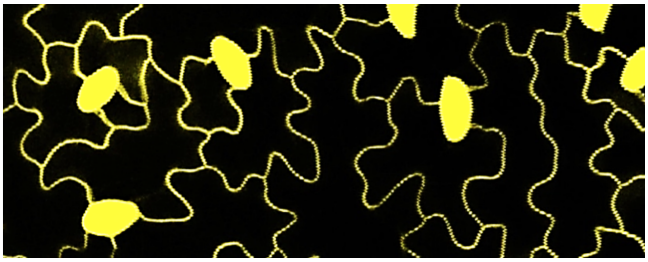
Exercise 8



We start with the observation that epidermal cells in leaves make jigsaw-puzzle-like shapes. Then we make a hypothesis that these shapes are a way for cells to accommodate mechanical stress while having a large surface area.

1. What is mechanical stress? Provide the simplest definition possible.
2. How do we measure mechanical stress:
   i) computationally,
   ii) experimentally?
3. Starting from a small cubic cell, how do you expect maximal mechanical stress in a single cell to behave if you:
   i) elongate the cell (expand it in one direction),
   ii) expand the cell in 2 directions,
   iii) expand the cell in 3 directions,
   iv) add lobes to the cell?
4. How would you evaluate the hypothesis that puzzle shapes are a way of avoiding high mechanical stress in large cells?
5. FEM simulations are computationally costly. What quick proxy would you choose for mechanical stress?
6. What measure of cell shape would you use to quantify the 'puzzleness' of cells? Think about how these different measures would perform in distinguishing cells of different shapes.
7. Now that you are equipped with a good shape measure, how would you check the plausibility of the hypothesis that puzzle shapes are observed in large cells?

8. How would you check if there is a relationship between cell shape and organ shape?

9. Can you think of other ways in which cells could potentially minimize stress on the cell wall or try to withstand it?