

Water Interview Fall 2010

Interview ID Number
School
Grade
Teacher
Student's Initials

Water Student Interview Fall 2010

Interview protocol for middle and high school students, pertaining to the movement of water and substances in water. Questions are directly related to questions on the written water student assessment.



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**Culturally relevant ecology, learning progressions and environmental literacy
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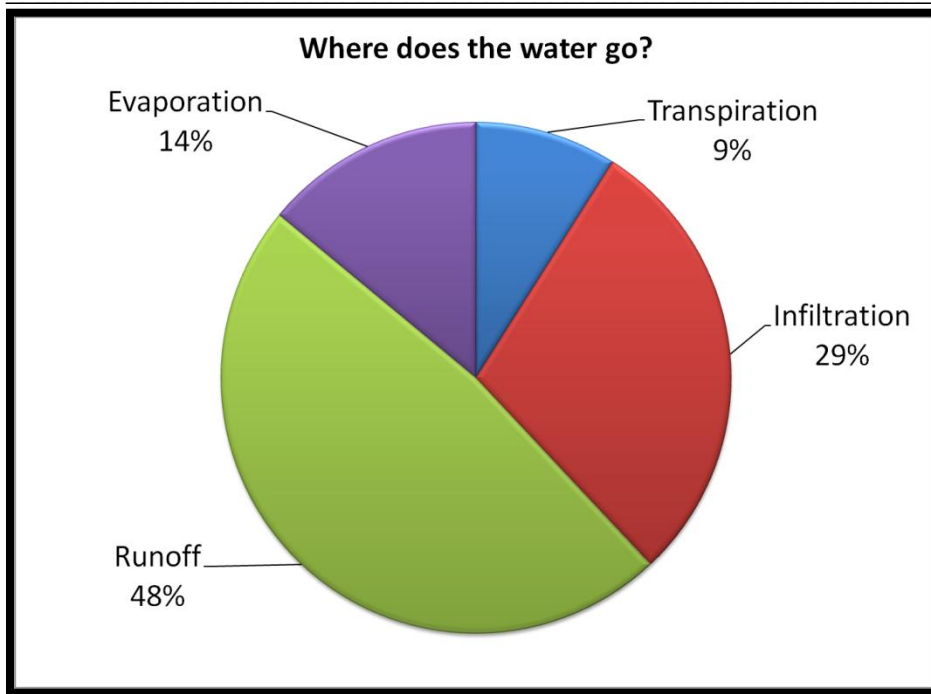


Pie Chart Cluster

The pie chart below describes where water goes on your school grounds when it rains. Use the chart to answer questions 1 and 2 below.

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Imagine that your school has decided to replace part of the school parking lot with an open space of grass and trees.

1. **Circle the percentage that you think is the best prediction for how much of the water will infiltrate after the school parking lot is replaced with grass and trees.**

(Circle one) 36% 17% 29%

Explain why you chose your answer.

Interview Questions

1. If the student says that she/he does not understand what any of the words mean, it is ok to provide a few definitions.
 - a. Infiltrate means that the water moves into the ground. Infiltration is the process of water moving into the ground.
 - b. Transpiration means water moving out of plants into the atmosphere.
2. Please explain in your own words what this graph shows.
 - a. Probe for student understanding that the pie chart is a representation of where water goes on the school yard and how much water goes there. Also probe for understanding of connections between groundcover and the amount of water that might follow each process.
 - i. What do these colored sections represent?
 - ii. What do these numbers mean?
 1. How do we decide how big to make a section or the numbers?
 - iii. What happens if we change the size of one of these sections? What happens to the size of the other sections?

