Matter
Lesson 3: Investigating Pollutants

Grade: 5	**Length of lesson: 100 minutes**	**Placement of lesson: 3 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: Different materials have different identifiable properties. Some matter seems to disappear when added to water, but the matter is still there. The matter in the water-pollutant mixture is made of small particles too small to be seen. **Science and Engineering Practices** • 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. • Using Mathematics and Computational Thinking: Measure and graph quantities such as weight to address science and engineering questions and problems. • Developing and Using Models: Develop a model to describe phenomena. **Crosscutting Concepts:** Scale, Proportion, and Quantity: Natural objects exist from the very small to the immensely large.		
Unit Central Question: How can we figure out what was mixed with pond water that could have changed the water?		**Lesson Focus Questions:** What might be in the water that could have killed the animals? What can we observe about each of those dangerous materials?
Science content storyline: Some properties that can be tested when materials are mixed with water include electrical conductivity, turbidity, pH, and solubility. Solubility measures a material's ability to dissolve into a solvent (usually water). When some matter (or materials) dissolve in water, the matter seems to disappear. The matter in the water-pollutant mixture is made of small particles too small to be seen.		
Ideal student response to the Lesson Focus Questions: There are several tests we can run to tell whether there are dangerous materials—detergent, dirt, fertilizer, salt, or oil—in the water. We can observe the water, and we can test for electrical conductivity, turbidity, and pH.		

Preparation

MATERIALS NEEDED

Teacher Resources:

- Lesson 3 video from Tennessee Aquarium
- PhET simulation

Student Handout

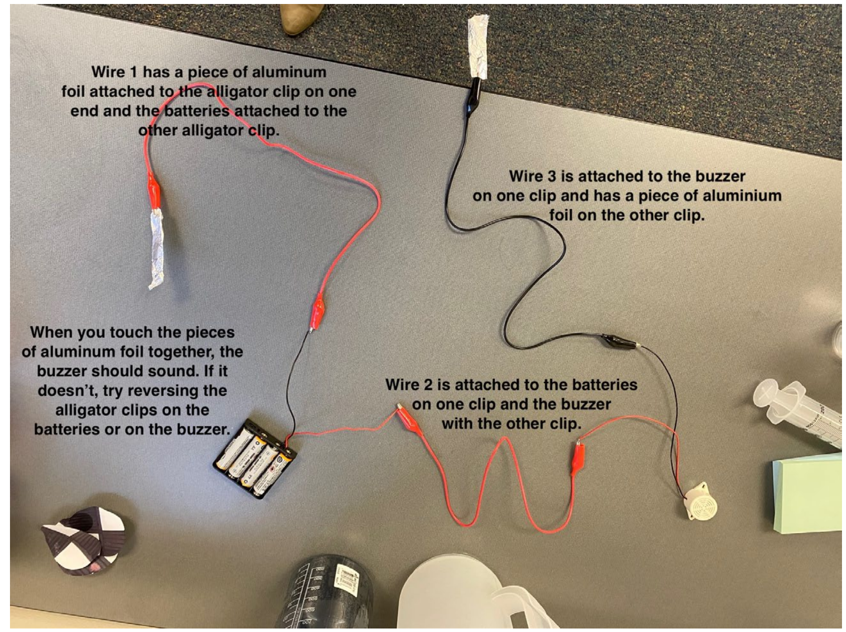
- Lesson 3_HO1 *Data Table* (1 per student)

Other Materials

- 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
    - small bottles with lids that could be used to shake mixtures
    - 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
- Optional: petri dish, sand, food coloring

AHEAD OF TIME

- Review the "Properties of Matter," "The Particulate Nature of Matter," "Interactions of Matter," "Dissolving," "Solutions that Conduct Electricity," and "The Universal Solvent" sections in the *Content Background* document.
- Review the materials needed to create a circuit.



