

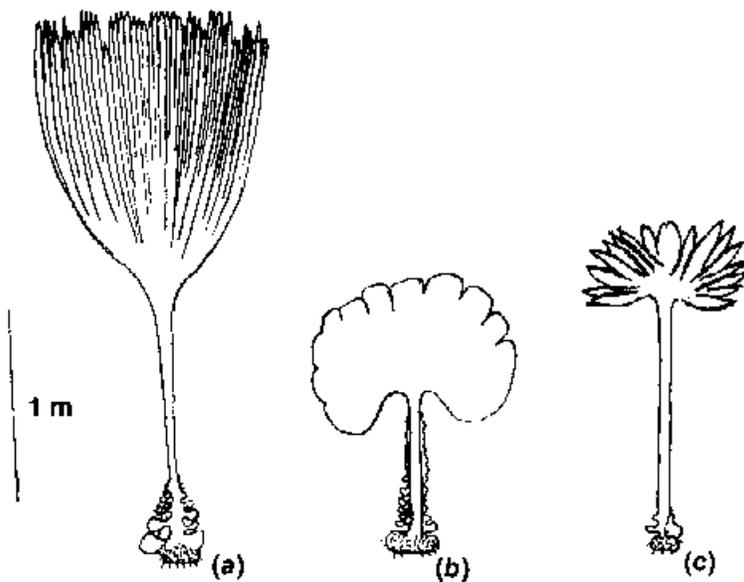
How do nutrients and wave action affect kelp structure

Grade level: Middle and High school

Background:

Kelp need nutrients, particularly nitrogen to grow and survive. In order for nitrogen to be absorbed through diffusion by the cells on a kelp blade, water needs to supply those nutrients. Kelp live in a variety of zones with the intertidal and subtidal habitats. These zones have different levels of wave action. For example, kelp like *Macrocystis* may be subject to strong current speeds, delivering high nutrients, but may also have shredded blades. Other kelp living in the higher intertidal zones are subjected to high pounding of waves, delivering intermittent nutrients. Growth may be slower and thallus may be thicker.

Morphology of kelp is controlled by current speed and nutrients:



Tradeoffs (a) Strong current speeds: High nutrient availability so you get high growth BUT shredded thallus. Long, flat tough blades=cuneate at base and divided into many digits

(b) Weak current speeds: Keeps thallus in tact, but low gas exchange, so there is lower growth. Curved blades are heart shaped at their base (cordate), lack digits and are very fragile, tearing under their own weight.

(c) Wave pounding: Shreds the kelp, and erodes it, and you have relatively lower growth because gas exchange is not constant (O₂ and CO₂). Short, extremely tough blades with 3-10 digits (increase in cortical cells, increases thickness).

Performance objectives

Students will be able to:

- Research different species of kelp and their habitats
- Understand the mechanism that nutrients are delivered to kelp blades by water flow and diffusion
- Understand the trade offs between nutrients and wave action for kelp morphology
- Make predictions based on their knowledge of kelp structure

Materials:

Computer and internet or books for research on kelp

Pictures and / or live samples of kelp

Procedure

Have students research different kelp species and find pictures of them to compare. Ideally, it would be great to be able to collect live species, but pictures will do if that is not possible.

1) Collect data on each species: Where do they grow? How big do they get? What is the shape of their thallus and blades?

2) Draw the kelp species and identify the morphological structures.

3) Predict, based on the morphology, the level of nutrients, strengths of thalli and level of growth. Students will need to use critical thinking skills to make these predictions based on their knowledge of how nutrients are supplied to kelp.

Extensions:

For younger grades:

The teacher can give students different pictures of kelp and ask them to place the kelp on a chart that indicates different levels of nutrients and wave action.

Resources:

Trade offs:

http://www.ukmarinesac.org.uk/communities/infralittoral/ik2_3.htm

Kelp morphology:

http://www.geol.utas.edu.au/kelpwatch/facts_b.html#morph

Relationship between wave action, light, temperature and nutrients: (From Lesser et al. 2009, "Ecology of mesophotic coral reefs")