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- iv. What are some reasons why we might change the size of these sections?
 1. Probe for understanding of the relationship between what happens on the school yard and what is represented in the pie chart.
 - a. What might happen to the size of this section [point to infiltration section] if more water infiltrates into the ground and everything else stayed the same?
 - b. What might happen to the size of this section [point to the infiltration section] if there is more evaporation into the air and everything else stayed the same?
3. Please tell me more about all of the differences you can think of between a parking lot and a space covered with grass and trees.
 - a. What happens to water on a parking lot? Where does the water go? Why?
 - i. Probe for understanding of permeability.
 - ii. Probe for understanding of infiltration and where water that infiltrates goes. You may ask students to draw a picture.
 - iii. Probe for understanding of evaporation and where water that evaporates goes. You may ask students to draw a picture.
 - iv. Probe for understanding of runoff and where water that runoff goes.
 - b. What happens to water on a grassy surface? Where does the water go? Why?
 - i. Probe for understanding of permeability.
 - ii. Probe for understanding of infiltration and where water that infiltrates goes. You may ask students to draw a picture.
 - iii. Probe for understanding of evaporation and where water that evaporates goes. You may ask students to draw a picture.
 - iv. Probe for understanding of runoff and where water that runoff goes.
 - v. Probe for understanding of transpiration and where transpired water goes.
4. Do you still agree with the answer you wrote? Why or why not?
 - a. Some students wrote explanations that do not match their choice of percentage of water. Do not point this out but give them the opportunity to reason through their answer.
 - b. Some students may change their mind after talking about where water goes. Give them this opportunity and be sure to probe why they would change their mind. Probe their reasoning about where the water goes and how it gets there.
5. If you look at the pie chart above and you changed the size of the section that represents infiltration to the number you selected here, which of the other sections do you think will change? Why?
 - a. Have the student redraw the pie chart to show the changes that the student suggests happen. (This is a higher level question; ask if you have indications that the person is at level 3 or level 4).

Pie Chart Cluster Continued

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2. Do you think the percentage of water that will evaporate will be greater than, less than, or stay the same as the percentage of water that evaporated before the parking lot was replaced?

(Check one)

A GREATER percentage will evaporate

A SMALLER percentage will evaporate

THE SAME percentage will evaporate

Explain why you chose your answer.

Interview Questions

1. Tell me what (greater percentage, smaller percentage, same percentage – depending on what student wrote) means.
 - a. Probe for understanding of relationship of percentage to volume of water. (e.g., greater percentage means more water evaporates, etc.)
2. Tell me more about the answer that you wrote, about why you chose your answer.
 - a. You might be able to use responses to interview question #3 above to further probe this students' answers.
3. What are some variables (factors) that affect how much water evaporates into the air?
 - a. Probe for understanding of the role of permeability, temperature, relative humidity, groundcover.
 - b. Probe for role of plants in moving water into the atmosphere.
4. If you were to assign a number to represent what you said would happen (greater, smaller, stays the same) in this situation, what number would it be? Tell me why you chose that number.
5. If you look at the pie chart above and you changed the size of the section that represents evaporation to the number you selected here, which of the other sections do you think will change? Why?
6. Compare what you said would happen to infiltration to what you think will happen to evaporation. Have the student re-draw the pie chart to show both changes.
 - a. Do you think these two answers make sense together?
 - b. Tell me more about how infiltration can (increase/decrease/stay the same) and evaporation can (increase/decrease/stay the same time). How can this happen?
 - i. Probe for whether or not students see that increases in the volume of water moving through one or more variable requires decreases in the volume of water moving through other processes.

7. Do you still agree with the answer you wrote? Why or why not?

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- a. Some students wrote explanations that do not match their choice of percentage of water. Do not point this out but give them the opportunity to reason through their answer.
- b. Some students may change their mind after talking about where water goes. Give them this opportunity and be sure to probe why they would change their mind. Probe their reasoning about where the water goes and how it gets there.

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Soccer Game Cluster

Your soccer game gets canceled at half time due to a massive down pouring of rain. As you run for cover, you notice that there are large puddles forming on the grass covered playing field, but no puddles forming in the sand covered playground just a few steps away.

