Plates and Gates

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Activity modeled on research by Strugnell, et al, about a cold water octopus that lives near Antarctica.

Megaleledone setebos
A shallow water species of octopus found all around Antarctic and only in the Southern Ocean. It is a close relative of the deep sea species. The picture is a juvenite. Adults can reach nearly 1 m.
(Ask Jose about the one recently found that was 1.2 m!!)

An excellent example of why interdisciplinary science is so important to understanding Earth as a "system of systems."
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Directions: Timeline

- Using the colored paper strip, mark :
- “0”—present on the right end of the strip
- “100 mya” on the left
- Mark distance between “0” and “100” in approximately equal intervals of “10” (you might want to have your students use a meter stick and a meter length of paper)

Directions: Map Cards

- Place your map cards on the appropriate position on your timeline. (some may not be on the paper—figure approximately where they should be placed on the table/ desktop)

1. What changes occur between the first card and last card?
2. Which continents moved closer to the Poles?
3. Which continents moved to latitudes closer to the Equator?

Directions: Climate Cards

These cards represent how the climate of Antarctica changed over geologic time.

1. Look at the Climate Cards.

How has the average temperature changed over time?

2. Place them in order using the dates at the bottom of each card.

What changes occur in the global position of Antarctica between the first and last card?

What role did ocean currents play in the change in climate?

Octopus Background

Marine animals depend on dissolved oxygen in the water to survive. Cold water holds more oxygen than warm water and can support more organisms.

Many species of octopuses squirt ink to distract and confuse predators. In the deep water, light is very low and squirting ink as a defense mechanism is of little value and of high metabolic demand. Because of this, deep-water species of octopuses have very small ink sacs with little or no ink in them, and some have no ink sacs at all.

