

## **Content package for interactive whiteboards: The tropical rainforest**

This guideline provides an overview of the content and didactic context of the media in the content package for interactive whiteboards entitled “The tropical rainforest.”

General information on the use and teaching concept of the content packages for interactive whiteboards is provided in the teaching method “Working with a content package for interactive whiteboards,” which is also included in the media package.

### **1 Introduction to teaching this topic**

#### **1.1 Motivation for the topic**

For students, the topic of “tropical rainforests” is difficult to grasp in their day-to-day lives. Most of them associate tropical rainforests with the “jungles” they are familiar with from books and movies or the “idyllic greenhouse” environment that they may have experienced themselves at a botanical garden. Very few know that a tropical rainforest is a sensitive ecosystem that is of vital importance for the existence of our planet. The intention of this content package is therefore to familiarize the students with this world that is strange to them – the tropical rainforests – and to sensitize them to the fact that consumer behavior in rich countries destroys tropical rainforests and that they themselves are more or less involved in this destruction. They will learn what they themselves can do to protect tropical rainforests.

The curricula of German schools cover the topic of tropical rainforests under various aspects, primarily in geography and biology classes in grades 8 and 9. Tropical rainforests are usually mentioned in connection with ecology, nature conservation and species protection, and sustainability, and the terms “biotope” and “biodiversity” come up repeatedly.

- Biotope or ecosystem: specific characteristics (for example, heights of vegetation, thus the layer structure), nutrient poverty of the soil, habitat for plants and animal communities, and also for indigenous peoples.
- Species protection and nature conservation: animals and plants that are found only in rainforests.
- Natural region problem area, due to the threats that rainforests are exposed to: slash-and-burn and mechanical deforestation due to population pressure and population growth, depletion/overexploitation of resources, intensive monoculture.
- Influence on the global climate (rain balance, CO<sub>2</sub> absorption); negative impacts on the global climate to be expected as a result of the continual destruction of rainforests.

In addition, tropical rainforests are also covered in the curricula in the following contexts, which are not included in this content package but should nevertheless be dealt with in class:

- Comparison of rainforest habitat with the local forest; for example, in the moderate latitudes (working out the differences in types of forests).
- Economic area in terms of compatible economic use: contrast between traditional and industrial uses; questions about the possibility of sustainable use, and whether the interests of the indigenous population and outside populations can be reconciled and whether reconciliation is even desired by the “acting powers.”

- Ability of indigenous peoples to survive if their livelihoods are endangered, and the social consequences of the actual changes in their habitat (population structures, way of life, loss of traditions).
- Positive approaches to the preservation of tropical rainforests; for example, the possibility of (gentle) tourism.

### 1.2 Media selection

The content package for interactive whiteboards entitled “The tropical rainforest” contains 28 individual media.

- 1 photo: The tropical rainforest of French Guiana
- 4 photo collages on: slash-and-burn and road construction in tropical rainforests (each with a satellite image), eco labels, crop genetic diversity
- 2 schematic diagrams on species diversity and on temperature variation and rainfall in tropical rainforests
- 1 interactive table with data on carbon storage in biomass and forests of the Earth
- 1 interactive labeling photo showing the soil characteristics in tropical rainforests
- 2 interactive labeling graphics on the layers and geographical locations of tropical rainforests
- 3 interactive graphics on the topics: trade winds, typical day in a tropical forest, connection between slash-and-burn and the global climate
- 1 interactive mind map on rainforests in general
- 2 interactive multiple-choice tests with questions on general knowledge about rainforests and their destruction
- 1 matching exercise to deepen the students’ knowledge on the three levels of rainforest protection
- 5 information sheets on the topics: general characteristics of rainforests, soil characteristics, species diversity, genetic wealth, and consumer tips for rainforest-friendly behavior
- 1 inquiry task on the rainforest pharmacy (with link list)
- 1 role-playing game on the dangers for rainforests
- 1 link list with links to other information on the topic

The media package contains also 2 video clips: “Historical evolution of land use” and “Slash-and-burn in rainforests”

### 1.3 Background information for teachers

The media can be combined in various ways in terms of content and teaching method, depending on the focus of the class.

