Matter
Lesson 5: Identifying Pollutants

Grade: 5	Length of lesson: 145 minutes	Placement of lesson: 5 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: Properties of matter are used to identify substances. **Science and Engineering Practices** • Constructing Explanations and Designing Solutions: Use evidence to construct or support an explanation or design a solution to a problem. • Planning and Carrying Out Investigations: Conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials is considered. **Crosscutting Concept:** Cause and Effect: Cause and effect relationships are routinely identified, tested, and used to explain change.		
Unit Central Question: How can we figure out what was mixed with pond water that could have changed the water?		**Lesson Focus Question:** How can we identify the pollutants in the pond water?
Science content storyline: Properties are characteristics of substances that can be observed or measured. Tests and observations can be used to figure out properties of a substance. Properties of matter can be used to identify substances.		
Ideal student response to the Lesson Focus Question: We can use our understanding of properties and how to test for different pollutants. We designed an investigation to figure out what the pollutants are. The turbidity test let us know detergent is in the pond water. The electrical conductivity tells us that salt is in the water.		

Preparation

MATERIALS NEEDED	AHEAD OF TIME

Teacher Resources: none
 	
Other Materials
• Healthy and unhealthy pond water samples
• Supplies for the materials station
  ○ plastic containers with lids for holding pollutants (2 per pollutant: motor oil, salt, hand soap, dirt, and fertilizer)
  ○ 10-mL measuring spoons (1 per plastic container of dry pollutants)
  ○ 9-oz. clear cups (2 per small group, 1 per activity, wash and reuse)
  ○ craft sticks for stirring (1 per mixture, wash and reuse)
  ○ 5-mL syringes (1 per container of wet pollutants)
  ○ 6 50-mL syringes for measuring water
  ○ medium-sized containers for groups to get water from the materials station
  ○ hand lenses (1 per group)
  ○ #2 paper coffee filters (1 per group if they choose to use it in their observations)
  ○ coffee filter holders (3 per class, groups can take turns using if they choose to collect data about filtering pollutants)
  ○ 1 kitchen scale sensitive to the gram
• 3”x3” sticky notes (about 30 total. Quantity varies by number of pieces of evidence students brainstorm and collect). 2 colors are needed for the data collection.
• transparent tape
• 11" × 14" blank paper (optional; 1 per group)
• chart paper and markers
	• Review the information about properties of matter and interactions of matter in the *Content Background* document.
	• Prepare the materials station for students to run all tests on the healthy and unhealthy pond samples. Students may think of additional tests that are needed with the pollutants to collect evidence.

Lesson 5 General Outline

Time	Phase of lesson	How the Science Content Storyline Develops
5 min	**Link to Previous Lesson:** Review ideas about variables that affect how quickly salt dissolves.	
5 min	**Focus Question:** Introduce today's focus question: **How can we identify the pollutants in the pond water?**	
30 min	**Setup for Activity 1:** Review each of the tests we have conducted on the pollutants. Identify evidence that would support claims that the pond is or is not polluted with salt, detergent, or fertilizer. Develop charts with sticky notes describing possible evidence for each claim.	Properties are any traits of a material that can be measured.
20 min	**Activity 1:** Develop a plan to test the unhealthy pond water. Develop labeled investigation procedures the describe their plans.	
10 min	**Follow-up to Activity 1:** Conduct a gallery walk to share and get feedback on their plans.	
10 min	**Setup for Activity 2:** Review feedback and revise investigation procedure.	
20 min	**Activity 2:** Conduct the investigation groups planned.	
20 min	**Follow-up to Activity 2:** Share results and reach consensus about what is in the water and not in the water.	
20 min	**Summarize** and **Synthesize:** Write an argument (C, E, R) about what is in the water and what is not in the water.	Properties of matter are used to identify substances.
5 min	**Link to Next Lesson:** Link science ideas to the next lesson.	

