

Supplemental Material

CBE—Life Sciences Education

Dauer *et al.*

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Interview Script:

General Tracing Questions: Tree Growing



1. [Elicit a list of enablers: air, water, soil (nutrients), and sunlight.]
“What does the tree need in order to grow?”
2. [For enablers not listed by students ask the following until all enablers, sunlight/soil/water/nutrients, are mentioned.]
“Other students told me that the tree needs X to grow. Do you agree?”
3. [Follow up with specific probes about role of all the enablers in growing.]
“How does the tree use air to grow?”
“How does the tree use water to grow?”
“How does the tree use soil (nutrients) to grow?”
“How does the tree use sunlight to grow?”
4. “Does a tree do anything with the air that surrounds it?”
[Possible alternate wording for lower-level students: Does the tree breathe?]
“What does it do? (How does it do that?) What gases are involved?”
5. “Is there a connection between exchanging gases (breathing) and growing for the tree?” [If student says yes] “What is the connection?”

Arguments from Evidence Questions

[Show the image of Karen and Mike silhouettes.]

“We are interested in how people use evidence to support their ideas. We’re going to talk about two students who disagree with each other about how plants gain weight when they grow. One student Karen said: “The plant gains most of its weight from materials that came from the air.”

“Another student, Mike said: ‘The plant gains most of its weight from materials that came from nutrients in the soil.’

1. “Who do you think is right?”

“Now let’s talk about the quality of their arguments that support their idea.” [Start with the argument that the student agrees with; either Karen or Mike could be first. Show the card associated with Karen or Mike one at a time.]

Karen who you _____ [agree/disagree] with, explains, ‘You can grow a big plant in a little pot without a lot of soil.’ Karen adds some evidence to her argument and explains ‘A seed weighing 1 g was planted in 80 g of soil. After two years the plant weighed 50 g and the soil weighed 78 g.’

1. “Can you explain Karen’s argument?”
2. “How does Karen’s argument support her idea that the plant gains weight from materials that came from the air?”
3. “Are there some weaknesses in Karen’s argument? Explain what they are.”

4. *What evidence would strengthen Karen's argument?*

Mike who you ____ [agree/disagree] with explains, 'Plants have roots to take up nutrients from the soil to grow.' Mike adds some evidence to his argument and explains 'A plant grown with no fertilizer weighed 50 g, and a plant grown with 3 g of fertilizer weighed 65 g.'

5. *"Can you explain Mike's argument?"*
6. *"How does Mike's argument support his idea that plant gains weight from materials that came from the soil?"*
7. *"Are there some weaknesses in Mike's argument? Explain what they are."*
8. *What evidence would strengthen Mike's argument?*

Mass and Energy Tracing Questions

1. *"The tree gains weight as it grows. Suppose the tree gains exactly one pound of wood. Where does that one pound of wood come from?"*
2. *"Does something in the tree's environment have to lose weight in order for the tree to gain weight?"*
[Alternative explanation for lower level students: "When you gain weight, you use the food you eat, so it loses weight. Is there anything like that for the tree—the tree uses it so that it loses weight when the tree grows?"]

[If the student answers "yes."] *"What loses weight when the tree gains weight? If the tree gains exactly one pound, can you predict how much weight [the materials named by the student] will lose?"*
3. *"What parts of the tree's environment will lose weight? How much?"*
4. *"Do you think that the tree needs energy?"*
[If yes] *"Where does the tree get its energy? Out of the things that you named before [sunlight/soil/water/nutrients], which ones are sources of energy for the tree?"*
5. *"What is the difference between the things that give the tree energy and the things that don't?"*
6. *"Do different things give the tree different kinds of energy? Explain."*
7. *"Why does a tree need energy? Where does that energy go inside the tree? Is it still energy? Does it change into other things? How?"*