- Prepare the handout.
- Prepare a class chart that will be an extension of the Properties chart from Lesson 2. This chart will extend the rows for each of the five pollutants and the new columns will be titled, "pH," "Conductivity," "Turbidity," and "Temperature."
- Check to make sure the link to the PhET simulation works and set the simulation settings to show neon in a liquid state before beginning. If possible, zoom in your screen on the projector enough to cut off the menu that shows it's neon

• supplies to test each property
  ○ circuit for electrical conductivity: 3 alligator clips, 1 buzzer, 1 battery holder, 4 AA batteries (1 per class; groups will need to take turns using this)
  ○ Secchi disks for turbidity (1 per group)
  ○ pH strips cut into 1/2 or 1/3 (1 per group)
  ○ thermometer (1 per class; groups will need to take turns using this)
• blank 8 ½ x 11” or 11x17” paper for groups to draw models (1 per small group)
• Pencils or coloring supplies for models
• Tape or magnets to hang up expert groups’ models on the board
• chart paper and markers
• sticky notes
	instead of water to help students focus on the grade-level-relevant detail of the simulation—that matter is made of particles too small to be seen—rather than the molecular structure of water. The concepts of molecules and atoms are in middle school. We just use the term *particles* to stick to grade-level standards. Zooming in on the internet browser is not possible, so if you are not able to zoom in using the zoom on a projector, if students ask why you haven’t selected water, just note that neon shows us the type of model of particles that we develop in fifth grade.
	https://phet.colorado.edu/sims/html/states-of-matter-basics/latest/states-of-matter-basics_en.html

Lesson 3 General Outline

Time	Phase of lesson	How the science content storyline develops
3 min	**Link to Previous Lesson:** Review definition of *pollutant* and review the properties of each pollutant that students figured out last time.	
2 min	**Focus Questions:** Revisit the Lesson Focus Questions: **What might be in the water that could have killed the animals? What can we observe about each of those dangerous materials?**	
10 min	**Setup for Activity 1**: Look at initial (premixed) weight of salt and water separately and make predictions about the mass (or weight consistent with grade-level standard boundaries) when mixed. Find and discuss results.	Matter remains in water, even if it seems to disappear. We can show this by measuring the weight before and after mixing. When matter is mixed together, mass is conserved even when matter seems to vanish.
30 min	**Activity 1:** Use agreed-upon procedures to design the next stage of investigation (control, quantities of pollutant and water, time of mixing). Introduce procedures for each of the common tests for each group to complete and chart what each test will tell us. Test each mixture.	Some properties that can be tested when materials are mixed with water include electrical conductivity, turbidity, pH, and solubility.
15 min	**Follow-up to Activity 1:** Share results.	Properties are observable and measurable.
10 min	**Setup for Activity 2:** Revise zoomed-in model from the last lesson and then view and discuss a particle model simulation.	The matter in the water-pollutant mixture is made of particles too small to be seen.
10 min	**Activity 2:** Construct a particle model for matter. Have groups each construct a particle model of one of the pollutants.	Matter is made of particles too small to be seen, and these particles remain in the water even if we cannot see them. We can reperesent seen and unseen particles using models to show how the particles interact.
10 min	**Follow-up to Activity 2:** Wrap up by comparing models and introducing the terms *solubility* and *dissolve*.	Solubility measures a material's ability to dissolve into a solvent (usually water).
5 min	**Summarize and Synthesize:** Summarize the properties we now know about each of the pollutants. Discuss whether there are any we can eliminate from being in the pond water.	
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
3 min	**Link to Previous Lesson** <u>Synopsis</u>: Review definition of *pollutant* and review the properties of each pollutant that students figured out last time.	Link science ideas to other science ideas. (Slide 1-2)	In our last lesson, we learned what properties are, and we talked about the properties we observed of each of the five pollutants. **Can anyone remind me what the word *pollutant* means?** **What were the five nonpoint source pollutants we learned about last time?** Great. I'd like you to do a quick turn and talk to remind each other what properties we discovered about each of those pollutants.	Something dangerous to living things in the air, in water, or on land. Salt, dirt, fertilizer, detergent, and oil.
2 min	**Focus Questions** <u>Synopsis</u>: Revisit the Lesson Focus Questions we'll continue answering today: **What might be in the water that could have killed the animals? What can we observe about each of those dangerous materials?**	Set the purpose with a focus question. (Slide 3)	Today we'll continue with the same focus questions we began investigating last time: **What might be in the water that could have killed the animals? What can we observe about each of those dangerous materials?** **What have we learned so far that will help us answer our focus questions? What do we still need to figure out?** While we made several observations during our last lesson to begin learning about each pollutant, today we'll continue to investigate these pollutants to learn more about each one's properties.	We figured out properties of each pollutant. We didn't figure out how to test the pond water for each pollutant.