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 ideas about variables that affect how quickly salt dissolves.	Link science ideas to other science ideas.	During our last lesson, we investigated what factors affect how salt dissolves into water. **Who can remind the class what we learned about the variables that affect how quickly salt and other soluble solids dissolve?**	If the water was warmer, salt dissolved faster. If the salt crystals were bigger, the salt dissolved more slowly. When we mixed it faster, the salt dissolved more quickly.
5 min	**Focus Question** Synopsis: Introduce today's focus question: How can we identify the pollutants in the pond water?	Set purpose with a focus question. (Slide 4)	***NOTE TO TEACHER:*** *Adjust the next section to reflect student ideas. If the class didn't generate any questions around which pollutants are in the pond water, introduce the day's focus question yourself as the first matter the class will need to investigate to help us figure out what's happening with the pond water.* Thanks for that summary of the big ideas we figured out last time. Let's look at some of the ideas you all clustered together on our Driving Question Board during Lesson 1. This cluster of questions is all about wondering how we can tell what is in the water. We are going to focus on these questions today. During this lesson we'll work together to figure out this focus question: **How can we identify the pollutants in the pond water?** ***NOTE TO TEACHER:*** *Tell students to copy the focus question into their notebook. Move the*	How cloudy or turbid the water is. If it conducts electricity. Solubility. pH.

<table>
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<tr><td></td><td></td><td></td><td>class on by asking students to turn to a partner and share what properties we have used to eliminate certain pollutants as possibilities. What properties can we test for or observe?

Remind students that they can use their ideas from their notebook for reference.</td><td></td></tr>
<tr><td>30 min</td><td>Setup for Activity 1

<u>Synopsis</u>: The class reviews each of the tests we have conducted on the pollutants. Students identify evidence that would support claims that the pond is or is not polluted with salt, detergent, or fertilizer. Students develop charts with sticky notes describing possible evidence for each claim.

<u>Main science ideas</u>: Properties are any traits of a material that can be measured.</td><td>Engage students in constructing explanations and arguments.

Make explicit links between science ideas and activities (before activity).

(Slide 5)</td><td>We have conducted several tests on the possible pond water pollutants. Let’s consider the evidence we have collected so far and what claims we can make about the pond water.

Let’s start with the oil. We have already eliminated oil as a possible pollutant, but let’s take a moment to consider the evidence we have to support that claim.

We could make one of two claims:
There is oil in the pond water.
There is not oil in the pond water.
These are called counterclaims.
Write out each claim in a table on chart paper.

<table><tr><th>Claims</th><th>Evidence</th></tr><tr><td>There <u>is</u> oil in the pond water.</td><td></td></tr><tr><td>There is <u>not</u> oil in the pond water.</td><td></td></tr></table></td><td></td></tr>
</table>

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			You will work with your table group and review the evidence we have collected over the last four lessons. When you find evidence that supports one of the claims, write it down on a sticky note. *Distribute 2 sticky notes to each table group.* On the sticky note, write out the evidence in a complete sentence. Write only one piece of evidence on each sticky note. If you have two different pieces of evidence, you will have two sticky notes. ***NOTE TO TEACHER:*** *The class has already determined that oil is not in the pond water. The class will use a discussion about oil to become comfortable evaluating evidence and determining what evidence supports a claim. This initial discussion about oil is intended to be quick and serve as practice for the process they will do independently for the pollutants the class is still not sure about.* Now that you have written out evidence on sticky notes, who would like to read their evidence and place it on the chart? **As you share your evidence, did other groups identify that same evidence? If you did, do you agree that it supports the claim identified?** If we agree the evidence supports the claim, we can stack those sticky notes into one clump on the chart to represent one piece of evidence.	*Sticky notes for the "not" column could include the following:* There is no observable layer of oil on the top of the water. Oil does not mix with water.

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			NOTE TO TEACHER: *Facilitate this discussion and clarify any uncertainty about what evidence would support each claim. If students bring up evidence that does not support either claim, you can clarify that it is possible for evidence to not clearly support either claim.* *Once the sticky notes have all been placed, ask the class to consider the evidence that was identified for each claim.* **Which claim has the strongest evidence?** We have also concluded that dirt is not one of the pollutants in the pond water based on our observations, but there are still three pollutants we're not sure about: salt, fertilizer, and detergent. ***NOTE TO TEACHER:*** *Some classes will have wanted to eliminate fertilizer as a possible pollutant in the unhealthy water during Lesson 3. If it's possible to maintain enough of a question around fertilizer (like by noting not all fertilizer is blue), it will make this discussion richer and require that students use pH to eliminate fertilizer as a possibility. If they're insistent, you can conduct the following discussion using only detergent and salt, both of which are in the unhealthy pond water.*	The claim that oil is not in the pond water.