It is recommended that teachers work through the topic in the following steps:

- **Introduction to the topic of “tropical rainforests”**  
(climate, geography, characteristics of tropical rainforests, soil and humus, species diversity in tropical rainforests)
- **Significance of tropical rainforests**  
(as carbon sinks, for the climate, for genetic wealth, as a pharmacy)
- **Destruction of tropical rainforests**  
(the extent of rainforest destruction, why the chain saw reigns, consequences of rainforest destruction)

- **Protection of tropical rainforests**  
(consumer behavior, environmental organizations, politics)

Note: The button for calling up each medium is also indicated in the following list of media.

Other sources of information for teachers and students (for example, for presentations) are compiled in a link list:

Medium



Link list for “The tropical rainforest” interactive whiteboard content

## 2 Introduction to the topic of “tropical rainforests”

The specific characteristics of tropical rainforests can be worked out with this content package. Unless indicated otherwise, the information refers to the tropical rainforest in the Amazon Basin.

Notes:

- All sections of the content package lend themselves to comparison with the forests of the moderate latitudes; for example, with respect to the soil characteristics or layer structure.
- At the start, a clear distinction should be made between the meaning of the term “tropical rainforest” and the popular everyday term “jungle.”

### 2.1 Climate

Why is a rainforest called a “rainforest”? The answer is very simple: Because it rains a lot in a rainforest. The classic, permanently humid tropical rainforests can develop where:

- The air is warm throughout the entire year, with constant temperatures of 23 °C to 27 °C.
- It rains a lot, at least 1,500 millimeters per year.
- The relative humidity is high, at least 70 percent.
- The amount of rain is greater than the amount of water that evaporates.

The tropics constitute a zone without pronounced seasons. There are no seasons that correspond to spring, summer, fall, and winter. Nighttime is basically winter in the tropics, because the daily temperature fluctuations far exceed the annual fluctuations (see Section 2.3.2).

The **annual** temperature fluctuations and the annual rainfall are visualized based on a comparison between the capital cities of French Guiana (Cayenne) and Germany (Berlin).

Medium



“Rainfall and temperatures in tropical rainforests”

**Teaching ideas:** Using data sources on the Web (see information in the link list), the students can compare the temperature variations and rainfall of other rainforest regions.

### 2.2 Geography

The term “tropics” comes from Greek and means change, turn, or rotation. According to the definition, the parts of the land surface located between the Tropic of Cancer in the north (23°27' northern latitude) and the Tropic of Capricorn in the south (23°27' southern latitude) are referred to as the “tropics.”

The geographical location of the tropical rainforest regions and the names of the countries that have tropical rainforest regions are compiled on a world map that can be labeled interactively.

Medium



“Where are the tropical rainforests?”

### Why is there so much rainfall at the equator?

The strong sunshine heats the humid air directly above the equator. The warm air rises, cools off, and releases the excess moisture as rain. The cooled air, which is now dry, travels away from the equator very high in the atmosphere and then falls toward the two tropics. When it comes near the ground at the tropics, it is picked up by the trade winds, loaded with moisture again over the oceans, and transported back toward the equator. The cycle then starts over again.

A simulation illustrates this phenomenon:

Medium



“Trade winds”

## 2.3 Characteristics of tropical rainforests

There are a few universally valid characteristics that are typical for classic, evergreen tropical rainforests. They are summarized in the following information sheet.

Medium



“Characteristics of rainforests”

### 2.3.1 The layer structure

A primary characteristic of tropical rainforests is that the vegetation is divided into layers, similar to the stories in a house. An interactive labeling graphic provides information about the number of layers and the relative heights:

Medium



“The layers of tropical rainforests”

Note: The division of tropical forests into layers is very controversial in science: There is much debate over whether such complex systems can be simplified in this way.