3. **Where could the water landing on the sandy playground be going?**
4. **How does the water on the sandy playground get to where it's going?**
5. **The next week you come back to the soccer field and you notice there is no water on the grassy field. Where is that water now?**

Interview Questions

- Probes for where the water goes.
 - Sand Absorbs Water
 - Tell me more about what you mean when you say the sand absorbs the water. What is happening?
 - When you say that the sand absorbs the water, tell me where the water is. (probe to see if the water is inside the sand or in between the sand grains).
 - Please draw a picture of what the water looks like in the sand.
 - How does the water get into the sand?
 - What happens to the water after it goes into (or is absorbed by) the sand?
 - Water goes to the groundwater:
 - Tell me more about what groundwater is.
 - Please draw a picture here of what groundwater looks like.
 - What happens to the water after it goes into the groundwater.
 - Is there anything that would prevent the water from reaching the groundwater?
 - Water goes into/ is used by/ is absorbed by the grass or plants.
 - Tell me more about what you mean when you say that the grass absorbs the water (or the water is used by the plant, etc).
 - Where does the water go?
 - How does the water get into the grass/plant?
 - Where does the water go after it is in the grass/plant?
 - Water evaporates
 - Where does the water go when it evaporates?
 - Tell me what happens when water evaporates.
 - If the student talks about molecules, ask
 - What happens to the water molecules when water evaporates?

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Soccer Game Cluster Continued

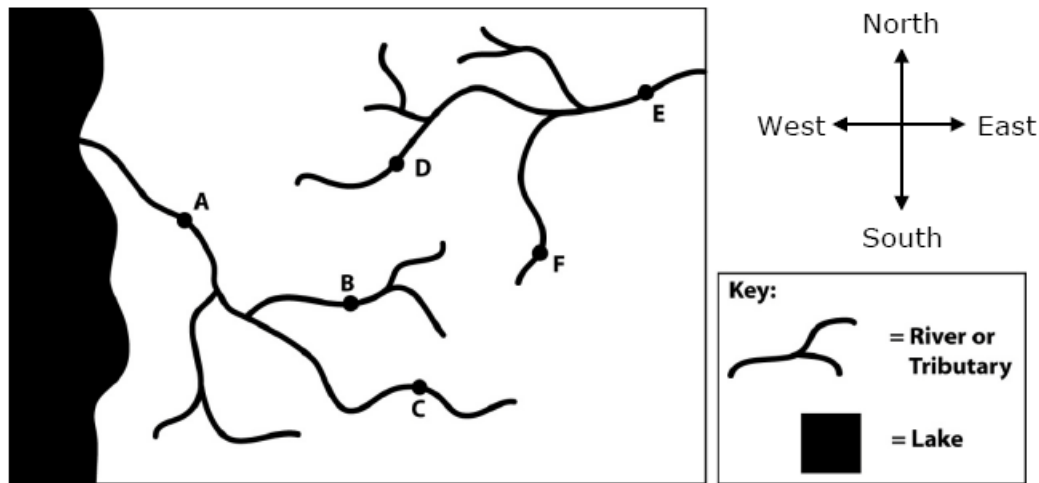
- Water goes into the air/atmosphere/clouds
 - Tell me more about how the water gets into the air/atmosphere/clouds.
 - Please draw a picture of what the water looks like in the air/atmosphere/clouds.
 - Where does the water go after it is in the air/atmosphere/clouds.
 - If the student talks about molecules, ask
 - How do the water molecules get into the air?
 - What is the difference between water molecules in the air and water molecules in the puddle?
- Is there any place else the water could go? (use probes above to follow-up)
- Probes for how water gets to where it is going (if not covered in above probes)
 - Please tell me what you mean by infiltration/draining/soaking. Describe what happens.
 - How long do you think this takes?
 - If the student mentions pores or pore spaces or spaces between sand particles
 - How big are these spaces?
 - How does the water get from one space to the next?
- Why do you think there were puddles on the soccer field and not on the sandy playground?
 - What is different about the soccer field and the sandy playground?
 - Please draw a picture of the difference between the soccer field and the sandy playground
 - Use probes above for where water goes in the sandy playground, as necessary?
 - If student mentions that the grassy field is denser, harder, or has more clay or is less permeable:
 - Please tell me what you mean by _____
 - How does that affect where the water goes?