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
10 min	**Setup for Activity 1** <u>Synopsis</u> Look at initial (premixed) weight of salt and water separately and make predictions about the mass (or weight consistent with grade-level standard boundaries) when mixed. Find and discuss results. <u>Main science ideas</u>: Matter remains in water, even if it seems to disappear. We can show this by measuring the weight before and after mixing. When matter is mixed together, mass is conserved even when matter seems to vanish.	Ask questions to elicit student ideas and predictions. Engage students in analyzing and interpreting data and observations. Make explicit links between science ideas and activities (before activity).	***NOTE TO TEACHER:*** *Adjust the dialogue here depending on what students said about salt in previous discussions. If anyone raised a question about whether the salt is still in the water, bring up that question as something you'll investigate now.* In our previous lesson we noticed that salt disappeared in the water. **If it disappears, how do we know if it is still there?** We're going to do a quick investigation all together to figure out if the salt vanishes or if it is all still there. **If I were to weigh this scoop of salt and this cup of water before mixing them, how much do you think the mixture will weigh after I mix them together?**	I think it'll weigh the same amount as just the water because the salt disappears. **Why do you think that?** I think that since you can't see the salt anymore, it can't add any more weight. I think it'll weigh a little more than the water but not as much as the salt plus the water weight. Since it disappears, it'll be a little more but not as much as the whole weight.

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				I think it'll weigh the salt plus the water weight because you can just add them up.
			OK, let's try it out. (*Weigh each substance separately and note the weight of the salt, the water, and the cup. If there's time, have students turn and talk about their predictions for the weight when you mix the salt and water together. If there were a range of answers for the previous predictions, have a few share their reasoning. Mix the two together and weigh the total in front of the students.*) It looks like the total of the weight of the salt plus the weight of the water is the same or about the same as the two substances mixed together. **Does that surprise anyone?**	
		(Slide 4)	**Can anyone tell me what they think that means about what happens to the stuff that looks like it vanishes when we mix it in with water?**	It means it's all still there, but we just can't see it. **Can you tell the class how you figured that out?** When we make lemonade or put sugar in tea, the sugar disappears but we know it is there because it tastes sweet.
			NOTE TO TEACHER: *If anyone expresses any skepticism about whether the salt is still in the water, show students that you are pouring some of the salt water into a petri dish to check in an upcoming lesson. The water will evaporate and leave behind salt crystals, so you can provide evidence that the salt is still there. Alternatively, after the class learns about conductivity today, you can return to this mixture and test it for*	

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		(Slide 5)	*conductivity to demonstrate that the salt is still in the mixture.* That idea, that there's the same amount of stuff even when it seems to vanish, is an important science idea. Scientists call that *conservation of mass*. **Can anyone explain what *conservation of mass* means using an example of your own?** Now that we know some pollutants can still be in the water even though we can't see them, let's look at some other investigations we can do to identify pollutants.	
30 min	**Activity 1** <u>Synopsis</u>: Use agreed-upon procedures to design the next stage of investigation (control, quantities of pollutant and water, time of mixing). Introduce procedures for each of the common tests for each group to complete and chart what each test will tell us. Allow groups to conduct additional tests if they have time. Groups work	Engage students in communicating in scientific ways. Engage students in analyzing and interpreting data and observations.	During our last lesson we talked about how important it is for all our groups to use some of the same procedures while we investigate and making sure we use the same amounts for the variables we aren't testing. When we work together to design an investigation, this supports our Communicating in Scientific Ways row 10. We'll practice that row as we prepare for today's investigation. **What were some of the variables we talked about keeping consistent among all our groups?**	The amount of water we use. **Why is this important?** The amount of each pollutant we use. **What would happen if we didn't keep this the same?**

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	together to test each mixture. <u>Main science ideas</u>: Some properties that can be tested when materials are mixed with water include electrical conductivity, turbidity, pH, and solubility.		Those all sound like important variables to keep consistent so we can compare results across all our trials. **Did all of our amounts work in our last investigation (amount of water, pollutants, stirring, etc.)? Can we agree to use those same amounts, or are there any we have a reason to change?** ***NOTE TO TEACHER:*** *Capture the agreed-upon quantities on the board, so groups can reference the standardized amounts. If there was anything that didn't particularly work in Lesson 2, if a student doesn't bring it up, you may want to mention your concern and your reasoning to model the SEP of designing investigations.*	How much or how hard we stir it or mix it up. **What will stirring tell us about the material?** We should test the water all by itself and then test it with each pollutant. **Why is this important?** **Should we do all the tests for the water? Why/Why not?** We should record the same information in all our groups. **Where should we record this information?**