### 2.3.2 The climate

The climate in tropical rainforests is also unique. The weather report in the Amazon rainforest is basically the same 365 days a year: Patchy fog clears up quickly in the morning, and around noon it is hot. The rainforest heats up and stores the sun’s energy – the rainforest acts as a solar battery. Then the first clouds gather. It becomes very muggy in the early afternoon, the clouds grow thicker, and in the late afternoon there are torrential rainstorms accompanied by lightning and thunder – the rainforest acts as a rainmaker. Toward evening, patchy fog may form; the night is “cool” with temperatures around 21°C. The rainforest slowly releases the stored solar energy. In terms of the weather, that is a typical day in the Amazon rainforest.

An interactive graphic visualizes this fact.

Medium



“A day in the Amazon rainforest”

## 2.4 Soil and humus

Tropical rainforests grow in different soils. The most well known are the nutrient-poor soils in the Amazon. But precisely this lack of nutrients is the basis for species diversity in tropical rainforests. An information sheet and an interactive labeling photo showing a typical soil profile of the humid tropics provide details:

Media



“Soil and humus in tropical rainforests”

“Soil of tropical rainforests”

**Teaching ideas:** Take the students on a field trip to a forest near the school so they can investigate the soil characteristics of a forest. (This will not normally be a tropical rainforest.) A possible work assignment would be to determine the humus content of the soil; for example, based on the soil’s coloration or by means of a “combustion experiment.” The link list refers to suitable instructions.

Note: The rainforest soil can be used as a basis for discussion of the general problem of **soil erosion** due to the disappearance of increasingly large forest areas.

## 2.5 Species diversity in tropical rainforests

What is meant by the term “species diversity”? It indicates how many species of animals and plants live in a given habitat or a given region; for example, in a chestnut tree, in a meadow, in Germany, in the Amazon rainforests, or on Earth.

Although only 7 percent of the ice-free landmasses are covered by tropical rainforests, up to 90 percent of all known species of animals and plants are found in tropical rainforests. A graphic illustrates this fact:

Medium



“Tropical rainforests – many species in a small area”

An information sheet provides data on the causes of species diversity in tropical rainforests and the problem of extinction:

Medium



“Species diversity in tropical rainforests”

**Teaching ideas:** The students can learn about endangered species of animals and plants in an encyclopedia or on the Web. (Suitable links are included in the link list.) Which animal and plant species are at greatest risk of extinction? Can a connection with the disappearance of rainforests be identified?

## 2.6 For further study

The learned material can be reinforced based on 13 general questions on tropical rainforests. However, the test can also be used to review the information.

Medium



“The tropical rainforest (test)”

### 3 Significance of tropical rainforests

#### 3.1 As a carbon sink

No terrestrial ecosystem stores more carbon than the wood of existing forests: The biomass of the Amazon rainforests alone contains as much carbon as the entire human race burns in ten years. Approximately 20,000 metric tons of carbon are stored in each square kilometer of the Amazon rainforest.

The following table provides an overview of the percentage of carbon contained in the Earth's total biomass as well as in various forests. The table's contents can be filled in interactively.

Medium



“Tropical rainforests as carbon sinks”

Note: A separate content package on the topic “greenhouse effect” is available on the media portal of the Siemens Stiftung.

#### 3.2 For the climate

Tropical rainforests not only absorb large amounts of carbon, but also produce clouds of vapor that protect the Earth's surface from further warming. These clouds reflect sunlight, much as snow and ice do. Tropical rainforests are the Earth's air conditioner. The following photo can be used to prepare the students for the topic:

Medium



“Tropical rainforests – the Earth's air conditioner”

Note: It is frequently suggested that rainforests are the Earth's green lungs because they release oxygen and absorb carbon dioxide. That statement is false, because an “old,” intact rainforest uses just as much oxygen during the respiration and decomposition processes as it produces during photosynthesis. Only young, growing rainforests release oxygen into the atmosphere.