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River Map Cluster

Use the map below to answer questions 6 and 7.



6. Can pollution in the river water at point B get to point C? (circle one) Yes
No
Explain why or why not.

Interview Questions

- Have the student complete the questions in writing and show you what they have written.
- Start by asking the student if they've learned about using maps that show rivers either in school or out of school? If they say yes, ask them to talk about when they learned about maps that show rivers (Was it in geography class? At home with parents?), and ask about what they learned. Does the student use maps in their everyday life at all outside of school? If yes, what's an example?
- Probe students' responses to the question by asking "how can you tell by looking at the map?" questions for responses such as...
 - The points are connected by the river
 - Water flows to connected places
 - Big water flows into small water
 - Small water flows into big water
 - Water flows in both directions
 - Rule of V's
 - Etc.

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River Map Cluster Continued

- If students provide answers such as water flows downhill or water flows from high elevation to low elevation, ask students how they can tell from a map what is the top/bottom of the hill and/or where there is higher elevation or lower elevation on the map.
 - If student says that it will “depend on the current” ask them if we can tell which way the current is moving, and how that works?
 - If student says that the pollution can get to point C by groundwater, ask them if we can tell which directions groundwater will move underground, and how that works?
- 7. Draw an arrow showing the direction water is flowing away from point F. How do you know the water is flowing this direction?**

Interview Questions

If the student responded that...

- Water is moving down the page or south toward a place with a dead end or the place where the water (line) stops, ask what happens to the water when it gets to the place where the line stops?
- Water is moving downstream, ask how they can which way is upstream and which way is downstream.
- They can tell the direction because of the compass, ask how the compass tells the direction of the water --- how does that work?
- They can tell the direction because of slope or hills, ask where they think the top of the hill/slope is on the map, and how they can tell where the higher part of the slope/hill and the lower part of the slope/hill are by using the map.
- They can tell the direction because of elevation or topography, ask how they can tell what areas are higher or lower by looking at the map.
- Why doesn't the river that point B is on connect to the river that point F is on?
- If the student hasn't mentioned the term gravity, ask the student “tell me about what causes water to flow in a river?”
- Ask student, “which point do you think is at a higher elevation, D or E? Why did you choose this point?”

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- Finish by asking the student to draw arrows on the map showing which way water is flowing from the other points on the map besides F. Ask the student how they can tell which way the water is flowing from the points.

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Substances Cluster

The picture below shows part of a school campus with several grassy playing fields near a river. Use the picture to answer questions 8, 9 and 10.



8. A. If the playing fields were treated with fertilizer, do you think that some of the fertilizer could get into the river?

(Circle one) YES NO

If you think yes, describe how fertilizer could get into the river. If you think no, describe why fertilizer would not get into the river.

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Substances Cluster Continued

Interview Questions

Start by asking the student to talk about whether they've ever learned about fertilizer (either in school or out of school)? If yes, where did they learn about fertilizer and what do they know about fertilizer? What do people use fertilizer for? If student mentions that fertilizer helps plants grow, ask the student to explain how.

If the student responds to the "could some of the fertilizer get into river question"...

- With an informal mechanism (e.g., the water will push from the surface of the fertilizer or the fertilizer will blow into the river), ask the student to tell you more about how that works.
- That the fertilizer cannot go into the river, ask, what happens to all the fertilizer that gets put on the grass?
- By talking about runoff or fertilizer seeping into the river ask the student to tell more about how that works...
 - You mentioned that the fertilizer could run off across the grass/seep into the ground and get into the river. Are there any other paths the fertilizer could take to get into the river?
 - Does it matter if it's a sunny or a rainy day? Why?
 - If you were standing on the field and fertilizer was running off to the river, do you think you would be able to see the fertilizer running down toward the river? Why or why not? What would it look like?
 - If the student mentions fertilizer moving underground to the river, ask them to draw a picture of what it looks like underground where fertilizer is getting into the river.

