Matter
Lesson 7: Considering the School-Pond System

Grade: 5	Length of lesson: 70 minutes	Placement of lesson: 7 of 7
Anchoring Phenomenon: A healthy pond near a school has changed, and students see that there are a few dead fish in the pond.		
Unit Learning Goal: We can use our understanding of the particulate nature of matter and properties of matter to explain the world around us.		
Lesson Main Learning Goal: Models can be used to describe natural objects from the very small to the immensely large. Models can explain interactions in systems. The particulate nature of matter and properties of matter can help us explain much of the world around us.		
Unit Central Question: How can we figure out what was mixed with pond water that could have changed the water?		**Lesson Focus Question:** How did the pollutants get into the pond in the first place?
Science content storyline: Properties of certain types of matter (pollutants) cause them to be problematic in water systems. Pollutants (matter) that are soluble can enter waterways and travel some distance. We can scale up our model to show how pollutants and water travel in the larger system around the school and the pond. We can use our understanding of the particulate nature of matter and properties of matter to predict and explain what pollutant is in water. **Science and Engineering Practices** • Analyzing and Interpreting Data: Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. • Constructing Explanations and Designing Solutions: Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. • Developing and Using Models: Develop a model to describe phenomena. **Crosscutting Concept:** Cause and effect relationships are routinely identified, tested, and used to explain change.		
Ideal student response to the Lesson Focus Question: The pollutants got into the pond water because when it rained or when someone applied water to the ground, the pollutants dissolved and ran down the hill in the water until they ended up in the pond.		

Preparation

MATERIALS NEEDED	AHEAD OF TIME
Teacher Resources: • Lesson 2 video from Tennessee Aquarium **Student Handout** • Lesson 7_HO1 *Pond Water Data* (1 per student) • Lesson 2_HO1 *Data Table* (student copy from Lesson 2) • Lesson 3_HO1 *Data Table* (student copy from Lesson 3) **Other Materials** • chart paper and markers	• Review the "Reflections on Models" section in the *Content Background* document. • Prepare the handout. • Create a chart with a rough sketch of the school/pond system that will be used for the class consensus model.

Lesson 7 General Outline

Time	Phase of lesson	How the science content storyline develops
5 min	**Link to Previous Lesson:** Review the key idea from Lesson 6 that pollutants are not easy to remove once they are in the water.	
5 min	**Focus Question:** Revisit the DQB to identify a cluster about how the pollutants got into the water in the first place. Introduce today's focus question: **How did the pollutants get into the pond in the first place?**	
5 min	**Setup for Activity 1:** Look at a map of the school-pond system and think individually about how the pollutants got into the pond then share ideas with a partner.	
10 min	**Activity 1:** Discusses ideas about what caused the pollutants to get into the pond and create a class model.	Models can be used to communicate our ideas. Matter is made of particles too small to be seen.
5 min	**Follow-up to Activity 1:** Discuss how thinking about particles helped explain what caused the pollutants to get into the pond.	Natural objects exist from the very small to the immensely large.
5 min	**Setup for Activity 2:** Review previous learning to identify ideas and representations (models) that will be useful in developing a model of the school-pond system that explains how the pollutants got into the pond. Class creates a class model.	
10 min	**Activity 2:** Students analyze data using properties to try to identify unknown substances.	The properties of a substance can be used to identify that substance.
20 min	**Follow-up to Activity 2:** Students develop an evidence-based explanation about what pollutant is likely in the water.	The properties of a substance can be used to identify that substance.
5 min	**Summarize and Synthesize:** Return to the Driving Question Board.	

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
5 min	**Link to Previous Lesson** Synopsis: Review the key idea from Lesson 6 that pollutants are not easy to remove once they are in the water.	Link science ideas to other science ideas. (Slide 1-2)	Last time, we learned that these pollutants are not easy to remove once they dissolve in the pond water. To recall what we have learned, we will now watch the video from Lesson 2 again to review each pollutant. Find the *Data Table* handout you used in Lesson 2 and add additional notes while we rewatch the video. Who would like to share an important or new idea you saw in the video?	
5 min	**Focus Question** Synopsis: Revisit the DQB to identify a cluster about how the pollutants got into the water in the first place. Introduce today's focus question: How did the pollutants get into the pond in the first place?	Set the purpose with a focus question. (Slide 3-4)	Let's revisit our DQB and consider what questions we have left to address. *Identify a cluster of questions on the DQB that most closely connects to the question of how the pollutants got into the water in the first place. Explain that we will now consider the focus question:* ***How did the pollutants get into the pond in the first place?*** *Write the focus question on the board or chart paper and direct students to record the focus question in their notebook.*	

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5 min	**Setup for Activity 1** <u>Synopsis:</u> Students look at a map of the school-pond system and think individually about how the pollutants got into the pond then share ideas with a partner.	Ask questions to elicit student ideas and predictions. (Slide 5)	In this lesson we will zoom out from the pond and consider the polluted pond water from a larger view: one that includes the school and the pond system. It is often helpful to consider the area surrounding the place of contamination when trying to identify the cause of pollution. In this case, we will look at the school site and pond system. I have a map that shows the school uphill from the contaminated pond. **If the school was the source of the pollution, where could the pollutants have come from?** **If the pollution came from the school, how do you think it may have traveled from the school to the pond?**	Maybe kids were using a lot of soap in the bathroom. **When we use soap in our bathrooms and kitchens, where does that water go?** Into pipes underground. (*See note in "Teacher talk" column.*) **What other ideas do we have about where the pollutants came from?** A custodian could have been cleaning off the side of the building with soap. Maybe kids had a car wash. We put salt outside when it's icy to melt the ice. Maybe rain or other water carried it down to the pond.