#### 3.3 For genetic wealth

Most food and feed crops grown around the world consist of just a few species: wheat, rice, corn, barley, potatoes, sweet potatoes, cassava, and soybeans. The variety in livestock is also modest: cattle, pigs, poultry, sheep, goats, and horses. In the timber industry, the preferred crop trees are spruce, fir, Douglas fir, and poplar. The variety of fishes in fish farming is limited to trout, salmon, bass, and carp.

In large-scale farming, we do not have genetic wealth, rather genetic poverty. However, people in rich countries sincerely think that they have a choice from a wide variety when they see the supermarket shelves full of fruits and vegetables. A photo showing a wide range of potato varieties makes clear that this belief is not true:

Medium



“Potato varieties from Ecuador”

Additional information on this aspect is compiled in an information sheet.

Medium



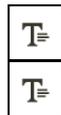
“Genetic wealth in tropical rainforests”

### 3.4 As a pharmacy

Half of all globally approved drugs originate from plants. To date, potential active ingredients for treating cancer have been discovered in 1,400 tropical plants. Some drugs created from tropical plants have been successfully used for a very long time, such as the active ingredient quinine for treating malaria. It is obtained from the cinchona tree in the Amazon. Increasingly, animals, particularly insects, are also being investigated for pharmaceutically active substances. The species diversity in tropical rainforests offers a rich source for this research.

The students can use an inquiry task to investigate this important topic in detail. (Useful links are compiled in a link list.)

Media



Inquiry task "Rainforest pharmacy"

Inquiry task "Rainforest pharmacy (link list)"

### 3.5 Summary

Tropical rainforests are thus vitally important for the ecosystem Earth. A mind map clearly summarizes this concept:

Medium



"The tropical rainforest (mind map)"

## 4 Destruction of tropical rainforests

The students are not familiar with a tropical rainforest from their day-to-day lives. At the most, they have been to a greenhouse or an aquarium where they came into contact with an artificial "tropical environment." Because they lack this everyday experience, the students must be taught in another way that they also contribute a bit to the destruction of rainforests even though they live somewhere completely different.

### 4.1 The extent of rainforest destruction

It seems as though the rapid rate of rainforest destruction has been slowed down a little in recent years. In the Brazilian section of the Amazon, the rainforests shrank at a record pace until 2005, and since then the annual losses have been declining. However, there are no signs of a reprieve since vast areas of rainforests are still being cut down. In its Global Forest Resources Assessment (FRA 2010), the United Nations Food and Agricultural Organization (FAO) estimates that 160,000 square kilometers of forest worldwide were destroyed annually from 1990 to 2000. In the subsequent decade from 2000 to 2010, this value decreased to 130,000 square kilometers, of which 40,000 square kilometers on average were attributed to South America and 34,000 square kilometers to Africa.

#### Tropical rainforests

In the three large rainforest regions of the world (Amazon Basin, Congo Basin, and Southeast Asia), 54,000 square kilometers of tropical rainforest were lost every year from 2000 to 2010 (The State of Forests in the Amazon Basin, Congo Basin and Southeast Asia, 2011). In the prior decade, from 1990 to 2000, the amount was 71,000 square kilometers annually. The losses have therefore slightly declined. Because there are other tropical rainforests beyond the three large rainforest regions (for example, Central America and Madagascar), the actual figures on annual rainforest losses are probably somewhat higher.

### Rainforest losses in the Amazon

The tropical rainforests in the drainage area of the Amazon Basin cover an area of 8 million square kilometers. Approximately 65 percent or 5.2 million square kilometers of the Amazon region are located in Brazil, and the remaining 35 percent are distributed among seven other South American countries. In the Brazilian section of the Amazon, there are still 4.2 million square kilometers of largely pristine primary forests. The FAO has calculated that in the entire Amazon, a total of 600,000 square kilometers of tropical rainforest were destroyed in the period from 1990 to 2010. For comparison: The area of Germany is 357,000 square kilometers.

