LESSON B4
FORESTS, HUMANS AND CLIMATE CHANGE

MAIN SUBJECTS
Natural sciences / Geography

DURATION
~ Preparation: 10 min
~ Activity: 1h (preparatory activity) + ½ day of field trip + 1h of debriefing

AGE GROUP
9-15 years

LEARNING OUTCOMES
On a field trip to the forest, students learn:
~ To get to know their local environment and its resources, using a sensorial approach.
~ To collect samples in a scientific way.
~ To define what is a tree and a forest based on certain criteria.
~ The needs of a tree.
~ That forests are home to a large biodiversity .
~ The impact of climate change on forests and how forests can limit climate change.

KEYWORDS
Forest, tree, photosynthesis, carbon storage, ecosystem, wood, biodiversity, deforestation

TEACHING METHOD
Outdoor teaching, experimentation, documentary analysis

PREPARATION 10 MIN

This lesson focuses on the forest. The activities listed below are only suggestions, to be applied according to your context. The idea here is to allow students to really 'feel' the forest in all its dimensions.
It could be appropriate to link this lesson with the previous one on soil.

THINGS TO CONSIDER PRIOR TO THE FIELD TRIP

- Gather information about nearby accessible forests or, if not possible, an urban park rich in a variety of plants and trees.
- Plan how to get there safely.
- Ensure that the legal aspects and requirements for such an activity are fulfilled.
- Ask parents, field experts or colleagues to help out.
- According to the weather forecast, remind students to wear appropriate clothes.
- Establish the safety and behaviour rules, such as no throwing, no sticks, no touching of stinging, sharp or poisonous plants, etc.
- Agree on a signal for the class to gather around you.

EQUIPMENT FOR THE FIELD TRIP

- **WORKSHEET B4.1** (one for 2 groups of 4; you may laminate them to be reused).
- **WORKSHEET B4.2** (one for each student).
- **WORKSHEET B4.3** (one for each group; each topic must be cut out along the dotted lines).
- **WORKSHEET B4.4** (one for each group of 4; you may laminate them to avoid damage).
- Plastic bags to collect samples.
- Camera and/or dictaphone machine and/or smartphone (to record forest noises).
- Gloves (to avoid being in direct contact with specimens that might be toxic).
- Thermometer to measure the air temperature.
- Luxmeter or a similar smartphone application.
- Tape measure or pieces of string and a metre stick/metre wheel – one for each group.
- Calculator or smartphone for each group.
- Books/internet access to answer your students' questions (you may also use the "Background for teachers").

EQUIPMENT FOR THE CLASSROOM

- **WORKSHEET B4.5** (one for each pair of students).
- Computer with internet access (one for each pair of students); if not available, print **WORKSHEET B4.6**.

FIELD TRIP PREPARATION 1H (ONE WEEK BEFORE)

In the previous lessons, students learned that many objects they use in their daily life come from natural resources, including plants. Explain that you are going to focus on forests. Tell your students that first of all you will ask them a couple of questions on this subject for their individual reflection. Secondly, a discussion with the whole class will take place and their ideas will be written on a class chart: *Do forests play a part in climate change? How?* (They may mention that

the temperature is colder under trees, that trees store CO_2 or that trees provide us with renewable and sustainable raw materials) *How does climate change transform forests?* (Students may mention the impact of droughts or species losses).

To answer the previous questions, you must explore these ones first:

- What is a forest?[1]
- Why is it important?
- How do forests grow?

1. To find out what they think, ask them to draw a forest. Then, keep the drawings and use them after the field trip to see if their thoughts have changed.

2. Split the class into small groups (4 students maximum) and give each group a large sheet of paper. Let them draw and discuss without interruption for about 15 minutes.