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			NOTE TO TEACHER: *If the idea comes up that materials that we use inside schools, homes, and businesses are the source of nonpoint source pollutants, it's important to address that these materials travel in a different system: they go into a water treatment system and not into natural bodies of water. We want to focus their ideas on substances used outdoors as the cause of this nonpoint source pollution.* *If students bring up reasonable ways that the salt and detergent could have been used outside, like a car wash or a school custodian washing off the side of the building for soap or salt on the sidewalk for ice, use those student-generated ideas for the next section. You may say something like, "Those are all realistic ways the pollutants might have ended up on the ground outside the school. If those things happened, take a moment to think about what might have caused them to go from the ground outside the school into the pond." If students don't generate ideas about how the pollutants could have ended up outside the school, use the script below.* I have two new ideas the share with you: 1. In the winter, after a heavy snowfall, salt was added to the road to melt the ice and made it safer to drive. 2. In the spring, the school held a car wash fundraiser, and families drove their cars onto the	**How do you think that works?** The water could have picked up the salt and moved it down.

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			school playground so students could wash the cars. Think about these scenarios. **How does this new information affect your current ideas about how the pond became polluted** and **how might this new information be represented in a class model of the school-pond system?** Turn and talk with a partner about your ideas.	
10 min	**Activity 1** <u>Synopsis</u>: Class discusses their ideas about what caused the pollutants to get into the pond and creates a class model. <u>Main science ideas</u>: Models can be used to communicate our ideas. Matter is made of particles too small to be seen.	Engage students in communicating in scientific ways. Engage students in developing and using content representations and models. (Slide 6)	Before we begin developing our class consensus model, we want to consider what we have already learned and how we have represented our learning in previous lessons. Take some time now to look through your notebook. • **What evidence have we collected already that would be useful in developing our model?** • **What models have we developed in past lessons that we can use here?** • **What information in our Progress Tracker should we consider?** You will have 5 minutes to look through your notebook on your own. Then we'll discuss what we all found together.	

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			In a small group, discuss the possible ideas and evidence we have for developing our school-pond system model. Remember to use your CSW prompts to discuss the possible resources in your notebook. Bring your notebook and let's circle up around our chart, and we'll work together to make **a model explaining what may have caused the pollutants to get into the pond.** As we create our model, let's remember our earlier models and how we've represented substances when we zoom way, way in. **Can I have one or two volunteers to capture our ideas on our class model?** As we discuss, let's make sure we share the floor and allow everyone to share their thoughts about this system. ***NOTE TO TEACHER:*** *Invite one or two students to create the model with input from the class. Your role during the discussion will be to allow students to guide the model and ask questions as needed. Push on student thinking with elicit, probe, and challenge questions about the ways these pollutants interact with water that are consistent with the properties of those substances (salt dissolves, soap spreads evenly). The ideas below should be represented in the model in a scientifically accurate way and are places you may want to jump in with elicit, probe, or challenge questions.*	**How might we show the particles of the pollutants? How have we shown particles in the past?** We used dots to show the particles. We made the dots different colors to show different things like water, salt, or detergent. **So, in this model should we include dots to represent the matter and use different colors of dots?** Yes.

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			1. *The particulate nature of matter: Are they representing the particles? Are the particles of water and the pollutants represented differently?* 2. *Conservation of matter: Are the dots or particles disappearing at any point? Have they considered how the number of dots is represented at various parts of the model?*	**What might have happened that caused these pollutants to be in this location?** School events allowed salt from the sidewalk and soap from cleaning to each mix with water and travel downstream to the pond. Our model should show particles of salt and soap each entering the water at the top of the hill, mixing, and traveling as a mixture to the pond. Let's show the salt, soap, and water with different symbols and colors.
5 min	**Follow-up to Activity 1** Synopsis: Class discusses how thinking about particles helped them explain what caused the pollutants to get into the pond.	Link science ideas to other science ideas. (Slide 7)	So now that we have thought about what might have caused the pollutants to get into the pond, how did thinking about particles helped us figure out and represent our ideas in a model about what was happening in the pond.	Some of the pollutants disappear in the water, so we need a way to show that they are in the water and how they move. Thinking about the particles lets us connect the stuff in the water with the evidence. We can show our thinking about what is happening in