The annual loss of 60,000 square kilometers of tropical rainforest worldwide corresponds to an area equal to 35 soccer fields (100 x 65 meters) that is lost every two minutes. In the amount of time it takes to say the words “twenty-one, twenty-two,” over one-half of a soccer field has been lost. (The link list provides a source that illustrates the disappearance of rainforests in multiples of soccer fields.)

Rainforest destruction is even visible from space, as shown by a couple of images from the National Aeronautics and Space Administration (NASA):

Medium



“Rainforest destruction – view from outer space”

### Example: Brazil

The analysis of satellite data by the Brazilian National Institute for Space Research (INPE) has revealed that from 2002 to 2013, some 161,000 square kilometers of rainforest were cleared in the Brazilian section of the Amazon alone. Most of this, specifically 134,000 square kilometers, occurred in the soy-producing states of Mato Grosso, Para, and Rondonia.

The destruction peaked in 2003 and 2004. In these two years alone, 52,000 square kilometers of rainforest in the Brazilian section of the Amazon were destroyed. Since then the deforestation rate has decreased. The INPE figures show that rainforest destruction in the Amazon has significantly decreased in the last ten years.

## 4.2 Why are rainforests being destroyed?

Rich countries’ craving for meat, agrofuels, and wood increases the pressure on tropical rainforests. Chain saws reign; walls of fire level the land. New areas of cleared land are constantly needed, even more rainforest areas are destroyed, and even more species disappear. A vicious circle has started. However, as long as dead rainforests are more valuable than living rainforests, the situation will not change much. There are many causes for this trend. It is not only the people in the tropical countries who are responsible for the overexploitation of the rainforest. In fact, it is particularly the people in Western industrialized countries for whom the rainforests are being destroyed. The main reasons for the destruction of tropical rainforests are the following:

- Slash-and-burn for new territory
- Logging of tropical wood
- Establishment of oil palm plantations for energy production (agrofuels)
- Conversion of rainforest areas to pastures and soybean plantations
- Extraction of raw materials (iron ore, gold, bauxite, etc.)
- Infrastructure (road construction)
- Building of dams
- Logging of wood for coal and firewood
- Land speculation

In a role-playing game, the students can look into these many dangers to rainforests. They can indirectly reflect on their consumer behavior and recognize that they also contribute a bit to the disappearance of rainforests.

Medium



“How we destroy tropical rainforests”

The image can be used to complement the role-playing game from the aspect of rainforest destruction due to infrastructure expansion.

Additional media related to the role-playing game are available on the following aspects of rainforest destruction:

Creation of useful areas for energy crops or agriculture

Medium



“Historical evolution of land use”

Infrastructure:

Medium



“Road construction in tropical rainforests”

**Teaching ideas:** “What does a cell phone have to do with the destruction of tropical rainforests?” Since nearly every adolescent owns a cell phone today, this topic in particular can establish a concrete reference for making it clear to the students that they are “complicit” in the deforestation of tropical rainforests. (Background information: A cell phone contains tantalum, a rare, expensive element that is extracted from coltan, a crude ore. We encounter tantalum in our daily lives as an indispensable component of cell phones, computers, and video game consoles. A lot of money can be made with coltan. It is estimated that 80 percent of the global coltan reserves lie underground in the Democratic Republic of the Congo (DR Congo), and tropical rainforests grow above the reserves. According to a UN report on illegal exploitation of raw materials in the DR Congo, primarily five raw materials are in high demand and are exploited: diamonds, gold, copper, cobalt, and coltan.)

