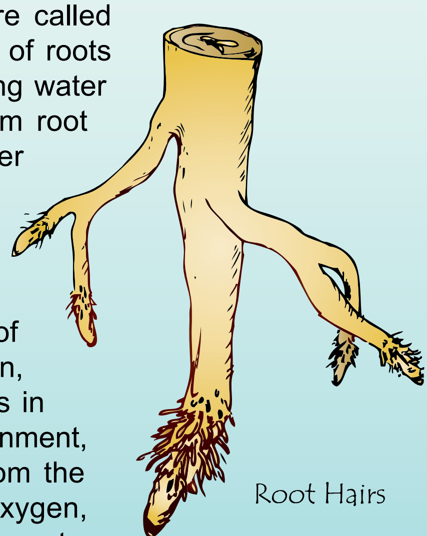
Headlines:

FLOODS DESTROY VEGETABLE CROPS IN GEORGIA!

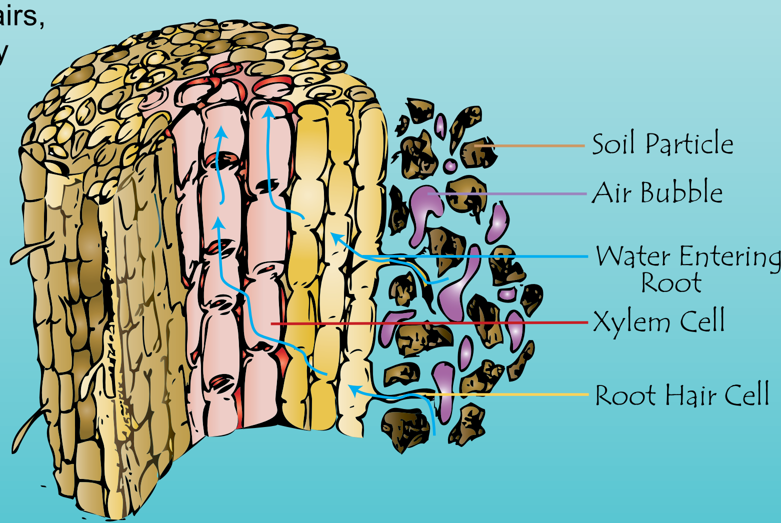
CORN CROPS DEVASTATED BY FLOODS IN THE MIDWEST!

Flooding is a serious problem for plants. But why do crops die when they're flooded for a prolonged period? Strange as it may seem, when plants are flooded, they die from lack of *water*. Specifically, their root hairs die from lack of oxygen (they suffocate), and subsequently, the rest of the plant is cut off from its water supply. How does this happen?

The water-absorbing cells of roots are called *root hairs*. Root hairs are cells at the tips of roots that bear the full responsibility for absorbing water and dissolved minerals from the soil. From root hairs, tubes called **xylem** transport water and dissolved minerals upward to the rest of the plant. Root hair cells have tiny hair-like protrusions that reach into the surrounding soil matrix. The soil matrix is a mixture of soil, water, and tiny pockets of air. Like all cells, root hair cells need oxygen, and they absorb it from nearby air bubbles in the soil matrix. However, in a flooded environment, excess water in the soil drives oxygen from the spaces between soil particles. Without oxygen, root hair cells die and can no longer draw in water to supply the rest of the plant. Without live root hairs, the root essentially becomes sealed off, and the plant has no other way to obtain water from the soil matrix. Therefore, flooded plants die from lack of water.



Root Hairs



Water Entering Root

Flooding also causes the soil to become **toxic** to plants. Normally, oxygen in the soil bonds with iron, magnesium, sulfur, nitrogen, and potassium. Plants can easily absorb and use minerals in this **oxidized** form. However, in flooded soils, microorganisms experience a limited oxygen supply and snatch the oxygen from oxidized compounds. Without oxygen, the minerals combine with other elements and become unusable or even toxic to plants.

However, plants that naturally live in wet places don't die! How are they able to survive in water when **upland plants** cannot? They have adapted strategies for overcoming the hazardous conditions of living in water. Plants described in the first part of this book live in or float on the surface of water. Formally, these water plants are called *aquatic plants*. The second part of this book describes plants that are rooted in the substrate with their upper stems and leaves out of the water. **Ecologists** call the latter ***emergent wetland*** *plants*. The term *emergent* refers to the upper plant parts that grow above the water.

This book only considers **vascular plants**—that is, organisms in the plant kingdom with specialized **phloem** cells for conducting sugar and specialized xylem cells for transporting water and dissolved minerals. Plants without vascular systems transport materials from cell to cell without specialized conducting **tissues**. Non-vascular plants include **bryophytes** (mosses, liverworts, and hornworts). **Algae** and certain bacteria are other types of non-vascular **photosynthetic** organisms.

Adaptations for living in water evolved at different times and from unrelated groups of upland plants. To understand how plants adapted to living in water, we first need to understand the basic requirements of plants for gas exchange, exposure to light, structural support, and reproduction.