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			Next we will move on to consider the remaining possible claims: There is salt in the pond water. There is *not* salt in the pond water. There is fertilizer in the pond water. There is *not* fertilizer in the pond water. There is detergent in the pond water. There is *not* detergent in the pond water. In your data tables or from our class table, review the tests we conducted over the last few lessons for salt, fertilizer, and detergent. **What evidence would support each claim?** We will now use the same process to identify possible evidence. Write one piece of evidence on a sticky note. ***NOTE TO TEACHER:*** *Distribute sticky notes to each table group. If you want to jigsaw this activity so different groups are focusing on different pollutants, that could speed up the evidence generation. Facilitate the sharing of sticky notes, similar to the one with oil. Place sticky notes with similar evidence on top of each other so that everyone's ideas are represented on the charts.*	*Evidence for salt could include the following:* It will conduct electricity *(buzzer will sound)*. It will disappear into the water. It looks like the plain water. The pH was 7. *Evidence for fertilizer could include the following:* The water is blue. The buzzer will make noise. There is stuff at the bottom of the water if not filtered. The pH was 4.

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<tr><th>Claims</th><th>Evidence</th></tr>
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<tr><td>There <u>is</u> detergent in the pond water.</td><td></td></tr>
<tr><td>There is <u>not</u> detergent in the pond water.</td><td></td></tr>
<tr><td>There <u>is</u> salt in the pond water.</td><td></td></tr>
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Now that we have identified what evidence would support each claim, we can plan new investigations to gather data to serve as evidence for what could be in the water. Once we have evidence, we will return to our charts and consider which claim or claims our evidence supports.
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<td>Evidence for detergent could include the following:
The buzzer may sound but very quietly.
The water is cloudy. The water was really turbid.
The pH was 6.</td>
</tr>
</table>

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			NOTE TO TEACHER: *There may be students who consider soap as an insulator which would mask any electrical conductivity from salt. This could lead students to say that a lack of electrical conductivity is evidence that soap is in the water. This is an idea that you would want to probe further and possibly test on the side to confirm that a salt, soap, and water mixture will still conduct electricity. For example, if they put soap and salt in water, does the buzzer sound?*	
20 min	**Activity 1** Synopsis: Students develop a plan to test the unhealthy pond water. Students develop labeled investigation procedures the describe their plans.	Make explicit links between science ideas and activities (during activity). (Slide 6)	You have planned and conducted several investigations already in this unit. You will now plan an investigation to test the pond water. Think about the past investigations we have conducted. You will want to consider what variables you will control and what measurements you will take to capture data. You will describe your plan using a sketch of the procedure as we did in the last lesson. We have an example of what a sketch of a procedure could look like, but you will need to draw your investigation to show us how you will collect the data you need. Remember, the goal of this process is to test our unhealthy pond water to figure out which pollutants are in it. You can use your CSW stems to discuss your initial ideas, including stems from #10 design an investigation to get more evidence.	

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			Once you have some ideas about what evidence you want and the investigation plan to gather that evidence, transfer your plan to a sketch of your investigation procedure. Remember to use stems from CSW #6 listen to others' ideas and ask clarifying questions. **Any questions before you begin?** ***NOTE TO TEACHER:*** *Circulate around the class as groups work. Prompt student thinking with elicit, probe, and challenge questions. These plans will be shared with other groups to receive feedback. Students should draw and write out their investigation procedure on 11" × 14" paper or chart paper to facilitate the sharing.*	**Can you tell me about your plan?** **Will your plan give us that evidence we need to figure out which of our claims are true?** **What will this step tell you?** **Tell me more about why you included this step.**
10 min	**Follow-up to Activity 1** Synopsis: Students conduct a gallery walk to share and get feedback on their plans.	Engage students in communicating in scientific ways. (Slide 7) Engage students in constructing explanations and arguments. Make explicit links between science ideas and activities	As you finish up, please post your investigation procedure where other students can see it. You will now give feedback to one another's plans. The goal of this feedback is to help one another design investigations that will provide accurate data so we can figure out which claims are correct. Sometimes we want to be kind to our classmates, so we might say "Good job!" or "This looks great!" That feedback is nice to hear, but it doesn't help us figure out ways to improve our work. Take a moment to think about what type of feedback will help you make your plan better.	