3. Bring the students together for a short discussion on the three questions above.

4. Tell them that a good way to find out more about forests is to go on a field trip but they must first prepare well.

5. Ask them: *How will you discover what a forest is? How will you gather samples in the forest?*[2] *Which tools should you use to collect, observe and recognise organisms? How can you keep track of your observations?*

6. Split them again into groups to plan the field trip. Help them out with hints and questions about how:

- **To collect:** your bare hands, gloves, butterfly net, transparent box.
- **To observe or recognise:** the naked eye, magnifying glass, goggles, a ruler, book or identification keys[3].
- **To conserve:** boxes, bottles, bags, marker pens.
- **To take notes or illustrate:** notebook, pencil, eraser, camera, smartphone.

TEACHER TIP

For a week – until the day of the field trip – a box can be left in the classroom where students can put objects they may find "useful" for their mission.

7. Each group chooses a spokesperson and the whole class decides on a list of equipment, discussing the use and the relevance of each object. Some missing ones might be suggested using questions – *what if you want to observe from a remote place?* or *what if you want to record an observation without hurting yourself / the animal / the plant?* Once this has been agreed on, the list is written in the notebook of each student.

8. Explain that each of the group members will have a specific role and make sure you clarify each one of them:

- The cartoonist
- The photographer
- The scientist
- The sound recorder

9. Together, you can discuss the rules, so the field trip takes place in the best possible way. Make the students note them down.

10. If relevant, set up a list of questions for the expert, if you have contacted one.

FIELD TRIP OBSERVATION HALF A DAY

PART 1: GETTING FAMILIAR WITH TREES AND FORESTS

1H30

1. On the day of the field trip remind the students that they have a common group objective: to gather answers to the questions raised in class through pictures, drawings, samples and recordings.

2. Announce that each group leader is an accompanying adult and is in charge of distributing helpful material, including **WORKSHEET B4.3**. Explain that if they have any questions they can ask you or the other adults to give them a helping hand.

3. Distribute **WORKSHEET B4.2** to each student. Verify their understanding.

4. Invite a few students to recall the field trip rules.

5. Promote sharing of their interesting discoveries to the class after their exploration.

6. Ask the students to rejoin their groups and to randomly draw the roleplay cards (**WORKSHEET B4.1**). Give them the equipment needed and let them explore for 45 minutes.

1 This part of the lesson is largely inspired by module 1 of the FAO, Discovering forests: Teaching guide, Rome, 2018, p. 64; available here: https://www.fao.org/3/i6208e/i6208e.pdf

2 This part of the lesson is based on a resource from *La main à la pâte* about biodiversity by Gabrielle Zimmermann, available here: https://www.fondation-lamap.org/fr/page/20221/la-biodiversite

3 One example in the UK: https://www.nhm.ac.uk/content/dam/nhmwww/take-part/identify-nature/tree-identification-key.pdf

TEACHER TIP
During a previous visit you made in the area, you may have noticed something interesting for your class: for example, a stump where we can observe tree rings, an anthill, or a noteworthy plant. Once you have gathered your students together, this should be the perfect moment to show it!

7. Once the time is up, gather the whole class together and allow each group 5 minutes to present what they found. They can show samples and pictures, play sounds, or give an explanation about something.

8. Hold a general discussion to check what they have learned:

- *What is a forest?* The idea behind this questioning is to lead the students to the understanding that the forest is an ecosystem in itself. It is indeed made up of trees, but also of smaller trees (shrubs), grasses, mosses and animals.
- *What are trees made of? What are the 4 main parts?* Trunk, branches, leaves and roots. *What are their functions?* Leaves react to light, the trunk conducts the sap, branches allow the leaves to spread out in space to get more light, and roots absorb minerals and water.
- *Why are forests useful for human purposes?* Trees produce oxygen which we need to breathe; wood for..., fruits for..., leaves may also be useful; trees are associated with some cultural/religious beliefs. *And for other living beings?* Have them notice the biodiversity around them.

TEACHER TIP
You can ask your students to pick one element that may be useful to humans; they will have to present it to the class and explain its utility.

