# STOP 9, 20’ Records from the past

- Instruction sheet -

## Background information

To help to make climate forecasts for the future, it is useful to study past climate. The field of science which aims to gain better insight into past climate on Earth and the mechanisms that are causing climate change is called palaeoclimatology.

The floors of oceans and lakes are covered with various layers of mud-like sediments, which contain fossils. One type of fossil from lake or ocean sediments that is often used by palaeoclimatologists is diatoms. Each kind of diatom has a different shape of its skeleton. This difference is used to identify the various fossil types of diatom.

In addition to this, every species grows optimally under a certain temperature called the optimal temperature (To), so the presence of a certain species can provide some clues about the climate at the time when the individuals were still alive.

Scientists can determine the temperature at the time of formation, which is called the balanced average temperature (Tm), by applying the following formula:

$$T_w = \frac{(n_{S1} \times T_{o,S1}) + (n_{S2} \times T_{o,S2}) + (n_{S3} \times T_{o,S3}) + (n_{S4} \times T_{o,S4})}{n_{S1} + n_{S2} + n_{S3} + n_{S4}}$$

$T_w$ – balanced average temperature (°C)
Sn – type of diatom
$T_{o,Sn}$ – optimal temperature of the type of diatom (°C)
$n_{Sn}$ – amount of diatoms of a certain type

## Aim

Reconstructing a climate history by analyzing the types of diatoms from a sediment core.

## Materials

10 Petri dishes that correspond to sediment samples from different parts of a sediment core. The depth and age are indicated on each Petri dish. (BP years= years Before Present)

| Sample number | Age (BP years) | Depth (cm) |
|---|---|---|
| 1 | 1000 | 5 |
| 2 | 2000 | 10 |
| 3 | 3000 | 15 |
| 4 | 4000 | 20 |
| 5 | 5000 | 25 |
| 6 | 6000 | 30 |
| 7 | 7000 | 35 |
| 8 | 8000 | 40 |
| 9 | 9000 | 45 |
| 10 | 10000 | 50 |

Each Petri dish contains 12 pink, green, yellow and purple beads. Each color represents a specific type of diatom that survives best in certain temperatures (= optimal temperature, To).

| Type of diatom | To (°C) |
|---|---|
| pink | 20 |
| yellow | 15 |
| green | 10 |
| purple | 5 |

## Procedure

1. Color the attached diagram (on the worksheet) according to the diatom composition found in each Petri dish. Count the amount of beads of each color found in each Petri dish and color the circles accordingly. From the bottom (horizontal axis) to the top of each column of circles, color first the pink ones, then the yellow ones, the green ones, and the purple ones.
2. Draw a line above the top set of pink dots ; this will give you a line with the age on the X-axis and the number of diatoms per type on the Y-axis.
3. Calculate the balanced average temperature (Tm) for depths at 1000 years BP, 4000 years BP and 7000 years BP . Fill the “Table of the Tm values” and answer the question according to the instructions provided.

This activity has been adapted for IESO2011 from the original version titled “Experiment from the Past” published by International Polar Foundation http://www.educapoles.org/

# Records from the past (2,4pt)

– Worksheet , Diagram -

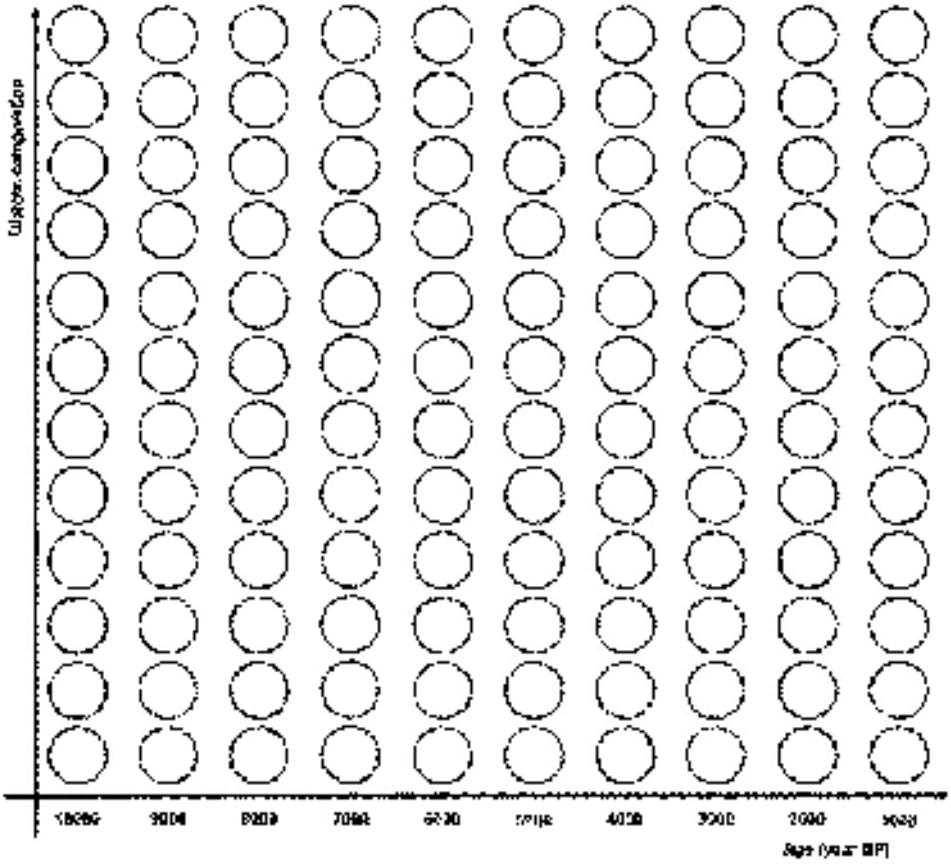

**Table of Tm values**

| Age (years BP) | $n_{pink} * T_{0,pink}$ | $n_{yellow} * T_{0,yellow}$ | $n_{green} * T_{0,green}$ | $n_{purple} * T_{0,purple}$ | $n_{total}$ | Tm (°C) |
|---|---|---|---|---|---|---|
| 1000 | | | | | | |
| 4000 | | | | | | |
| 7000 | | | | | | |

$$T_m = \frac{(n_{S1} \times T_{o,S1}) + (n_{S2} \times T_{o,S2}) + (n_{S3} \times T_{o,S3}) + (n_{S4} \times T_{o,S4})}{n_{S1} + n_{S2} + n_{S3} + n_{S4}}$$

$T_m$ = balanced average temperature (°C)
Sn = type of diatom
$T_{o, Sn}$ = optimal temperature of the type of diatom (°C)
$n_{Sn}$ = amount of diatoms of a certain type

## Analysis of the results

Question 1 (0,6pt)
Put the 3 time periods listed in the table above in the following ordinated list from the coldest (1) to the warmest (3)

| | | |
|---|---|---|
| 1 (coldest) | = | time period_____Age (years BP) |
| 2 | = | time period_____Age (years BP) |
| 3 (warmest) | = | time period_____Age (years BP) |

Question 2 (1,5pt)
The curves for the two warm periods show exactly the same maximum in terms of number of “pink diatoms” while the balanced average temperature (Tm) for these periods differ, how can you explain that? (mark one correct answer)

a) The most recent warm period has more “purple diatoms”
b) The Tm takes into account the relative composition of diatoms present in each sample
c) The Tm takes into account the age of each samples
d) The optimal temperature of the “pink diatoms” changes according to the ages