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		(Slide 7)	We have another video to learn about some tests scientists use to test water quality. ***NOTE TO TEACHER:*** *Show video. Model each of the tests—electrical conductivity, pH, temperature, and turbidity—using plain water as a student explains the process and supplement any needed explanation. Model recording the results of each test on a class chart that is an extension of Lesson 2's Properties chart. Students will capture their group's results on a data table or in their notebooks. Use the same expert groups as you did in the previous lesson. Groups will share out their results after their investigations like in Lesson 2.* Today we have the supplies to test for electrical conductivity, pH, temperature, and turbidity. If your group has other tests you want to run on your pollutant and water mixture for which we have the materials to do, you may do those investigations in addition to these that the whole class will do. Notice that we only have one circuit to test for conductivity and one thermometer. Your group will need to use those tools then put them back or share them with the next group who needs them. Your group will get one pH strip and one Secchi disk each, so you don't have to share those. **What**	

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			questions do you all have about how to do any of those investigations? Record your results on the data table *(Distribute HO3.1 to each student).* We can title this data table the same thing we did in our last lesson: Properties. Since properties are traits of a material that can be observed or measured, the properties we will be investigating are some properties that can be measured. Just like last time, you can record the results for your group's pollutant in one of these rows and write the same column headings along the top as I wrote on our class chart. Take a look at our materials station. You'll send one person from your group to get the supplies needed. When we're all done with our investigation, please be sure to put the materials back and clean up those that you use so that our station looks the same way that it does now. Let's plan to take 15 minutes for our investigations, then we'll share our results. **Any questions before we begin?** ***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 lead to consistent results among groups. In addition to*	**What are you discovering about the pollutant as you test it?** **What did you observe that told you ___ did or did not conduct electricity?** **Is there one test in particular that you think would help you identify if there is ___ in the water? Why would that test help?**

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			process questions, ask questions to the groups about how they're understanding and interpreting the data and observations they're collecting. *At some point during the lesson, a student might comment on temperature as a measure that doesn't make sense since the water has changed temperature since it was collected. Draw attention to this with the whole class and note that it's important as scientists to consider which tests make sense to run for different investigations. This is a moment to highlight the idea that in our case, since the water has been sitting in the classroom, it will not tell us anything meaningful about the pond. Note that while this is an important consideration when testing water quality in the field, this test will not help us learn more about the samples in the classroom.*	
15 min	**Follow-up to Activity 1** <u>Synopsis</u>: Groups share their results. <u>Main science idea</u>: Properties are observable.	Engage students in analyzing and interpreting data and observations.	OK, now that we've had a chance to test each of the pollutants mixed with water, let's share the results each expert group found. Let's consider whether we can add any ideas to our class Properties chart. Let's start with the plain water. **What did our class find in our investigation of our control substance?**	There was no electrical conductivity. It wasn't at all turbid. The pH was 7.

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			What did you find when you investigated the oil? ***NOTE TO TEACHER:*** *If any student or group asks questions about another group's results (or you note that they are incorrect), have the group quickly run the test again.* **What did you all discover about the dirt?** **What results did you find about the fertilizer?**	We found it didn't disappear in the water. It made little bubbles on the top then settled on top of the water in a thin layer. We noticed it didn't conduct electricity. We could see the Secchi disk clearly through the oil and water, so it wasn't turbid. The pH was 7. It didn't disappear in the water. It took a while, but it settled at the bottom and some floated at the top. It didn't conduct electricity. The water with the dirt was very turbid. The pH was 7. A little bit dissolved in the water. We know this because the water was blue. But there were some particles left at the bottom or floating on top. The buzzer went off. After we filtered it, it wasn't at all turbid. Before we filtered it, all the leftover stuff in the bottom made it turbid. The pH was 4.