PART 2: FORESTS AND CLIMATE CHANGE 1HR (ON THE FIELD)

9. Once they have become familiar with their environment, explain that you are going to focus on the link between climate change and forests. Have them recall the main facts about climate change. They should mention the major role of carbon dioxide (see lesson A3, page 50). Reiterate some key carbon facts:

- Carbon exists in the Earth's atmosphere mainly as carbon dioxide, but in a very small proportion (circa 0.04%).
- Carbon is an essential building block of life – about half of the dry weight of most living organisms is carbon.
- Forests store 86% of the planet's above-ground (as opposed to in the oceans) carbon, and 73% of the planet's soil carbon.

10. Hold a class discussion: *How do trees handle carbon dioxide? Where is it stored? How much carbon can a tree store?*

11. Explain that they will become scientists; they have developed a quick carbon calculator which allows us to get a rough measure of the amount of carbon stored in trees. Give a copy of **WORKSHEET B4.4** to each group so they have a fact sheet to answer the first question.

12. Ask the students to read the carbon calculator conversion chart. If they do not understand the headings, explain it to them. *How are they going to measure the dry weight of the tree?* They need to find out the circumference. *Where are they going to measure the circumference?* Use the diagram to explain chest height circumference. Demonstrate how to measure a tree. *Is one measure enough? How many times should we measure? Should it be the same way/at the same place each time? How do we make sure no measurement is lost?* Record on a table. Each group collects a tape/piece of string and a metre stick, selects a tree, and starts measuring.

13. Ask them to calculate the average circumference for their tree and estimate the dry weight and carbon stored in the tree. *How will this carbon finally be released from the tree?* By respiration, chopping down and burning, rotting or decomposing.

TEACHER TIP
To help your students realise the amount of carbon "their" tree can store, you can ask: *How many 1kg sugar packages would they have to pile up to represent this?*

14. Have them gather around you and ask: *How can forests help us with climate change?* Trees can store carbon in their trunk, roots and leaves and use it to manufacture their food – as sugars; in this way they can help us reduce the concentration of greenhouse gases and, thus, climate change.

WRAP UP 5 MIN

Before departing join in a circle and ask the students what they have learned from this activity. *What surprised you and what did you enjoy most? What did you learn about trees, forests and climate change? What did you like about working in small groups?*

BACK IN THE CLASSROOM 1H

1. Once you are back in the classroom, each group can gather what they collected and put pictures, drawings, sounds and/or videos on this collaborative wall: https://digipad.app/p/62197/a489296342453. Before posting, ask them to describe precisely what their pictures, sounds, videos, etc. represent and where exactly they found them in the forest.

2. If some questions remain unanswered, ask your students: *How can you answer these questions? Experiments? Documentary analysis?* etc.

3. Ask them: *Do you think every forest in the world looks alike? How can you explain their differences?* Distribute **WORKSHEET B4.5**.

4. If you have internet access, tell your students to go on the Global Forest Watch website (https://www.globalforestwatch.org/map/) so you can see the impact of deforestation on a global scale. If you do not, you can distribute **WORKSHEET B4.6**.

TEACHER TIP
On the Global Forest Watch website, you can tick/untick different options. We suggest focusing on Forest Changes > Deforestation alert, and untick all the others.

5. Discuss how forests, even ones far away in other countries, are still very important to your community. They serve as large "carbon sinks", accumulating carbon and giving back more than 20% of the oxygen for the whole planet.

- *What would it be like if there were no trees or forests?*
- *How would our lives be different?*
- In groups, or as a class, have students discuss how they knowingly – and unknowingly – may contribute to deforestation of the world's forests. Ask: *How can you help prevent or solve such issues in your own community and the world?*

WRAP UP 5 MIN

Hold a classroom discussion allowing your students to summarise what they learned during these sessions:

- *What is a tree/forest?*
- *What are their needs?*
- *How can forests help tackle climate change?*

Take a moment to acknowledge their feelings: *Did you enjoy going outside? Which memories will you keep about this experience?*

BACKGROUND FOR TEACHERS

WHY GO ON A FIELD TRIP?

