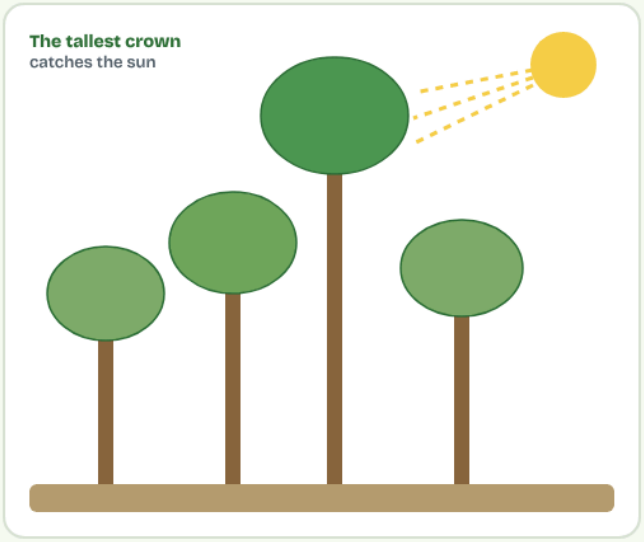
That is why

# Why do trees grow so tall, and why do they stop?

Trees race their neighbors for sunlight; the sun pulls water up a sticky chain, and gravity sets the ceiling.

## A The race for light

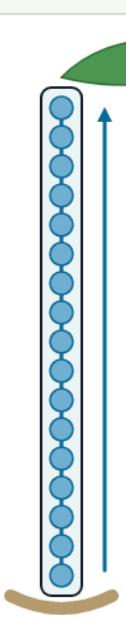



In crowded forests, trees grow upward to overtake their neighbors and reach stronger sunlight. Shorter trees are left in the shade.

**The cost of height**

The taller the tree, the harder it is to haul water up from the roots.

## B How water climbs



**1. Leaves pull**
Water evaporates from the leaves, creating a pull on the water below.

**2. A sticky chain**
Water molecules cling to each other (cohesion) and to the tube walls (adhesion).

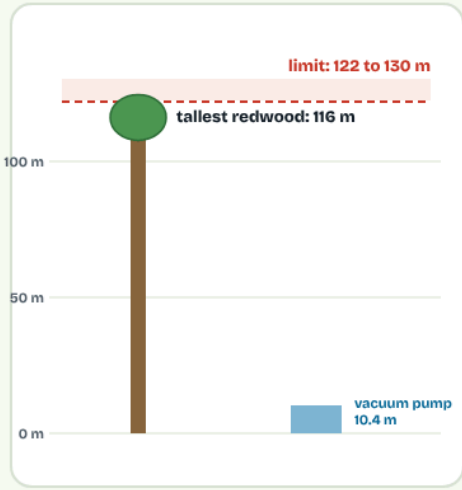
**3. Stiff pipes**
Xylem tubes are dead cells with stiff walls of lignin, so the pull does not crush them.

**4. Beyond suction**
Even the best vacuum pump can pull water up only about 10.4 m.

**Pull grows from soil to air**

Water potential: root -0.2, stem -0.6, leaf -1.5, air -100 MPa. Water moves toward the stronger pull.

## C The ceiling




**1 Drought at the top**

Top leaves get less water, so they grow smaller.

**2 Broken chains**

Air bubbles (cavitation) snap the water column.

**The sun pulls, the water holds together, and gravity sets the ceiling.**

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