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		(after the activity).	**Can anyone offer examples of the type of feedback that will help your group improve your plan?** You can also look at our CSW chart for ideas. ***NOTE TO TEACHER:*** *If any of these particular CSW ideas don't surface, be sure to bring them up.* When you are giving feedback, make sure you review the plan fully before beginning to write your feedback. You will write your feedback on a sticky note. You should write one comment per sticky note and put your name on the note so they know who to follow up with if the group has questions. Each group should try to leave at least two to three comments on each of the other groups' plans. ***NOTE TO TEACHER:*** *If time is limited, students should give feedback on two other groups' plans rather than on every group's plan. Provide 5 minutes for groups to give feedback and then*	This part needs more information. I can't tell what is happening in this step. 1: Areas you agree or disagree with the plan (CSW #7) 2. Areas that are not clear and you would like clarification (CSW #6) 3: Areas that make you think about improving your own plan (CSW #11)

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
			direct students to retrieve their plan and return to their table.	
10 min	**Setup for Activity 2** Synopsis: Groups review their feedback and revise to their investigation procedure.	Make explicit links between science ideas and activities (before activity). (Slide 8)	Review your feedback and consider what adjustments you should make to improve your investigation procedure. When you have completed your revisions, I will provide one final review. ***NOTE TO TEACHER:*** *Depending on how much time you have, you may ask groups to check in with you for one final review.*	
20 min	**Activity 2** Synopsis: Each group conducts the investigation they planned.	Make explicit links between science ideas and activities (during the activity).	You'll have 20 minutes to conduct your investigations and clean up. I'll come around and ask some questions about your work. You may get the supplies you need, and be sure to clean up your supplies when you're done. ***NOTE TO TEACHER:*** *Circulate among the groups to see if they need support with their investigations. Listen, watch, and ask probing questions as the groups work to gauge their process for conducting the investigations in a way that will allow the identified data to be gathered. In addition to process questions, ask questions to the groups about how they're understanding and interpreting the data and observations they're collecting. As groups finish their investigations, have them clean up their supplies.*	**What results are you finding so far?** **Based on our evidence charts, what do you think that means?** **How do you know that means ___ instead of ___?** **How could you connect those data back to the tests we did in earlier lessons to identify the properties of each pollutant?** **Do those data seem significant?** *(If they have found results you think are inaccurate)* **What would you say if I told you other groups found a different result for that test?**

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
20 min	**Follow-up to Activity 2** Synopsis: Class shares their results and reaches consensus about what is in the water and not in the water.	Engage students in analyzing and interpreting data. Make explicit links between science ideas and activities (after the activity). (Slide 9) (Slide 10)	You are now going to have about 10 minutes to review the data you collected. Discuss as a group what evidence you have and if any of that evidence supports one of the claims on our charts. ***NOTE TO TEACHER:*** *Distribute a new color of sticky note for students to write their evidence. The change in color is to identify the evidence that was gathered in this new round of testing.* Write your evidence on the sticky notes just as you did earlier in this lesson. Remember to write one piece of evidence per sticky note. ***NOTE TO TEACHER:*** *As students work, walk around the class and listen to their discussions. When helpful, remind them to use their CSW stems to discuss their ideas. Once students have identified the evidence from their investigation and placed them on sticky notes, refocus the students for a whole-group discussion.* We will now share the evidence gathered from our investigations. As we share our ideas with the class, remember to use our CSW stems to communicate, in particular, those from #6 listen to others' ideas and ask clarifying questions, #7 agree or disagree with others' ideas; add onto someone else's ideas, #9 consider if new ideas make sense, and #11 let your ideas change and grow.	

