

**ENVIRONMENTAL LITERACY CARBON INTERVIEW
FORM A**

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.

--- PLANT GROWTH ---

Tree Growing	
	
A small tree was planted in a meadow	After 20 years it has grown into a big tree, weighing 500 lb more than when it was planted.

Actor: tree

Enablers: sunlight, water, soil, and air

1. What does the tree need in order to grow?
2. You said that the tree needs **[sunlight, water, soil, air]** in order to grow. Follow up probes about each enabler:
 - a. How does [the enabler] help the tree to grow?
 - b. What happens to [the enabler] inside the tree?
 - c. Is [the enabler] used up to help the tree to grow? Does it change into other things inside the tree's body? Or, do you think it will not change inside the tree's body?
 - d. Does the tree 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 tree growth?
 - b. [If yes, same probes as for other enablers.]
 - c. [If no] Why not?
4. Scale
 - a. Do you think that the tree is made of cells? Why?
 - b. Do you also think that the tree is made of molecules? Why?
 - c. You said that the tree is made of both cells and molecules. How are the cells and molecules related? What's the connection?
5. Matter
 - a. Does the growing tree change the air? How does that happen?
 - b. The tree gets heavier as it grows. How does that happen?
 - c. Where do the increased materials come from?
 - d. Do you think the tree's body can naturally create more and more materials? Why?
 - e. Do you think the increased materials of the tree's body are changed from things outside of the tree? [If yes], how do these things change into the tree's body structure
 - f. If the student mentions glucose/starch/cellulose/carbohydrates, ask: Do you think it contains carbon atoms? [If yes], where does the carbon atoms come from?
 - g. [If the student talks about CO₂—O₂ exchange, ask]: You said that the tree needs Carbon dioxide and breath out oxygen. Where does the carbon atom of CO₂ go?
6. Energy
 - a. Does the process of tree growth involve energy? [If yes], where does the energy come from?
 - b. Why do you think the things you mentioned have energy?
 - c. [If the student associates energy with sunlight, ask]: Where does the energy of sunlight go? Is it used up? Does it change into other materials? Or, is it still energy? Where is it?
 - d. Do you think the tree stores energy inside its body? If yes, where does the tree store energy? In cells? In molecules? Where does that energy come from?

e. If students do not mention photosynthesis, ask: Is there any connections between the things you mentioned and photosynthesis?

7. Citizenship and Argumentation

- a. You said that ----- [summarize key claims about how a tree grows, especially about what is happening inside the tree, 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 plants or tree 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?

--- DEAD TREE DECAY ---

Tree Decaying



A tree falls in the forest. After many years, the tree will appear as a long, soft lump barely distinguishable from the surrounding forest floor.

Actor: Dead Tree

No enablers such as tree decay due to becoming old

Enablers: rain, wind, sun, bugs

1. What happens to the wood of the tree when the tree decays?
2. What causes the changes in the wood?
3. [If the student mentions decomposers/microbes/bugs/fungi, ask]: Do you think the tree will decay if there are no decomposers/microbes/bugs/fungi?
4. How does each of the things you have mentioned cause that change?
5. Matter
 - a. The tree lost a lot of materials over a long time. Where do you think the lost materials have gone?
 - b. What happens to the matter of the wood? Where does the matter that is no longer in the lump go? In what form (solid, gas, liquid)?
 - c. Do you think chemical changes are happening to the wood of the tree? [If yes], what are those chemical changes? Could you use molecules to explain your answers?
 - d. Do you think the dead tree's body contains carbon atoms? [If yes], where do the carbon atoms go when the tree is decaying?
6. Energy
 - a. Do you think energy is somehow involved in the event of decay? How?
 - b. Do you think that the tree contains energy when it was living? Why?
 - c. Do you think that the tree contains energy when it dies? Why?
 - d. When the tree dies, what will happen to its energy? Do you think it will go somewhere?
 - e. (If yes) Does that energy still exist somewhere? [If yes], where is it? In what form? How does that happen?
 - f. If students do not mention decomposition, ask: Is there any connections between the things you mentioned and decomposition?
7. Citizenship and Argumentation
 - a. You said that ----- [summarize key claims about how a dead tree decays, especially about what is happening to the materials of the dead tree, 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 dead plants decaying 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?