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	Main science idea: Natural objects exist from the very small to the immensely large.			the water and how it matches (or doesn't match) the evidence we collected.
5 min	**Setup for Activity 2** Synopsis: Students use and apply ideas in a new context.	Ask questions to elicit student ideas and predictions. (Slide 8) (Slide 9)	***NOTE TO TEACHER:*** *Adjust this next session to fit the types of conversations the class has had over the course of the lessons.* Some of you may have wondered how common it is that a pond in a community could actually become polluted. In fact, here's are some pictures (*display images in slide*) taken in another community where there is a small pond downhill from a school, and they recently had a bunch of fish die in that pond. Something changed in that water that made it unsafe for the fish that lived there. The thinking that we're doing about pollutants and their properties matters in our everyday lives, such as in this community. That community also investigated its pond water like we've been doing together during these lessons. We have this data table (*distribute HO7.1* Pond Water Data). These are the data collected by students in that community to determine what has polluted their pond water. The other students have sent their data to us because they know we have been conducting investigations on pond water pollutants.	

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			Review the data table individually: 1. Of the pollutants that we studied, what could possibly be polluting their pond water? 2. What additional test or data would you like to do or collect to make you more confident in your claim?	
10 min	**Activity 2** Synopsis: Students analyze data using properties to try to identify unknown substances. Main science idea: The properties of a substance can be used to identify that substance.	Engage students in communicating in scientific ways. Engage students in using and applying new science ideas in a variety of ways and contexts.	You will have 5–8 minutes to discuss in small groups before we discuss this all together as a class. Remember that claims need to be supported with data from the other class's data table or our own investigations. Claims also need to be supported with ideas we have learned during our investigations. **Discuss with your small group, what claims can you make about this data? What evidence do you have in this data to support your claim?** Let's come back together for a brief discussion about what you all discussed in your groups. ***NOTE TO TEACHER:*** *Ask elicit, probe, and challenge questions to support student thinking about the data they have received, investigations that they would want to conduct to get additional data, evidence from their own investigations, and what they have learned about using the properties of matter to identify unknown substances.* Class results of polluted water	**What do you notice about the data the students collected?** **Based on the data we collected, what do you think might be the pollutant?**

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<tr><th>Time</th><th>Phase of lesson and how the science content storyline develops</th><th>STeLLA strategy</th><th>Teacher talk and questions</th><th>Possible student and teacher dialogue</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><td>Test</td><td>Solubility</td><td>Conductivity</td><td>Turbidity</td><td>pH</td><td>Observations</td></tr>
<tr><td>Result</td><td>yes</td><td>a little</td><td>a little cloudy</td><td>4–5</td><td>murky</td></tr>
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NOTE TO THE TEACHER: The data mostly closely match the properties identified for fertilizer (e.g., soluble, does conduct electricity). However, as described, there are a few of these properties that students may want additional clarity about. The data from the other students do not mention this fizzing. Fertilizer also can make the water bluish, but this is not listed. Finally, the pH in the table has a range (4–5), so students may suggest repeating that test. Students may also follow lines of reasoning about what the mystery pollutant is <u>not</u> (oil because the mystery pollutant is soluble or soap because it is not cloudy). These lines of reasoning are fine as long as the claim is clear and there is evidence to support it. However, the process of elimination requires a more-complex approach to the written form of the explanation, which is the next step in this lesson. Still, this may be a productive means of sorting out ideas about the evidence during group discussions.</td><td>What data are the most useful? What data are not useful?

Can you say more about why that datum is useful? What makes you say that datum is not useful?

What data do you wish you had? Why?

Do the data suggest that certain pollutants are not the mystery pollutant? What data are you using to remove specific pollutants from the possibilities?</td></tr>
<tr><td>20 min</td><td>Follow-up to Activity 2

<u>Synopsis</u>: Students develop an evidence-based explanation about</td><td>Engage students in constructing explanations and arguments. (Slide 10)</td><td>NOTE TO TEACHER: Decide where you’d like students to write this explanation, either in their notebooks or on a loose sheet of paper to turn in.

You have collectively developed a class consensus model for the polluted pond we investigated in this unit and discussed the data collected from the other community.</td><td></td></tr>
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	what pollutant is likely in the water. Main science idea: The properties of a substance can be used to identify that substance.		You will now each write an individual explanation about the mystery pollutant in the other school's pond. **What could possibly be polluting their pond water, and what additional test or data would make you more confident in your claim?** *Remind students to support any claims with evidence from the other school's data .* *Allow students 15–20 min to write out their explanations.* ***NOTE TO TEACHER:** Explanations should use evidence from the data table to support the claim that they're making. As noted above, there may be more than one plausible response, so what you're looking for in their responses is whether the evidence they select supports their claim.*	
5 min	**Summarize and Synthesize** Synopsis: Return to the Driving Question Board.	Engage students in communicating in scientific ways. (Slide 11)	*Return to the Driving Question Board and ask students to consider the questions on the board.* *Tell students to identify what questions they think* • *we have answered as a class,* • *we have partially answered as a class, and* • *we did not answer.* *Conduct a quick discussion of the question sort. Celebrate the questions that students feel they can answer. Tell the class that the DQB is a record of students' curiosities*	

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			about our phenomenon and records our progress in understanding what happened in the pond. *This could be an opportunity for students to continue individually exploring questions, should you choose.*	