9. What is in the fertilizer that could get in the river? (In other words, what is fertilizer made of?)

Interview Questions

If the student responds...

- That fertilizer is made of "fertilizing stuff" or "dirty stuff" or other non-specific answer that doesn't indicate idea of substances, ask student "can you think of any ingredients that go into making fertilizer?"
 - Also ask, what do you think would happen if you mixed fertilizer with water? What would happen to the fertilizer? What would it look like?
 - People usually water their lawn after they put fertilizer down. Can you think of any reasons why that might be?
- By mentioning (non-specific) chemicals, ask student to talk about, "what are chemicals?" You can also ask:
 - Are all chemicals made by people?
 - Are all chemicals bad?
 - Can you think of any one chemical that is in fertilizer?

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Substances Cluster Continued

- Why would people use chemicals as fertilizer?
- What do you think would happen if you mixed fertilizer with water? What would happen to the fertilizer? What would it look like?
- People usually water the lawn after they put fertilizer down. Can you think of any reasons why that might be?

- By mentioning pesticides or toxins, or visible objects such as soil, dirt, mud, poop, manure ask the student “why do they put that into fertilizer?” And, “are there any other ingredients in fertilizer that you know of?”
 - Also ask, what do you think would happen if you mixed fertilizer with water? What would happen to the fertilizer? What would it look like?
 - People usually water their grass after they put fertilizer down. Can you think of any reasons why that might be?

- By mentioning compost, ask student “what is compost? What’s in compost? Why do people use compost as fertilizer?”
 - Also ask, what do you think would happen if you mixed fertilizer with water? What would happen to the fertilizer? What would it look like?
 - People usually water their grass after they put fertilizer down. Can you think of any reasons why that might be?

- By mentioning specific substances in fertilizer by chemical identity (e.g., nitrogen, potassium, phosphorus, etc.)...
 - Ask why they put that into fertilizer?
 - People usually water their grass after they put fertilizer down. Can you think of any reasons why that might be?
 - Also ask, what do you think would happen if you mixed fertilizer with water? What would happen to the fertilizer? What would it look like?
 - If the student mentions molecules, probe about what happens to the molecules.
 - Ask, if someone mixed fertilizer with water, do you know if it would form a solution or a suspension? If student says yes:
 - Ask how do you know?
 - If you wanted to think about whether fertilizer could get into the river, do you think it would matter if fertilizer was in solution or suspension? Why?
 - Do you think it matters for helping the plant grow whether the fertilizer is in solution or suspension? Why?
 - If student just mentions one or two chemical substances, ask if they know of any other ingredients in fertilizer.

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Substances Cluster Continued

10. If some fertilizer got into the river water, do you think that would make the river water better or worse?

(Circle one) BETTER WORSE

If you think better, describe how you think the fertilizer would improve the water. If you think worse, describe how you think the fertilizer would harm the water.

Interview Questions

If the student responds...

- That fertilizer is good for or would help the water without further explanation, ask the student to tell more about how fertilizer helps water.
- That fertilizer is good for water because it helps things live and grow, ask the student to talk about whether the fertilizer is good for all living things, or just some things? Ask, is there any reason you would not want to have fertilizer in river water?
- That fertilizer harms the water by talking about an informal mechanism such as by putting chemicals into the water or polluting the water, ask the student to talk more about why that would be bad for the water. Talk more about what would happen to the river if fertilizer got into it? Would the river water look different? How? Would the things that live in the river be affected? How?
- That fertilizer harms the water and explains with a school science story (e.g., change the biology of the river) ask the student to explain more about how that would work. How would the river water be different before and after the fertilizer got in? How might the living things like plants and animals in the river be affected by the fertilizer?
- That fertilizer harms the water and explains with a narrative about eutrophication, ask the student to say as much as they can about how that works.