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			What did your investigations show you about detergent?	The detergent and water mixture had a little electrical conductivity. The buzzer sounded a little or not much at all. /The detergent/water mixture didn't conduct electricity. We weren't sure if any of it was absorbed by the water. It didn't disappear because we could see it, but it did make the water cloudy. The water was really turbid. We couldn't see the Secchi disk at all. The pH was 5/6.
			And what did you find when you tested the salt?	The buzzer was loud! It all disappeared into the water/some sank to the bottom. It wasn't turbid at all. It looked like the plain water. The pH was 7.
			Thanks to your investigations, we've been able to add several ideas to our class chart about the properties about each of these substances. Next, we're going to consider whether our work together today can help us think about what these mixtures look like when we zoom way, *way* in.	

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10 min	**Setup for Activity 2** <u>Synopsis</u>: Students revise their zoomed-in model from the last lesson and then view and discuss a particle model simulation. <u>Main science ideas</u>: The matter in the water-pollutant mixture is made of particles too small to be seen.	Elicit student ideas. Engage in using content representations and models. (Slide 8) (Slide 9)	Let's take out the zoomed-in model you drew at the end of our last lesson. When you look at that model today, think about whether there's anything you want to add to or change in it. Think about the properties you figured out during these Lesson 3 investigations and how you could represent any of those in your model. If there are any changes you want to make, go ahead and do that now. I'm going to offer you one model that scientists have developed about how they picture what water looks like when you zoom way, way in. ***NOTE TO TEACHER:*** *Show PhET States of Matter simulation with neon in a liquid state. We're leaving it as neon because fifth grade students don't need to understand the molecular structure of water. Instead, we just want them to think of water as being made of particles too small to be seen. See additional guidance in the "Ahead of Time" section on p. 2-3. When they start to represent mixtures with the pollutants, they should be thinking about the pure water in terms of particles that all look the same and the mixtures as a combination of water particles and different-looking particles to represent the pollutant. They should not combine the particles to make new particles that are a combination of water and a pollutant—at the smallest level, it should look like two distinct types of particles. When students have a chance to work in their expert group to*	

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			create a new model, this is the point after which students should start to incorporate the particulate nature of matter into their models. If they are not yet making that transition, referencing back to this PhET simulation can be a way to challenge their thinking.	
			What do you notice?	There are small parts, and they move. There isn't "liquid." It's all just little circles. They mostly stay at the bottom of the container. Every once in a while, one bounces up in the container. Sometimes the clump moves around and there's empty space there.
			This model shows pure water. **How do you imagine it would look different if it were showing water mixed with one of our pollutants?**	Maybe there would be two different shapes all mixed together. Maybe the circles would change since there are different things in there. They might move more or less. They could stick together or break apart.
			NOTE TO TEACHER: *If students don't have ideas at this point about how to represent a mixture, it may help for you to draw a model of a mixture with two different colors of dots with a key showing one color represents water and the other representing dirt. If you model it, do a think-aloud as explained in the next section. If you model this*	

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			here, you can skip it at the beginning of the next section. This example will support students when they work in a small group to create a new model. **What similarities and differences do you have in your model compared to the PhET simulation?** **What questions do you have about this model?** One important idea that scientists use when they picture any type of matter—including all these pollutants and water—is that all matter, all stuff, is made up of tiny particles too small to see. Water is made of particles that are so tiny that we can't see them even with our strongest	The water looks like a bunch of little dots. The dots are all moving around. The dots stay at the bottom of the container all together. There would be different-colored dots mixed in. But they wouldn't all be the same—the oil would be floating on top of the water and the dirt would be all mixed inside. Mine has dots for the dirt and other stuff, but the water is all one blob. I combined the dirt and water particles to make dirt-water particles. Those stay separate. Are the particles really blue? Could I see them with a really, really powerful microscope?

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			microscopes. That is also true about salt, dirt, oil, fertilizer, and detergent. It's the differences among all the types of little particles that cause the properties we identified when we mixed them together with water.	
10 min	**Activity 2** <u>Synopsis</u>: Construct with the class a particle model for matter. Have groups each construct a particle model of one of the pollutant and water mixtures. <u>Main science ideas</u>: Matter is made of particles too small to be seen, and these particles remain in the water even if we cannot see them. We can reperesent seen and unseen particles using models to show how the particles interact.	(Slide 10)	Let's consider a couple mixtures together, then each expert group will create a model that shows how your pollutant's particles behave or look when we mix them with water. Let's think about what it would look like if water were mixed with sand. **How could I show water particles mixed with sand particles in a model?** ***NOTE TO TEACHER****: If it helps students to have this visual, you may want to have a little sand and food coloring on hand to make each of these mixtures. As your students offer ideas, capture what they're describing. As needed, ask probe questions to make sure they're applying ideas they defined in the last two lessons about how they want to represent the properties.* *If students think the sand or food coloring particles would combine with the water particles to form a new, distinct particle, let them know that in Lesson 6 the class will get more evidence for why this isn't the case, but for now let students know that whether the particles combine is a really important idea that scientists have studied for a*	The sand would sink to the bottom and would separate from the sand. I think most of the sand would sink to the bottom, but the water would be a little cloudy from some of the sand particles floating around. **How could I represent that in our model?** You can make little blue dots for the water and little brown dots for the sand. **Tell me more about the brown dots. Where should I draw them in relation to the water's blue dots?**

