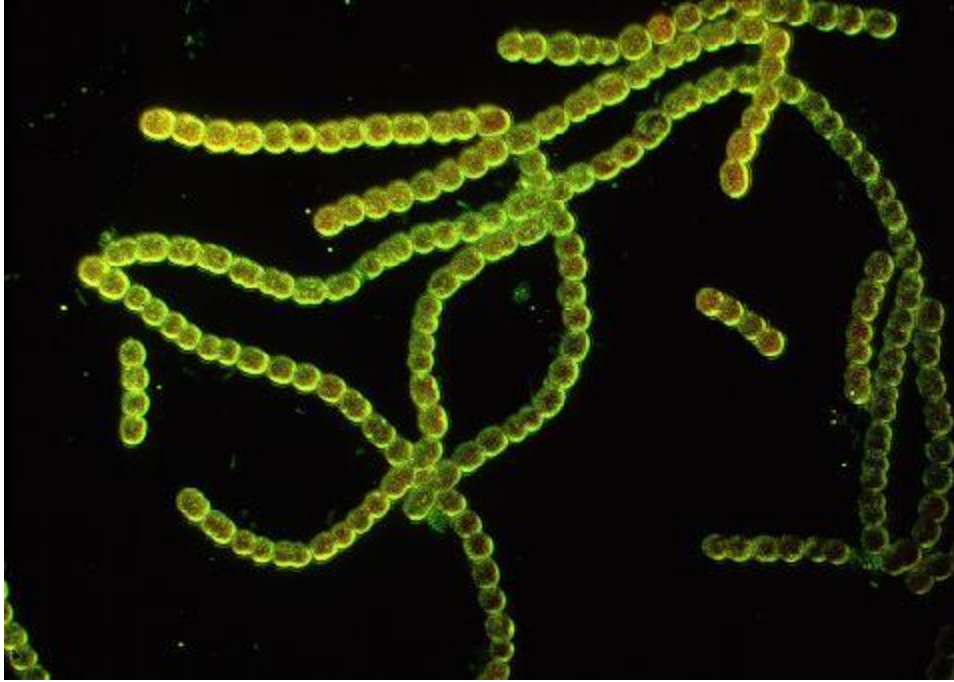
- Teachers should review Day 1 materials to understand that cyanobacteria blooms are natural but that the influx of nitrogen from fertilizers can increase the blooms
- Teachers should stray away from students concluding that cyanobacteria is bad

Materials for Gallery Walk

- Interactive Map - will need computer set up
[Association to Preserve Cape Cod Cyanobacteria Monitoring Map](#)
- [Video](#) about Monitoring Program on Cape Cod
- Printed/computer display text from [CDC](#) about harmful effects to people/animals
- Animal alert poster from the [CDC](#)
- [Article](#) from Cape Cod Times
- Image from [Association to Preserve Cape Cod Cyanobacteria](#)
- Images 3- 4 were filtered by creative common license permission via google



https://commons.wikimedia.org/wiki/File:Chloroplast-cyanobacterium_comparison.svg



<https://www.memphremagog.org/en/cyanobacteria>

- Images 1-2 were filtered by creative common license permission via google



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