

ENVIRONMENTAL LITERACY CARBON INTERVIEW

FORM B

Please start by briefly introducing yourselves---include the idea that you are a member of Environmental Science Literacy Research Project from MSU. Then, briefly explain the purpose of the interview: In our work, we seek students' ideas about such processes as tree growth, girl growth, girl running, dead tree decaying, flame burning, car running, lamp lightening, and cross processes. Our goal is to use these ideas to design classroom tools/materials for use in teaching and learning science. The purpose of this interview, therefore, is to seek your help in terms of your ideas about some of these processes. Please feel free to ask questions at any time during the interview.



Next, please write down the student's names, grade (and age) here below---you may ask the student to help you spell his/her names. At this point, you may proceed to the interview items (Page 2).

Name _____ Grade _____ Age _____

The questions highlighted in green are for higher level students.

It is possible that you may not be able to finish all the interview questions.

--- BABY GIRL GROWTH ---
A Baby Girl Growing

 <p><small>1000 Words Photography</small></p>	
<p>The baby weighed 22 lb when she was 5 months old.</p>	<p>The baby has grown into a big girl, weighing 50 lb.</p>

Actor: Girl's body

Enablers: food, water, air, exercises, sleep

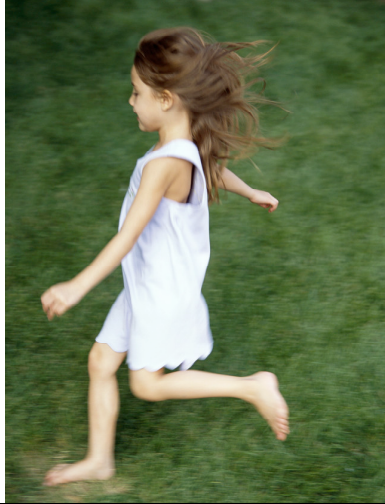
1. What does the baby need in order to grow?
2. You said that the baby needs **[food, water, air, exercises, sleep]** Follow up probes about each enabler.
 - a. How does [the enabler] help the baby to grow?
 - b. What happens to [the enabler] inside the baby's body?
 - c. Is [the enabler] used up to help the girl to grow? Does it change into other things inside the girl's body? Or, do you think it will not change inside the girl's body?
 - d. Does the baby use [the enabler] for energy? How does that work?
 - e. Some people say that the tree does not use air (or oxygen if the student mention it before) to grow the materials of her body. Do you agree? Why?
3. Follow-up probes on enablers not mentioned
 - a. Some other students have mentioned [other enabler]. Do you think [the other enabler] is necessary for the baby growth?
 - b. [If yes, same probes as for other enablers.]
 - c. [If no] Why not?
4. Scale
 - a. Do you think that the baby is made of cells?
 - b. Do you also think that the baby girl's body is made of molecules? Why?
 - c. You said that the girl's body is made of both cells and molecules. How are the cells and molecules related? How does that happen?
5. Matter
 - a. The baby gets heavier as she grows. How does that happen?
 - b. Where do the increased materials come from?
 - c. Do you think the girl's body can naturally create more and more materials? Why? [If no], why can't the girl's body create materials?
 - d. Do you think the increased materials of the girl's body are changed from things outside of her body? [If yes], how do these things change into the girl's body structure
 - e. [If the student mentions glucose/starch/cellulose/carbohydrates, ask]: Do you think it contains carbon atoms? If yes, where do the carbon atoms come from?
6. Energy
 - a. Does the process of baby growth require energy?
 - b. [If yes], where does the energy come from?
 - c. Why do you think the things you mentioned have energy?
 - d. [If the student associates energy with food, ask]: Where does the energy of food go? Is it used up? Does it change into materials? Or, is it still energy? Where is it?
 - e. Do you think the baby stores energy inside her body?

- i. [If yes], where does the baby store energy? In cells? In molecules?
- ii. [If yes], where does that energy come from?
- f. If students do not mention digestion, ask: Is there any connections between the things you mentioned and digestion?

7. Citizenship and Argumentation

- a. You said that ----- [summarize key claims about how a baby girl grows, especially about what is happening inside her body, including changes in matter and energy]. Did I summarize what you said correctly?
- b. Suppose a friend said, 'I don't believe you.' What would you say to convince your friend that you were right?"
- c. Is there anything that you have observed about people growing that provides evidence that you are right? How does that evidence show that your reasoning is correct?
- d. Could you suggest an experiment or investigation that would show whether you are right? What would you expect the results of your investigation to be? How would those results show that you are right?