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			long time. Let the class know that for all the mixtures they are investigating, the particles for each individual substance stay the same but that both types of particles are mixed together in the same container.	Some sand would be spread out throughout the water, but some would just sink right to the bottom. So, we should put some brown dots on the bottom and some mixed in with the water. **Could we see the sand when it's in the water?** Yes. **How should we represent that with our model?** Maybe we should make the sand a dark brown to really make it show up well. We could make the blue water like everywhere in the model and just show the brown dots of sand at the bottom. **If we make the blue "everywhere" will that match how water was represented in our PhET simulation?** No. **How could we make our model match the ideas we saw in the PhET simulation?** Instead of making the blue water everywhere, we should show that it's made of dots representing the particles that are too small to be seen.

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			Great! OK, at your table groups discuss how you would represent a mixture of water and food coloring. In 2 minutes, each group will share some ideas. Now that we've talked through how to represent these other mixtures, with your expert groups you are now going to make a model that shows your pollutant mixed with water. You have 5 minutes to create this model. The final step of our model will be to make a caption that explains that thinking. We're going to write some pairs of sentence stems. The first sentence stem is "We showed ...." We'll draw a circle around a part of our drawing that represents an important idea about properties. For example, in this one we could write, "We showed the sand particles as dark brown." And we'll draw a circle around one of our sand particles and connect it to this sentence. The next sentence stem we'll use is "This represents …" or "We drew this to show ...." In this example we could write, "We drew this to	The particles of blue for the water and red for the food coloring would all be mixed together. We said the particles would become purple to show that they're mixed together. No, but remember how we said that in all these mixtures, the particles would still be two separate kinds of particles that are mixed in with each other?

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			show that sand doesn't disappear when it's in water." **Any questions about your task?** ***NOTE TO TEACHER:*** *Hand each group either an 8 1/2 x11" or 11x17" sheet of blank paper. As the groups work, circulate and ask questions to help them refine their thinking around their captions. If they want to show anything that relates to pH or electrical conductivity, you can let them know they don't need to go too much in depth considering those. Rather, focus probe and challenge questions on the properties that came from the visible observations they made.* *Also pay attention to whether groups are modeling the matter as "stuff made of tiny particles" or "stuff with some tiny particles in it." If it looks like they're still thinking about matter as "stuff with tiny particles in it," offer a challenge question about whether their model shows the same idea that was in the PhET simulation—that all matter is made of particles too small to be seen. This is a key science idea and one that can be tough for students to synthesize. This is the point in the lesson sequence where we want to challenge students to apply this idea.* *The use of the crosscutting concept of "scale, proportion, and quantity" can be useful in this discussion to emphasize the point that what we observe at the macroscale (the water-pollutant*	**Can you tell me about your model?** **Why did you choose to represent the ___ (pollutant) like this?** **Which property or properties does your model show?** **I notice you colored the background blue in your model. Can you tell me more about what that shows?** That shows the water. Then we drew little dots to show the ___ (pollutant). We drew a line along the top, showing oil. **How is your representation similar to and different from the PhET model we looked at together?**

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			mixture in the cup) can be explained at the microscale (the particles of water and of the pollutant and how they interact).	
10 min	**Follow-up to Activity 2** <u>Synopsis</u>: Wrap up by comparing models and introducing the terms *solubility* and *dissolve*. <u>Main science idea</u>: Solubility measures a material's ability to dissolve into a solvent (usually water).		You all included a lot of details in your models. Let's start by putting all the models on the board and gathering around them to take a look at how other groups represented the particles in their mixtures. Let's keep our Communicating in Scientific Ways sentence stems in mind. **Does anyone have a clarifying question or an observation about another group's model?** ***NOTE TO TEACHER:*** *Have a few students share but keep this part of the conversation brief. If nobody else says it, note that you see their models show that matter is made up of particles too small to be seen.* I notice that groups represented the properties we've been discussing in several different ways. One big difference I notice is how salt is represented compared to the other pollutants. **Can a representative that group tell us about why you represented salt like you did?** Last time, we noted that even though the salt seems to vanish, it's still there. When a substance seems to disappear when mixed into water, we say it *dissolves*.	

