Digging for Diatoms: Discovering Past Climates

A How-To Guide for Educators

Grades: 7 to 9

Curriculum links: Science; classification, ecology, geology.

Words in ***bold italics*** can be cross-referenced to the Glossary, while hypertext words will refer you to a relevant web site.

Slide #1: Title
We are about to scratch the surface of climate science and dig deep into the world of ***diatoms*** and what they can tell us about the ***climates*** of the past!

Slide #2: What are diatoms?
Diatoms are single-celled organisms that can be found almost anywhere but usually near, in or on water! Their shells are made of glass – silica to be precise – and the can assume a variety of striking shapes! The majority of diatoms fall within one of two categories: the pennates and the centrics. Pennates are elongated and pen shaped while centrics are round or rounded! Every diatom's shell is made of two sections that fit together like the lid and container of a shoebox.

Slide #3: Pen-shaped or rounded?
A good example of a pennate diatom is the genus known as Cyclotella. Nitzschia is a prime example of a centric diatom.
These images and those that will be seen later have been captured using a scanning electron microscope. An electron microscope uses a beam of highly energetic electrons to examine objects on an extremely fine scale. Thus obtaining resolutions that cannot be achieved using regular light microscopes.

Slide #4: A diatom by any other name…
Only 15,000 of the estimated 100,000 species of diatoms have so far been located! Different species are usually categorized according to their shape but also according to their function and responses to environmental conditions. These can be either physical or chemical or both. The most important chemical response factors for diatoms are: nutrients, acidity and salinity; while the most important physical factors are: light and temperature. Of course, all of these factors codependent. They are not mutually exclusive: as more light reaches the water, more nutrients are available to diatoms.

Produit par :
Musée canadien de la Nature / Canadian Museum of Nature
Canadä
En collaboration avec :
The Centre For Traditional Knowledge
En partenariat avec :
Fonds d'action pour le changement climatique
Agence canadienne de développement international (ACDI)
Postes Canada
RBC Fondation
VISITEZ : nature.ca/sila

Slide #5: Who touched the thermostat?
Diatoms' sensitivity to ecological factors such as temperature and light, combined with the fact that their glass shells are preserved in the sediment where they settle, makes them unique candidates for reading the climates of the past. In a way, diatoms are windows on the past! By dating a sediment sample and identifying its diatom record, we can determine if it is a cold or warm period. Such analysis can be made for the very distant past because the diatoms' glass shells are well preserved in the lake-bottom sediment.

Slide #6: The core of this experiment…
This is exactly what was done by Canadian Museum of Nature scientists at the bottom of Lake JR01 on Boothia Peninsula in Nunavut. That is where they were able to extract a sediment core sample of nearly 5 metres reaching as far back as 6,700 years before present - which covers the Middle Holocene period and the beginning of recorded human history! The sample was dated using C14 radiocarbon analysis.

Slide #7: Where and how they core?
Lake JR01 has a very atypical name… The "JR" in the name stands for Josephine River which is near the coring site, while "01" is for the first lake encountered in the area. Before the coring process takes place, millions of diatoms die over thousands of years leaving behind their empty glass-like shells that eventually settle to the bottom of the lake. Layers of rigid and intact diatom shells will accumulate season after season giving us a record of their existence from past millennia.

Slide #8: Coring a core…
In order to extract this "time capsule", a corer (known as a Livingstone square-rod sampler) is thrust into the sediment layer at the bottom of the lake. Once the desired depth is reached, the core is extracted along with the sediment that is trapped within its tube. This core is then transported back to base camp and packaged before it is readied for analysis in the laboratory.

Slides #9 to #12: The usual suspects
When analyzing the core, each slice is dated and scrutinized under the scanning electron microscope do determine what number and type of diatoms compose the sample. Here, four common diatom genera are featured with hints at identifying them across a complete sample. They are: *Fragilaria* (cold), *Nitzschia* (warm), *Cyclotella* (warm), and *Amphora* (cold).

Slide #13: Remember
One last thing to remember when considering diatom core samples… a more diverse and abundant flora usually points to warmer conditions while a less diverse and sparser flora is indicative of colder conditions. Now let the guessing game begin!

Slides #14 to #18: Core sample images
A variety of diatom core samples from different periods in the timeframe of the JR01 core are showcased. You are asked to consider whether they are representative of colder or warmer climate regimes. These periods are: Early to Middle Holocene (warm); Neoglacial (cold); Medieval Warm Period (warm); Little Ice Age (cold); 45 years ago (warm). It is important to know the characteristics of specific genera and the overall rule of the flora diversity and abundance.

Slide #19: Let's recap!
An overview of the different periods introduced earlier. Images of the estimated landscape of the Lake JR01 region is proposed for each period ranging from 6700 years ago to today.