--- GIRL RUNNING ---
A Girl Running



Actor: Girl
Enablers: food, air, water

1. What does the girl need in order to run?
2. You said that the girl needs **[food, water, air, sleep]**. Follow up probes about each enabler.
 - a. How does [the enabler] help the girl to run?
 - b. What happens to [the enabler] inside the girl's body?
 - c. Is [the enabler] used up? Does it change into other things? Or, do you think it does not change?
 - d. Does the girl use [the enabler] for energy? How does that work?
3. Follow-up probes on enablers not mentioned
 - a. Some other students have mentioned [other enabler]. Do you think [the other enabler] is necessary for the girl growth?
 - b. [If yes, same probes as for other enablers.]
 - c. [If no] Why not?
4. Breathing:
 - a. Do you think breathing helps the girl to run? Why?
 - b. Do you think moving and breathing are related events? Why?
5. Warmth:
 - a. The girl will get hot when she runs. How could that happen?
 - b. You mentioned about heat. Do you think heat is energy? Where does heat come from?
6. Scale
 - a. Do you think that the girl's body is made of cells?
 - b. Do you also think that the baby girl's body is made of molecules? Why?
 - c. You said that the girl's body is made of both cells and molecules. How are the cells and molecules related? How does that happen?
7. Matter
 - a. The girl lost weight after she ran everyday for a month. How does that happen?
 - b. Where do the lost materials go? Are they used up? Do they change into other things? Why?
 - c. Does the event of girl running change the air? How does that happen?
 - d. [If the student mentions carbon dioxide from breathing, ask]: Do you think carbon dioxide contains carbon atoms? [If yes], where does the carbon atoms come from?
8. Energy
 - a. Does the process of girl running require energy?
 - b. [If yes], where does the energy come from?

- c. Why do you think the things you mentioned have energy?
- d. [If the student associates energy with food or body structure, ask]: Where does the energy of food/body go? Is it used up? Does it change into materials? Or, is it still energy? Where is it?
- e. If students do not mention cellular respiration, ask: Is there any connections between the things you mentioned and cellular respiration?

9. Citizenship and Argumentation

- a. You said that ----- [summarize key claims about girl running, especially about what is happening inside the girl's body, including changes in matter and energy]. Did I summarize what you said correctly?
- b. Suppose a friend said, 'I don't believe you.' What would you say to convince your friend that you were right?"
- c. Is there anything that you have observed about people running that provides evidence that you are right? How does that evidence show that your reasoning is correct?
- d. Could you suggest an experiment or investigation that would show whether you are right? What would you expect the results of your investigation to be? How would those results show that you are right?

--- USING ELECTRICAL APPLIANCES ---

Lamp lighting



Actor: lamp

Enabler: electricity

1. The lamp will not light if it is not plugged in. Do you know why?
2. What does the lamp get from the outlet? If the student mentions electricity or electrical energy, ask the following questions:
 - a. Why can electricity help the lamp to light? Can you use energy to explain that?
 - b. Do you think electricity is related to energy? If yes, what energy form is it?
 - c. Where does electricity come from?
 - d. [If the student mentions power plants ask]: Where do power plants get the energy from to generate electricity?
3. About 50% of electricity used in US comes from coal. Do you know how that happens? Can you use energy to explain this question? Where does the energy of coal come from?
4. [If the student mentions about burning coal, ask]:
 - a. Do you think coal has energy? Where does that energy go?
 - b. Do you think the coal changes into energy? Or do you think it changes into other things?
 - c. Do you think that using a lot of electricity will cause global warming?
5. Citizenship and Argumentation
 - a. You said that ----- [summarize key claims about how lamp lighting, especially about tracing energy back]. Did I summarize what you said correctly?
 - b. Suppose a friend said, 'I don't believe you.' What would you say to convince your friend that you were right?"
 - c. Is there anything that you have observed about electricity that provides evidence that you are right? How does that evidence show that your reasoning is correct?
 - d. Could you suggest an experiment or investigation that would show whether you are right? What would you expect the results of your investigation to be? How would those results show that you are right?

CROSS PROCESSES

COMPARE PROCESSES

1. Elementary, middle and high school students:

Pictures: Plant growth, A baby girl growing, Car running, Tree decaying, Wood/Candle burning, A girl running

- Each of these pictures is about a **process or change**. Can you divide the pictures into three groups in terms of process or change? Explain each group.
- Please re-group the cards. This time please sort cards in terms of how energy changes.
- Please re-group the cards. This time please sort cards in terms of how materials change.

2. Middle and high school students:

Pictures: Tree growing, A girl running, Tree decaying

- Think about the role of these processes in an ecosystem, can you sort these pictures into two groups? Explain each of the groups.

3. High school students:

Pictures: Plant growth, A baby girl growing, Car running, Tree decaying, Wood/Candle burning, A girl running

- Can you sort these pictures again? This time, please sort the pictures in terms of changes of matter and energy.

4. High school students:

Pictures: A girl running, Tree decaying, car running

- Can you think of a reason for putting these pictures together? If not, what processes can put together? Why?

5. High school students:

Tree growing, a girl running, tree decaying

- Can you think of a reason for putting tree growing separate from the other two pictures?

CONNECT PROCESSES

Show students all the pictures:

1. How are all these events connected?
2. How could they be connected in an ecosystem?
3. How are these processes connected in their ways of using and changing air?
4. How are they related to global warming?
5. How many pictures can you connect together? Please make as many connections as you can.

CARBON CYCLING AND ENERGY FLOW

Fluxes

1. Can you explain what these arrows mean to you?
2. How are the arrows alike and different? Do they all have the same meaning, or do some arrows have different meanings?
3. What does the arrow from trees to the coal represent? How is that like and different from the arrow from the boy and rabbit to the atmosphere?
4. Are there missing arrows on this diagram? Where?

Reservoirs

[These questions would make sense only if the student seems to recognize that the arrows all represent movements of carbon].

1. Where would you find carbon in this diagram?
2. Is the amount of carbon in the atmosphere getting larger, staying the same, or getting smaller?
3. How are the arrows connected to the amount of carbon in the atmosphere?
4. Do you think energy is also changing when carbon moves? [If yes], How does energy change? Please choose two arrows to explain.

Note: Do not ask questions about ocean-atmosphere carbon cycle.

Atmosphere

