SECONDARY GROWTH
A *Tilia* stem before secondary growth
Cell division starts to form cambium (meristem)

Pith rays (parenchyma)

Residual procambium
Cells begin dividing

Vascular cambium forms

Secondary xylem and phloem form
cell of vascular cambium at start of secondary growth

one cell differentiates into xylem, one stays meristematic

divisions and differentiation continues

division

initial

division

surface of stem or root

DIRECTION OF GROWTH

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Developing cambium
Interfascicular cambium (from ray parenchyma)

Fascicular cambium (from procambium)
As the stem enlarges, the epidermis is broken, and must be renewed (as phellem/cork).
How many years’ growth?
Roots also have secondary growth
Most monocots do not have secondary stem or root growth

Maize stem
Summary

Dicot stems (and roots) develop a vascular cambium, in which cell division produces new xylem and phloem.

They also develop a cork cambium that produces cork (to replace epidermis) and phelloderm.

Secondary xylem is the wood of commerce.