Ask the student

- If you worked at this school and were in charge of taking care of the playing fields for the sports teams, would you put fertilizer on the fields? Why or why not?
- What do you think are some of the pros and cons of using fertilizer on the playing fields?
- Can you think of any ways you could use the fertilizer to minimize the drawbacks while maximizing the benefits? (Can you think of any ways you could use the fertilizer to help keep the playing fields in good shape while also protecting the nearby environment?)

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Tree Cluster



Like many rivers, the Sturgeon River in northern Michigan has lots of large trees growing along its banks.

- 11. A large tree can use 200 gallons of water a day. Where do those 200 gallons go? Please fill in the table below. List all the places the water could go. (List one place in each row. Use as many rows as you can)**

List all the places the water could go. (List one place in each row. Use as many rows as you can)	How does it get there?	How much of the water that the tree uses would go there? (all, most, half, a little) Circle one for each row.	
		All	Most
		Half	A little
		All	Most
		Half	A little

Interview Questions

- Probes for where the water goes
 - Atmosphere/Air - Transpiration/evaporation
 - Tell me more about how that works (evaporation, transpiration).
 - How does the water get there
 - Is the water in the air/atmosphere different from the water in the tree? (probe for phase changes)
 - If the student refers to microscopic or atomic-molecular scale
 - What happens to the molecules? (probe for phase changes)

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- How much water moves through the tree this way?

Tree Cluster Continued

- Why do you think that?
- How would you know?
- Photosynthesis/respiration
 - Please tell me more about how water is part of photosynthesis/respiration.
 - What happens to the water? (probe for whether or not student can describe this process at an atomic-molecular scale).
 - What is made?
 - Where does the water go?
 - How much water is used in photosynthesis/cellular respiration?
 - Why do you think that?
 - How would you know?
- Water is stored in or goes to leaves/trunks/stems/roots
 - How does the water get there?
 - What happens to the water when it gets there?
 - How much water goes there?
 - Why do you think that?
 - How would you know?
 - If student mentions rigidity/turgor/turgidity
 - How does this work?
 - How much water is required?
 - Does the water stay there?
- Other locations not part of the tree – probe the possibility that the student did not understand the question and the possibility that the student does not consider the tree to be part of the water cycle.
 - What does it mean that the tree uses 200 gallons a day?
 - What would the tree use the water for? (use probes above as necessary)
 - How would it get there?
 - Tell me more about how the water gets to the (ocean, soil, rivers, etc.)
 - How does the water get there?
 - Can it go through the tree to get there?
 - Please tell me how that would happen.

12. What would happen to the amount of water in the river if all of the trees died or were cut down? Be sure to give reasons for your answer.

- Probes for where the water goes
 - Water is absorbed by the trees/ is used by the trees/ trees drink the water
 - Please tell me what you mean when you say (the trees absorb the water, the trees use the water, etc.)

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- How does the water get into the trees?

Tree Cluster Continued

- What happens to the water once it is in the trees (or the trees drink the water)?
- Water evaporates
 - Please tell me more about what you mean when you say that the water evaporates.
 - What happens to the water?
 - Where does it go?
 - How does it get there?
 - If the student mentions molecules
 - What happens to the molecules?
 - Why does the water evaporate faster without the trees?
- Probes for floods/increased runoff/river spreads out/river is gone because trees are gone
 - Please tell me more about why the river will flood.
 - How do the trees prevent flooding?
 - What do the trees do to the water?
 - What do the trees do to the banks of the river?
- Probes for other answers
 - Tell me more about that. Please explain what happens.
- Probes for other effects
 - What else might happen?
 - Please tell me more about that. (see probes above)
- Probes for amount of change
 - How much do you think that (trees using water/ increased runoff/ etc.) will affect the river? Will it be a big change or not a big change?
 - Why do you say that?