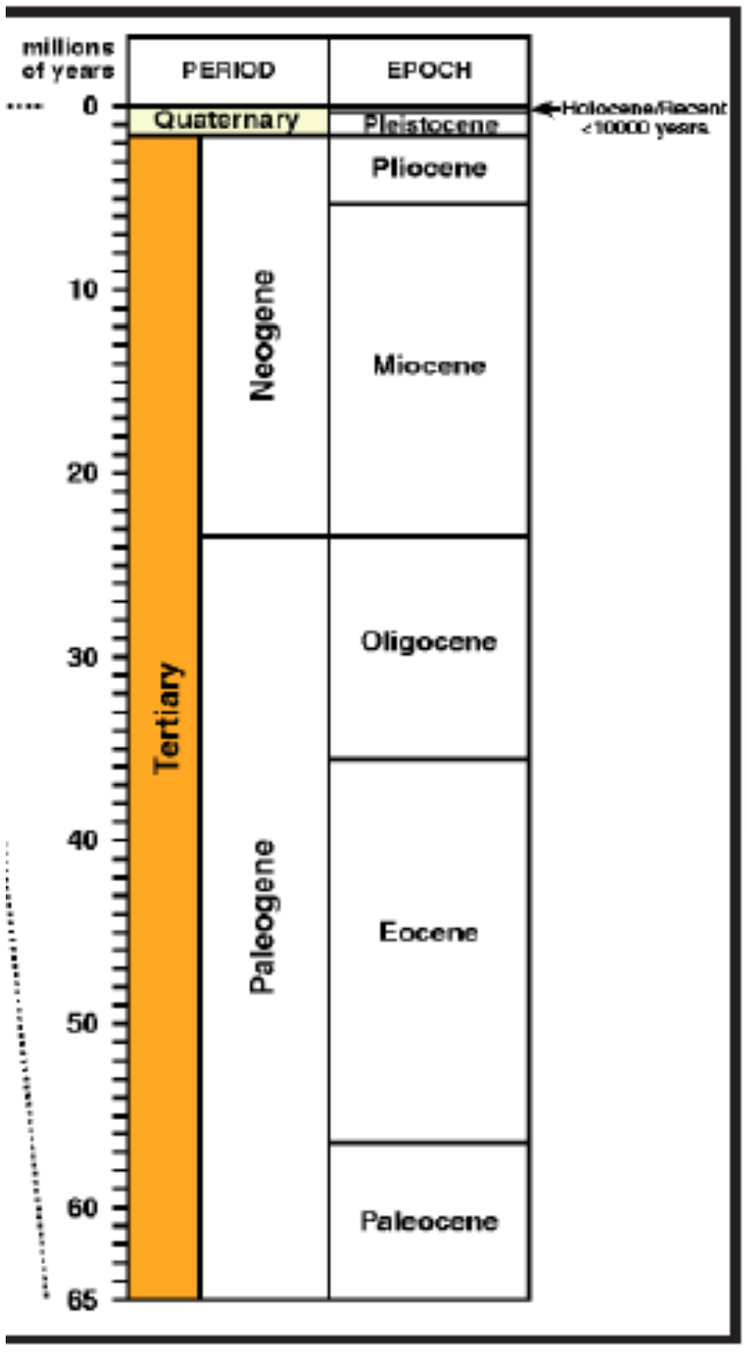
Directions: Biology Cards

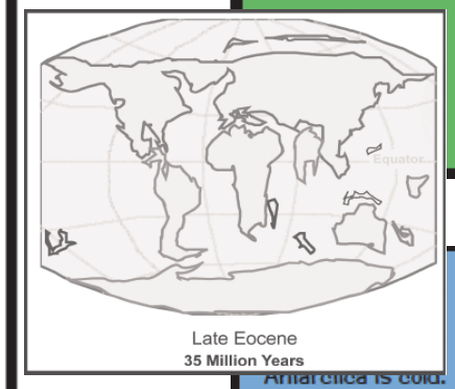
Place the cards in order based on the date at the bottom of the card.

1. What changes in diversity and location of octopuses occurred between the first card and the last card?

2. What could have happened between 35 mya and 15-20 mya so that the Pacific octopus species were able to move to the Atlantic Ocean?

These cards tell the story of how deep sea species of octopuses grew in diversity in the Southern Ocean and extended their habitat range, deeper and deeper as the oceans grew colder.





Learn more:

Strugnell, J., Rogers, A.D., Prodöhl, P.A.,Collins, M.A. & Allcock, A.L. (2008) The thermohaline expressway: the Southern Ocean as a centre of origin for deep sea octopuses. Cladistics. 24: 853-860.

The Big Ideas

- **Notice that the events are scattered along the timeline except for one card in each group that occurs around 35 mya.**
- **These events (one geographic, one climate and one biological) are related and driven by the opening of the Drake Passage. Plate tectonics, although slow, have a large affect on climate change, and in this case triggered the isolation of Antarctica from warm northern waters.**
- **Cold water can hold more oxygen, so the deeper water could then sustain life. The octopuses, which before could only survive on the shallow ocean shelf, began to diversify and invade the deeper waters.**

Big Ideas…continued

- **With the cooling of the oceans, Antarctica's climate cooled, which triggered the growth of the ice sheets.**
- **When the Drake Passage opened, the ocean currents were no longer restricted by the presence of South America and began to circle Antarctica creating the Antarctic Circumpolar Current. The waters around Antarctica became very cold.**
- **This resulted in isolation and cooling of Antarctica, and ice sheets began to form.**

How will melting ice affect sea level?

1. Build land with gravel on one side of each of the pans
2. Pour water into the pan, leaving part of the land above water
3. In one pan--add ice to the water; in the other, add ice to the land
4. Mark the water level with a Vis-a-Vis on the outside of the pan

<u>Make a prediction</u>:
Will melting *sea ice* affect sea level?
Will melting *land-based* ice affect sea level?

Add a Post-it note to the statement with which you agree.

Ice Sheet	Estimated Sea-Level Rise
Greenland	7 meters
West Antarctica	7 meters
East Antarctica	70 meters

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Life in an Acid Bath

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