This lesson gives you an opportunity to teach outside the classroom, on a field trip. The idea is to give some disciplinary input: a forest isn't only an association of trees, but also contains many different types of organisms and represents an ecosystem in itself. Trees need light to grow and use carbon dioxide in order to do so; thus, they play a key role in climate change mitigation.

This lesson also allows **the development of various skills,** including the recognition of forest sounds, collecting samples in a scientific way, and working in groups.

But the most important aspect of a field trip is **to make students aware of their local environment:** by allowing them to link their knowledge with a concrete local place, they will be more involved in the protection of this forest and more likely to engage in action to tackle climate change.

TREES AND CLIMATE CHANGE

Trees differ from most other plants by their perennial (long-lived) woody trunk. They can be classified as deciduous trees, which lose their leaves seasonally, such as oaks, or as evergreens, like pines. Trees grow both in height and in diameter. Some tree species have visible rings that facilitate the study of their growth, as they represent the inner living layers under the bark that have aged and become inactive. These growth rings reflect seasonal changes (including changes in climate). The leaves have a large surface area: they capture both light and gases for respiration and photosynthesis. The trunk is solid and gives height to the tree. The roots grow far and wide beneath the soil to obtain water and nutrients.

Trees play a key role in climate change since they turn high amounts of atmospheric carbon into sugars (see lesson A5, page 71) or store this carbon in the soil. On the other hand, deforestation and wood burning lead to the release of carbon that was previously stored, increasing the atmospheric level and thus contributing to climate change.

CARTOONIST

My role

I make drawings of everything I can to describe how the forest is organised, the different trees, the leaves, the animals, etc.

SCIENTIST

My role

I pick up samples of leaves, branches, dead insects, etc. I try to identify them and put them in small bags to bring back to the classroom. I can also use some measuring tools (size, temperature, luminosity, etc.)

I have to wear gloves!

PHOTOGRAPHER

My role

I take pictures to have a clear vision of what is a forest, what is a tree, which animals I can observe, and the results of the experiments the scientist conducts.

SOUND AND VIDEO RECORDER

My role

I record the sounds of the forest and I try to identify them. I can also make some small movies of what I see.

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WORKSHEET B4.2

TRAINEE

My name: .....

My role: What will I have to do?

Write down the questions about forests that have been raised in class

e.g. What is a tree and how does it take in nourishment? What is a forest? Why is it important?

How do you feel being among trees? Use your senses...

Is the forest different from what you imagined?

Describe the elements that you gathered to answer these questions.

Which questions remain unanswered?

On the back of this sheet, make a labelled sketch which represents the exchanges between a tree and its environment (soil and atmosphere). On your sketch, you should use these terms: leaves – trunk – branches – roots – oxygen – carbon dioxide – soil – atmosphere – sunlight – water – minerals.

HELPING HAND

To be explained to the students when they need it... but not too early!

WHAT IS PHOTOSYNTHESIS?

Photosynthesis is a chemical reaction that takes place in the **leaves of trees and plants.** When leaves are exposed to sunlight, **they can use this light to turn carbon dioxide from the atmosphere into sugars.** This is how they can make their own food! During this process, plants and trees also need water absorbed from the soil by their roots and they release oxygen that goes into the atmosphere.

Note: **Plants also breathe!** In sunlight, they perform both photosynthesis and respiration but only respiration in darkness.

WHAT IS A TREE?