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
			There's a key science idea called *solubility*. Solubility is a property of substances. If something dissolves, we would describe that substance as soluble. If it dissolves very easily, we say it's very soluble. **Can anyone give me an example of a pollutant that dissolved very easily in the water?** Yes, so, salt is very soluble. We see that the groups represented the salt in their models as no longer visible. We know the salt is still there, even though we can't see it, because we weighed the materials and they weight the same before and after mixing. Now, if a substance doesn't dissolve very quickly or easily, we say it's not very soluble. **Can anyone give me an example of a pollutant that didn't dissolve very quickly or easily in the water, but it did dissolve a little?** Right. So, fertilizer isn't very soluble. When something doesn't dissolve at all, we say it's *insoluble*. **Which of our pollutants didn't dissolve at all in the water?** That's right. So, oil and soil are insoluble. Solubility is another property we can use to describe our pollutants.	Salt. Fertilizer. Soil. Oil.

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
5 min	**Summarize and Synthesize** <u>Synopsis</u>: Summarize the properties we now know about each of the pollutants. Discuss whether there are any we can eliminate from being in the pond water.	Engage students in using and applying new science ideas in a variety of ways and contexts. (Slide 11)	You all identified several properties of each of these pollutants through your investigations and you showed how those properties can be represented when we think about matter as made of particles that are too small to be seen. If we revisit our pond water and the pollutant properties you all identified, I'm wondering whether there are any of the pollutants we can eliminate at this point based on the properties we've investigated**. Does anyone have any ideas?** ***NOTE TO TEACHER:*** *Some students may be wary of crossing off any pollutants. If this is the case, invite them to consider what other tests they'd need to run to feel confident eliminating those options. They may suggest mixing soap and oil with water in case multiple pollutants change the properties. If this is quick and easy to investigate, you may want to let them conduct an investigation individually and report the result, if that will help them move forward in the storyline. If these proposed investigations are quick enough, they may be able to do them on the spot, but if you're running low on time, they may need to do these investigations either before the next science class or at the very beginning of class. Some students may want to eliminate fertilizer at this point because of the property of color. If you can keep fertilizer in the mix at this point (by offering that not all fertilizer is the same color), it will give*	We can eliminate dirt. **Why do you say we can eliminate dirt as one of the pollutants?** Because we'd be able to see dirt since it doesn't dissolve. We can eliminate oil because it sits on top of the water, and there isn't any oil on top of the pond water. We know it's detergent because we can see that it's cloudy. **What do others think? Can we end our investigation and conclude that it's just detergent in the pond water?** I guess there could be other pollutants in the pond besides

<table>
<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>them additional ideas to wrestle with and additional evidence they'll need to collect in Lesson 5. If the class reaches consensus that fertilizer isn’t in the water, you can cut that from the Lesson 5 investigation and the investigation will still work if the only remaining potential pollutants are salt and detergent.

You all have done a lot to get us closer to figuring out what’s in the pond water.</td><td>detergent. But it does look like detergent is in there.</td></tr>
<tr><td>5 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
Now that we have figured out some information about our focus questions, we will use a Progress Tracker to summarize our learning.

In your notebook, make a T-chart with a column for our focus questions and a column for what we figured out. I’ll make the same chart up here.

<table>
<tr><th>Questions</th><th>What I figured out</th></tr>
<tr><td>What might be in the water that could have killed the animals?

What can we observe about each of those dangerous materials?</td><td>There are several tests we can run to tell whether there are dangerous materials—detergent, dirt, fertilizer, salt, or oil—in the water. We can observe the water. We can test for electrical conductivity, turbidity, and pH.</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)	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 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, you can make the link between this lesson and the following lesson.* In our next lesson, we'll think more about salt and how it dissolves in water. Our next focus question is **What factors affect how quickly soluble solids dissolve into water?**	