### 4.3 Consequences of rainforest destruction

There are many consequences of tropical rainforest destruction. While soil erosion and species extinction are consequences that primarily affect the local people, there is one consequence that affects all people no matter where they live: climate change.

#### Climate and climate change

The loss of rainforests will result in reduced evaporation and thus change heat circulation, which could have a serious effect on the global climate. Water evaporates from the top of the closed canopy of tropical rainforests and rises as water vapor to heights of up to 8,000 meters. The rising water vapor transports the thermal energy generated on the Earth’s surface by sunlight high into the atmosphere. Raindrops do not form until the water vapor reaches these heights, where the heat is released. This heat drives weather activity and affects global air circulation. It is difficult to

foresee the consequences that a change in this circulation will have on the climate and in particular on the distribution of precipitation on Earth.

A simulation and a video explain to the students the disastrous consequences of slash-and-burn clearing of tropical rainforests on the global climate.

Media



“Consequences of slash-and-burn”

“Slash-and-burn in rainforests”

### 4.4 For further study

The learned material can be reinforced based on 15 questions about the destruction of tropical rainforests. However, the test can also be used to review the information.

Medium



“Destruction of tropical rainforests (test)”

## 5 Protection of tropical rainforests

Rainforest protection starts in day-to-day life. Think globally – act locally. This means that people who want to make a change should learn about the situation by looking into the causes of rainforest destruction; that is thinking globally. The students should recognize that people in rich countries can protect tropical rainforests by reflecting on their own consumer behavior: eat less meat (which also benefits health); use recycled paper; buy regionally produced food; use fair trade products; do not buy outdoor furniture made from tropical wood, etc.

Everyone can play a part in conserving tropical rainforests at three levels.

### 5.1 Consumer behavior

A person’s own sphere of activity and influence must not be underestimated. However, good intentions often fail because people do not know what they can do.

A photo collage provides information about product labels (for example, the FSC seal), which the students can use to guide them in environmentally and rainforest-friendly behavior. For example, it would help rainforests a lot if we bought only recycled toilet paper instead of paper made from virgin pulp, which requires wood.

Medium



“How to recognize rainforest protection”

Additional information and tips on how each person can make an individual contribution to environmental and rainforest protection are compiled in an information sheet. Based on this information, the students can make a list of what they should pay attention to when they shop in the future in order to behave in a “rainforest-friendly” manner.

Medium



“How I as a consumer can protect tropical rainforests”

## 5.2 Environmental protection organizations

This is the second level at which something can be done: support people and organizations that have dedicated themselves to protecting rainforests. In this case, passive help in the form of material support is just as valuable as active work for the environment, because nothing can be achieved without a financial basis.

The students could, for example, come up with a plan to buy a piece of a rainforest as a class, or organize a day of action whose proceeds will be used to benefit a rainforest protection project.

## 5.3 Politics

There are challenges, however, that cannot be solved through personal sacrifice or changed consumer behavior in one's own sphere of influence. They call for action at the third level, politics. Increasingly, politics must set incentives and guide citizens' and companies' behavior in the appropriate direction through laws and taxes. However, politics and industry ultimately respond to citizens' interests. By expressing their opinions, the students make it clear to politicians that protecting rainforests is very important to them. Based on the example of rainforest protection, the students will learn how they can influence politics in a general way; for example, by stating their concern in a letter to a local politician or by collecting signatures.

**Teaching ideas:** Involvement in government projects geared to the protection of tropical rainforests also fosters understanding of politics and issues with international connections. One suitable example is a UN project for the protection of rainforests, REDD (The United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries). The REDD principle is simple: Developing countries preserve their forests and receive money from industrialized countries for doing so. Can such approaches work? The students should discuss this issue.

## 5.4 Summary

An interactive exercise is available for further study of the three levels of rainforest protection:

Medium



“The three levels of rainforest protection”

Note: This interactive exercise can also be used to initiate a discussion about the three levels of rainforest protection among the students.