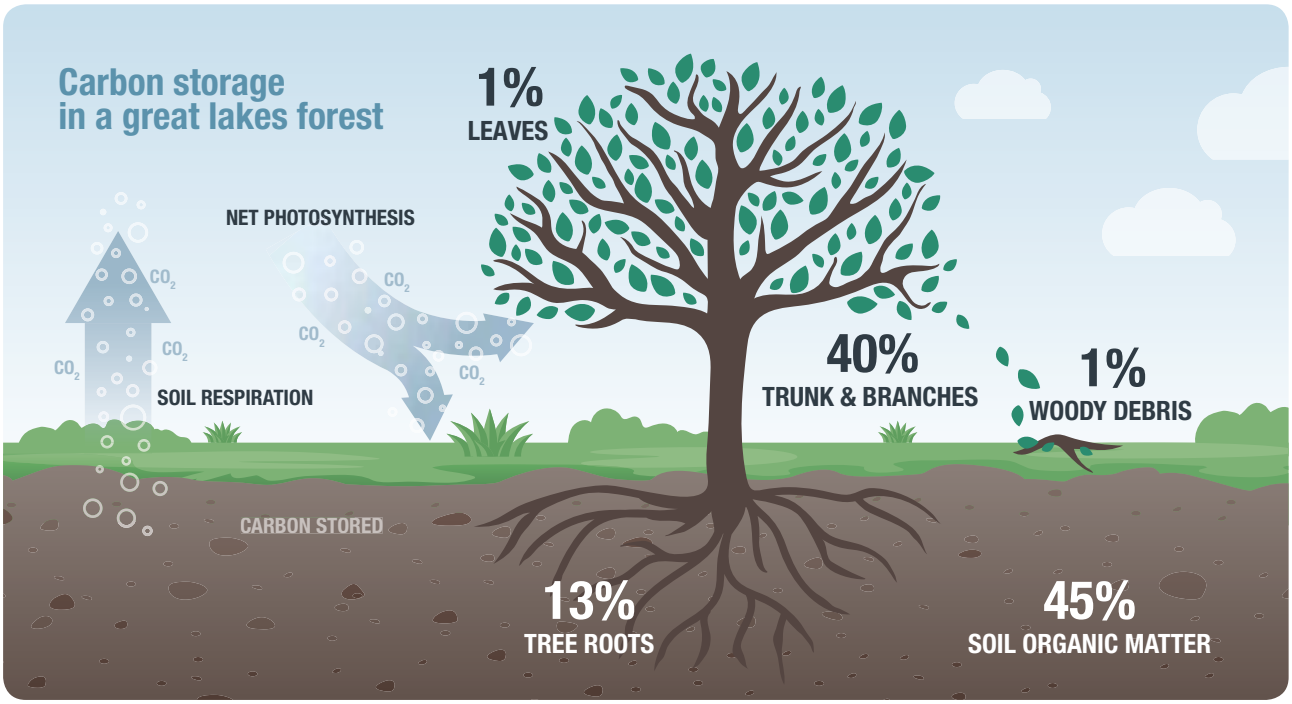
A tree is a plant that grows wood in its trunk. This wood contains **conducting vessels** which act in the same way as your veins carry blood: instead of blood, trees have sap that transports sugar, minerals and water, just as your blood does!

WHAT ARE THE DIFFERENT PARTS OF A TREE?

A tree consists of four visible parts, and one hidden under the ground:

- → **The leaves,** in presence of light and contact with the atmosphere, absorb carbon dioxide and release oxygen.
- → **The branches** to which the leaves are connected.
- → **The trunk** contains wood and is surrounded by bark.
- → **The flowers, fruits and seeds:** during the flowering season, flowers bloom and once pollinated, transform into fruits that contain seeds.
- → **The roots,** which are hidden in the soil, that absorb minerals and water.

WHAT BECOMES OF THE CARBON DIOXIDE IN PLANTS?