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
			We will have each group share one piece of evidence and what claim they think that evidence supports. We will then see if any other group identified the same evidence and discuss if we agree on which claim the evidence supports or if we need further discussion about the evidence. When we all agree about the claim the evidence supports, we will stack all our sticky notes about that evidence under the appropriate claim. The same piece of evidence may support more than one claim. In this case, the *same* evidence can be placed under more than one claim. If we find we have areas of disagreement, we'll pause and discuss those pieces of evidence. ***NOTE TO TEACHER:*** *There may be students who remain skeptical and ask "what if" questions such as "What if the oil is in gas phase?" or "What if the mixtures behave differently than the individual pollutants?" If this occurs, ask students to consider for which claim the evidence is* ***stronger*** *rather than which claim is true or proven by the evidence. If there are some students who are proposing reasonable investigations and there is time to conduct them, you may choose to allow some additional investigations.* *In this discussion, it may take some time to negotiate certain pieces of evidence. The fact that the polluted water is clear could be evidence to support <u>both</u> "There <u>is</u> salt in the water" and*	We found the pH was ___. But that evidence could support any of the three pollutants. The pond water did light up the lightbulb in the circuit. That means it has salt in it. The polluted pond water was cloudy or turbid. That means it has detergent in it or undissolved fertilizer. But we didn't see any fertilizer sitting in the bottom of the container, so that means it must be the detergent. Also, our group stirred and shook the pond water around,

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			"There is <u>not</u> salt in the water." This may take some negotiation for students to feel comfortable with. *Also, it's very important in this discussion for a student to note that there could be more than one pollutant in the water. If nobody brings up that idea, you'll need to surface the idea as an elicit question: "**Could there be more than one pollutant in the water?**" They will need to know that the answer to this is "yes" to correctly interpret the results of the investigations since no one pollutant from these five possible pollutants explains all the properties they discovered.*	and we saw bubbles. That means there's detergent in it.
20 min	**Summarize and Synthesize** <u>Synopsis</u>: Students write an argument (C, E, R) about what is in the water and what is not in the water. <u>Main science ideas:</u> Properties of matter are used to identify substances.	Engage students in constructing explanations and arguments. (Slide 11)	Now that we have collected and sorted our evidence, you are ready to write an argument about what pollution is in the pond water. You will need to select a claim and support that claim with evidence. You will also need to include a statement about why you selected the evidence to support your claim. You can have more than one piece of evidence to support a claim. You may write more than one claim if you think the evidence shows more than one of these claims is correct. ***NOTE TO TEACHER:** Allow students 15 minutes to individually write their arguments as an assessment moment. Before collecting their work, conduct a brief discussion based on evidence about the student arguments to reach consensus about the pollutants in the pond water.*	We decided that the pond water has salt and detergent in it.

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<tr><td>2 min</td><td>Link to Next Lesson

<u>Synopsis</u>: Teacher links science ideas to the next lesson.</td><td>Link science ideas to other science ideas (next lesson).

(Slide 12)</td><td>PROGRESS TRACKER

Let’s see if we can summarize what we have figured out so far. In your notebook, continue your Progress Tracker. Let’s fill in today’s focus question and what we figured out about it.

<table><tr><td>Question</td><td>What I figured out</td></tr><tr><td>How can we identify the pollutants in the pond water?</td><td>We can use our understanding of properties and how to test for different pollutants. We designed an investigation to figure out what the pollutants are. The turbidity test let us know detergent was in the water. The electrical conductivity tells us that salt is in the pond water.</td></tr></table>
As we wrap up our time today, let’s take a look at our Driving Question Board. Are there any questions that we answered today that we can</td><td></td></tr>
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Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
		(Slide 13)	add a check to? Are there any new questions that we thought of today? Let's add those to the board. ***NOTE TO TEACHER:*** *Link ideas from the Driving Question Board to the next lesson, if possible. If not, link to the next lesson by saying the following:* Now that we have identified what pollutants are in the pond water, next time we will move to looking at whether the pollutants can be removed from the water.	