

**Life Sciences Outreach Faculty Speaker Series for High School Biology Teachers**  
***How Biologists View Structure and Function***  
**Fall 2018**

**Station 4 Answer Key:**

1. Why can't you just have one large pipe in the plant? Why can't you just have a million small pipes in the plant?

Just one would be dangerous---if it is damaged or impaired there are no “back ups” to take over its job, so you want some redundancy in the system. A million small pipes would be inefficient because volumetric flow is directly proportional to the radius of the tube to the 4<sup>th</sup>! So if you had a million smaller tubes, flow would be too restricted and the plant wouldn't stay hydrated.

2. Can you identify a key difference between gymnosperm and angiosperm xylem conduits?

Angiosperms have vessels that are much wider in diameter than the gymnosperm tracheids.

3. Based on this figure, which one (gymnosperms or angiosperms) is more conductive to water flow?

Angiosperms.

4. How does higher conductivity potentially influence photosynthesis?

Higher conductivity potentially increases photosynthesis because it allows water to rehydrate the leaf quickly during transpiration. Therefore, stomata can be more open (and more photosynthesis can take place!) without a fear of becoming too dehydrated.

5. Why does the group of species that has conduits with higher conductivity not out compete the other group of species on a global scale?

Because efficiency comes at the price of safety! (Brings us back to the first question of “why not just have one large tube?”) Although the species have highly efficient conduits, this comes at the expense of increased risk of cavitation or damage. And this risk of loss of function is exacerbated by the fact that when there are few tubes that are large (in comparison to more tubes that are small) they have less functional redundancy. Have more redundancy in a system makes it less efficient but more resistant to overall impairment if only one part is damaged. Additionally, there are a couple other factors that influence the total plant conductivity that can potentially alter this stark difference in efficiency (i.e., they can have different resistance in conduit-conduit connections).

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6. How does size relate to safety? If a stem is punctured, would a species with larger conduits lose more or less functioning than a species with smaller conduits due to a cavitated conduit?

Given the same functioning xylem area, a species with larger conduits would lose more functioning than a species with smaller conduits due to a cavitated conduit. Larger conduits occupy a larger proportion of xylem area than smaller conduits. So therefore if one large conduit is punctured, it would result in a greater loss of functioning than a smaller conduit.

7. Which color represents gymnosperms, and which color represents angiosperms? (In other words, which group of species is safer?)

Angiosperms—blue  
Gymnosperms--red

8. What is one reason that gymnosperms are typically found in harsher environments (the boreal forest and at tree-lines)?

Because they are safer than angiosperms, gymnosperms can deal with harsher environments than angiosperms.