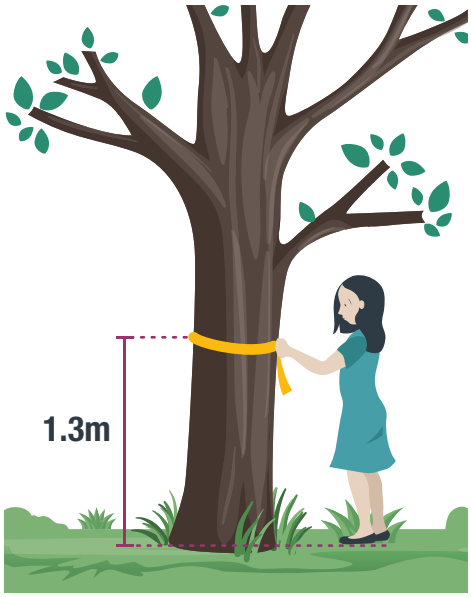


Source: Adapted from an infographic on http://climategreatlakes.com/feature-accounting-for-carbon/

INSTRUCTIONS FOR MEASURING THE TREE AND CARBON STORED

1. Measure the circumference of the tree at the standard chest height (1.3m) with a tape measure. Record the measure in centimetres. Repeat at least tree times, at the same height, and calculate the average measure.
2. When you've got your average circumference, look at the table to convert this to dry weight. Use the nearest value in the table to your value.
3. Because half of the dry weight of the tree is carbon, you then need to divide your answer by two. This tells you how much carbon is stored in the tree.
4. You can also calculate how much carbon dioxide was absorbed to create this carbon store, by multiplying your figure for carbon by 3.67.

CIRCUMFERENCE (CM)	TREE DRY WEIGHT (KG)
50	106
100	668
150	1,1964
200	4,221
225	5,771
250	7,641
275	9,842
300	12,410
325	15,350
350	18,700
400	26,674

