Draw a Tree to get Your Degree

**Mission:** Refine powers to observe, identify, understand and draw different kinds of useful features in plants.

**Technical Requirements**

1. Prepare drawings that are accurate and free of stylistic bias of the subject feature.
2. Provide sufficient detail to reveal the feature’s essential elements.
3. Scale drawings appropriately.
4. Label drawings to make them more informative.
5. Understand each feature in terms of its usefulness.

**Basic Tree Anatomy – from an Engineer’s point of view**

Structurally, trees simply are constructed of two branching exchange systems mounted at opposite ends of a connecting trunk. One exchange system lies below ground – the roots. The other is above ground, lifted up by the trunk – the branches. Since the below-ground environment is much different from the above-ground environment, these two branching systems exchange different sets of things with their surroundings.

**Above-ground Branching System**

This system exploits the fluid motion of the atmosphere to obtain necessary gases and to dispose of waste gases. For example, all living tissues in the tree need oxygen gas ($O_2$). Oxygen gas diffuses directly into the leaves, or through the bark to reach the underlying living layer of cells.

The tree makes its own sugar and other useful biological molecules. In order to accomplish this manufacturing process (photosynthesis), the tree needs certain resources from its surroundings. The above-ground branching system displays an array of leaves. The leaves support photosynthesis by collecting carbon dioxide gas from the atmosphere and light energy from the sun.

**Below-ground Branching System**

Unlike the above-ground environment, which is fluid, transparent and frequently bright, the below-ground environment is solid, opaque and always dark. The below-ground branching system anchors the tree and radiates tendrils that seek underground moisture. Although the underground environment is composed of solid particles, there are tiny spaces between them. Air and water can slowly move between these spaces. The roots spread out to intercept moving water. The tree takes in and distributes this water to the living cells that make up the rest of the tree – even to the leaves at the tippy top.
As the water moves through the underground particles, mineral salts will dissolve into the water and be carried along by it. Some of these mineral salts contain chemicals that the uses to construct itself after being absorbed by the roots. Biologists call these useful salts, **nutrients**. For example, nitrate is a nutrient that the tree uses for the construction of important biological molecules like, DNA and proteins. Phosphate is a nutrient that the tree uses for making DNA and cell membranes. All of this chemical construction activity happens inside each living cell – in a tiny, water-filled reaction vessel.

Living cells need water in order to remain chemically active (alive). Active cells maintain an internal water-filled reaction vessel where life’s chemistry occurs. If the water dries up, life’s chemistry stops.
Living cell with water-filled interior  | Part of a DNA molecule  | A large protein molecule

A section of a plant stem composed of hollow spaces surrounded by living cells. The cells construct, operate and maintain themselves by using materials gathered from the plant’s surrounding environment.

**Leaves are the main site of water loss**

Since leaves are the tree’s main manufacturing centers, they are in intimate contact with the surrounding environment – especially when it comes to gas exchange. Leaves exchange gasses with the atmosphere (mainly carbon dioxide and oxygen gas) through tiny pores on its undersurface. The internal exchange surfaces are kept moist with water in order to speed up the transfer of gas molecules from the leaf and the atmosphere. But in maintaining these moist exchange surfaces, some of the leaf’s water always escapes from the surface and is carried out of the pores and into the atmosphere. The point is that leaves are the tree’s main site of water loss.
There are several factors that can increase the amount of water lost by a leaf. They are listed below:

1. **Leaf size** – the larger the leaf, the more water it loses.
2. **Leaf temperature** – the warmer the leaf, the more water it loses.
3. **Direct exposure of leaf undersurface to moving air** – the more that a leaf’s undersurface is directly exposed to moving air, the more water it loses.

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**Your Assignment**

Your instructor will guide you to several trees of his / her choice on campus or elsewhere. Please prepare careful sketches that show leaf detail, growth habit, and the distribution of surface roots (if visible). Consult the below example as a guide.

Also, please write complete answers to the questions given between trees.

Name of Plant: Example

<table>
<thead>
<tr>
<th>Leaf Detail (example)</th>
<th>Growth Habit (some examples here)</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Leaf Diagram" /></td>
<td><img src="image2" alt="Growth Habit Examples" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Surface Root Pattern (example)</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3" alt="Root Pattern" /></td>
</tr>
</tbody>
</table>

Farthest radiation dist. = _____ ft.
Name of Plant:

<table>
<thead>
<tr>
<th>Leaf Detail</th>
<th>Growth Habit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Surface Root Pattern

Farthest radiation dist. = _____ ft.

Quiz prep question 1. What three important materials do roots collect from the surrounding environment?

______________________________

______________________________

______________________________
Name of Plant:

<table>
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<tr>
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</table>

| Surface Root Pattern |

Farthest radiation dist. = ______ ft.

Quiz prep question 2. Consider the tree represented in the drawing at left. What important resource can the above-ground exchange system obtain from its surroundings that the below-ground exchange system cannot?

Quiz prep question 3. Draw an arrow to indicate the main site of water loss on the tree at left.
<table>
<thead>
<tr>
<th>Leaf Detail</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
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<table>
<thead>
<tr>
<th>Surface Root Pattern</th>
</tr>
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</table>

Farthest radiation dist. = _____ ft.

**Quiz prep question 4.** Draw an arrow to represent the escape of water from the leaves at left. Be sure to distinguish between the leaf upper surface and the leaf under surface.

**Quiz prep question 5.** Why does the leaf tend to lose more water from one surface than the other?
Name of Plant:

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Surface Root Pattern

Farthest radiation dist. = _____ ft.

Quiz prep question 6. The tree’s exchange systems collect several kinds of materials from the surrounding environment. For the items listed below, write why each is useful to the tree.

Oxygen gas

__________________________

Carbon dioxide gas

__________________________

Mineral nutrients

__________________________

Water

__________________________