--- FLAME BURNING ---



Actor: flame

Enablers: fuels (wax, wick, wood), air

1. What does the flame need in order to keep burning?
2. You said that the flame needs **[wax, wick, air, wood ...]**. Follow up probes about each enabler.
 - a. How does [the enabler] help the flame to burn?
 - b. What happens to [the enabler] inside the flame?
 - c. Is [the enabler] used up? Does it change into other things? Or, do you think it does not change?
 - d. Does the flame 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 flame to burn?
 - b. [If yes, same probes as for other enablers.]
 - c. [If no] Why not?
4. Scale
 - a. Do you think that the flame is made of materials?
 - b. **If yes, do you think the flame is made of molecules and atoms? Please explain.**
5. Matter
 - a. What change will happen to the match?
 - b. Do you think the match will lose weight? [If yes], where does it go? Is it used up? Does it change into other things? Why?
 - c. What change will happen to the wax of the candle?
 - d. Do you think the candle will lose weight? [If yes], where does it go? Is it used up? Does it change into other things? Why?
 - e. Does the event of flame burning change the air? How does that happen?
 - f. **Do you think wax/wood contain carbon atoms? [If yes], where do the carbon atoms go when the flame is burning?**
6. Energy
 - a. Does the process of flame 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 wood or wax, ask]: Where does the energy of wood/wax go? Is it used up? Does it change into materials? Or, is it still energy? Where is it?**
 - e. Why do you feel warmth when the flame is burning? Do you think heat is released from burning?
 - f. **[If yes], how is heat released? Do you think heat is created in combustion, or do you think it is changed from other forms of energy in combustion? Please explain.**

- g. If students do not mention combustion, ask: Is there any connections between the things you mentioned and combustion?
7. Citizenship and Argumentation
- a. You said that ----- [summarize key claims about flame burning, especially about what is happening inside the flame, 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 burning 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?

--- CAR RUNNING ---

Car Running



Tom's family went to Chicago on vacation. When they came back, Tom's dad found that their car consumed 50 gallons of gasoline for the trip.

Actor: Car

Enablers: gasoline, air

1. What does the car need in order to carry the family to Chicago?
2. Why do people use gasoline instead of water to run their cars?
3. You said that the car needs **gasoline, air**. Follow up probes about each enabler:
 - a. How does gasoline/air help the car to run?
 - b. What happens to the gasoline/air inside the car when the car runs?
 - c. Does the car use gasoline/air for energy? How does that work?
 - d. Is gasoline/air always necessary for car running? Why or why not?
4. Follow-up probes on enablers not mentioned
 - a. Some other students have mentioned gasoline/air. Do you think it is necessary for car running?
 - b. [If yes, same probes as for other enablers.]
 - c. [If no] Why not?
5. Matter
 - a. When your family arrives at Chicago, the gas tank is almost empty? Where does the gasoline go?
 - b. Do you think the gasoline is used up? Or, does it change into other things?
 - c. Does the event of car running change the air? How does that happen?
 - d. Do you think gasoline contains carbon atoms? If yes, where do the carbon atoms go when the gasoline is used by the car?
6. Energy
 - a. Does the process of car running require energy? If yes, where does the energy come from?
 - b. Why do you think the things you mentioned have energy?
 - c. [If the student associates energy with gasoline, ask]: When the car stops, where does the energy of gasoline go? Is it used up? Does it change into materials? Or, is it still energy? Where is it?
 - d. After the car runs for a while, the front part of the car will become very hot. Why?
 - e. [If the student mentions heat, ask]: how is heat released?
 - f. You said that the gasoline is burning inside the car. Do you think heat is created in burning, or do you think it is changed from something else? Please explain.
 - g. If students do not mention combustion, ask: Is there any connections between the things you mentioned and combustion?
8. Citizenship and Argumentation
 - a. You said that ----- [summarize key claims about car running, especially about what is happening to the gasoline, 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 car 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?