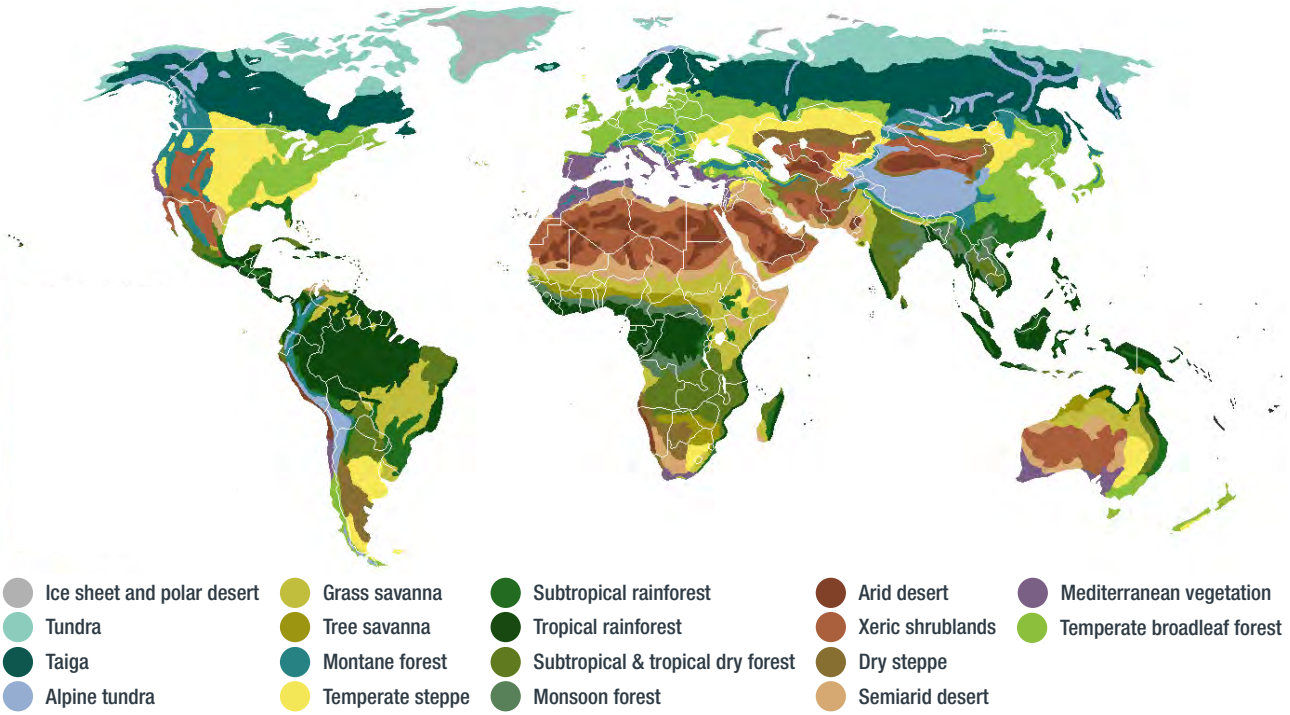


These values, provided by Forest Research, are for an individual hardwood tree in Westonbirt Arboretum. They can be used as an example. Trees will grow at different rates across the world depending on, for example, the species, soil, drainage, slope aspect and climate conditions.

These two maps represent the different types of vegetation and climates around the world.

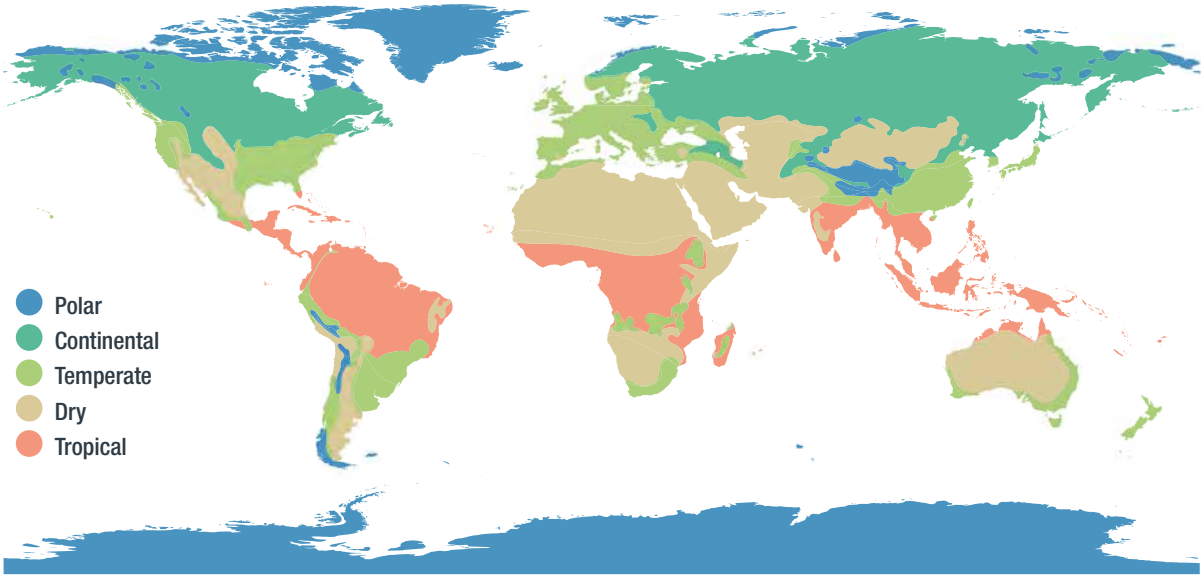
- Make a list of the different types of forests.
- Which type corresponds to the one you visited on your field trip?
- How can you explain the distribution of these forests?
- What may be the consequences of climate change on these forests?

MAP OF THE VEGETATION TYPES AROUND THE WORLD



Source: Wikipedia

MAP OF CLIMATE CLASSIFICATION



WORKSHEET B4.6

EXPERT

These two maps represent the progression of deforestation – using deforestation alerts – between 2004 and 2020. The pinker the stains, the more deforestation present.

MAPS OF DEFORESTATION ALERTS

Source: https://www.globalforestwatch.org/map