



Credit: Randika Segah/Dreamstime.com

Save our rainforests!

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What is happening to tropical rainforests?

1.1 What and where are tropical rainforests?

Let's explore 1

How well do you know about tropical rainforests?

Scan the QR code to watch a video clip about tropical rainforests. Write 'T' for a true statement and 'F' for a false one.

- 1 Tropical rainforests can be found in Antarctica.
- 2 Tropical rainforests make up 6% of the earth's surface.
- 3 Tropical rainforests provide food and medicine to us.



Tropical rainforests

There are large forests in tropical areas. In these areas, the air temperature is high and there is a lot of rain all year round. Because of this, these forests are known as **tropical rainforests**.

Tropical rainforests are **found in areas between the tropics** (Figure 1). **The largest** area of tropical rainforests is in the **Amazon Basin** in South America. A large part of the Amazon Basin is in Brazil. The second and third largest rainforests are found in the Congo Basin in Africa and in South-east Asia respectively.

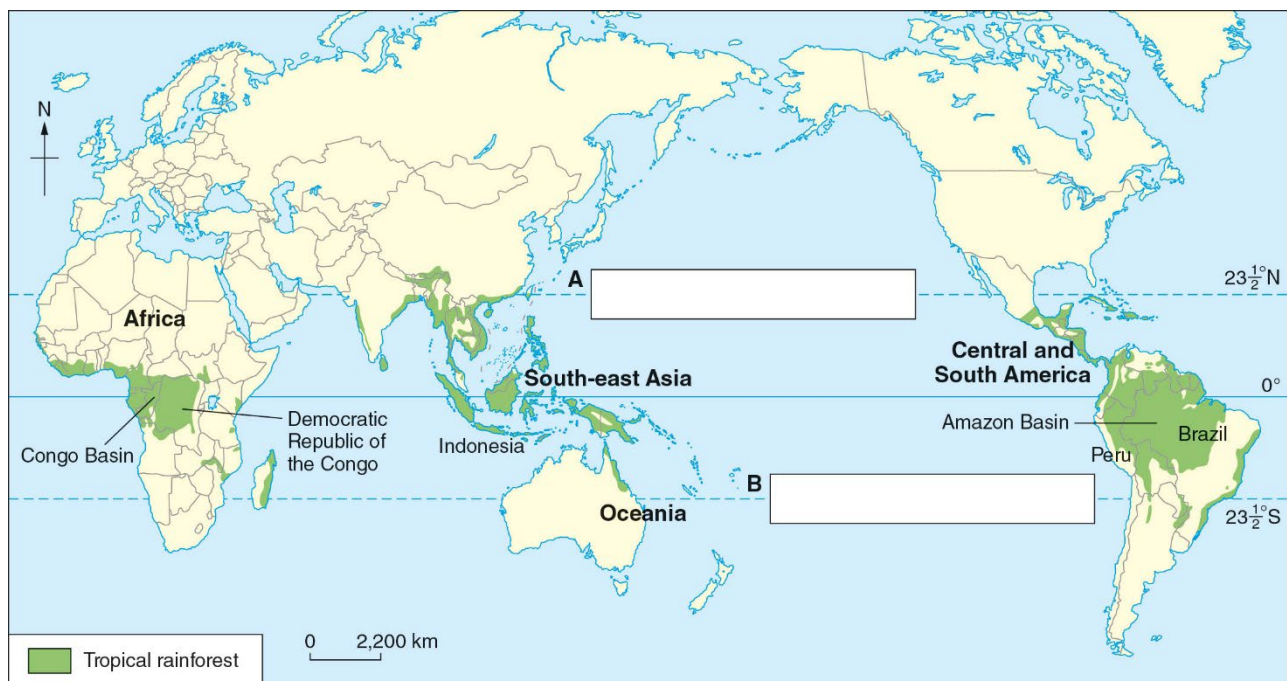


Figure 1 Global distribution of tropical rainforests

? Label latitudes A and B.

tropical rainforest 熱帶雨林 Amazon Basin 亞馬遜盆地 Brazil 巴西 Congo Basin 剛果盆地

More about the Amazon Basin

The Amazon Basin is the largest river basin in the world. Most of it is in Brazil (Figure 2).



General information

- The Amazon River is about 6,440 km long
- The Amazon Basin covers an area of more than 7 million km²
- The largest part of the basin and the river are found in Brazil

The natural environment

- Tropical rainforest is the major vegetation type in the basin
- It is home to over 2 million plant and animal species. More than 1,150 types of trees can be found in 1 km² of the forest

Native peoples

There are many native tribes in the Amazon. They have lived along the Amazon River for thousands of years



Credit: Robert Landau/Alamy Stock Photo



Credit: Nelson_A_Ishikawa/istock.com

Figure 2 The Amazon Basin

- 1 On which continent is the Amazon Basin?
- 2 Apart from Brazil, which countries does the Amazon Basin cover? Name TWO.

French Guiana 法屬圭亞那 Surinam 蘇里南 Guyana 圭亞那 Venezuela 委內瑞拉 Colombia 哥倫比亞 Ecuador 厄瓜多爾
Peru 秘魯 Bolivia 玻利維亞 Paraguay 巴拉圭 native peoples 土著

1.2 What is happening to tropical rainforests?

Let's explore 2

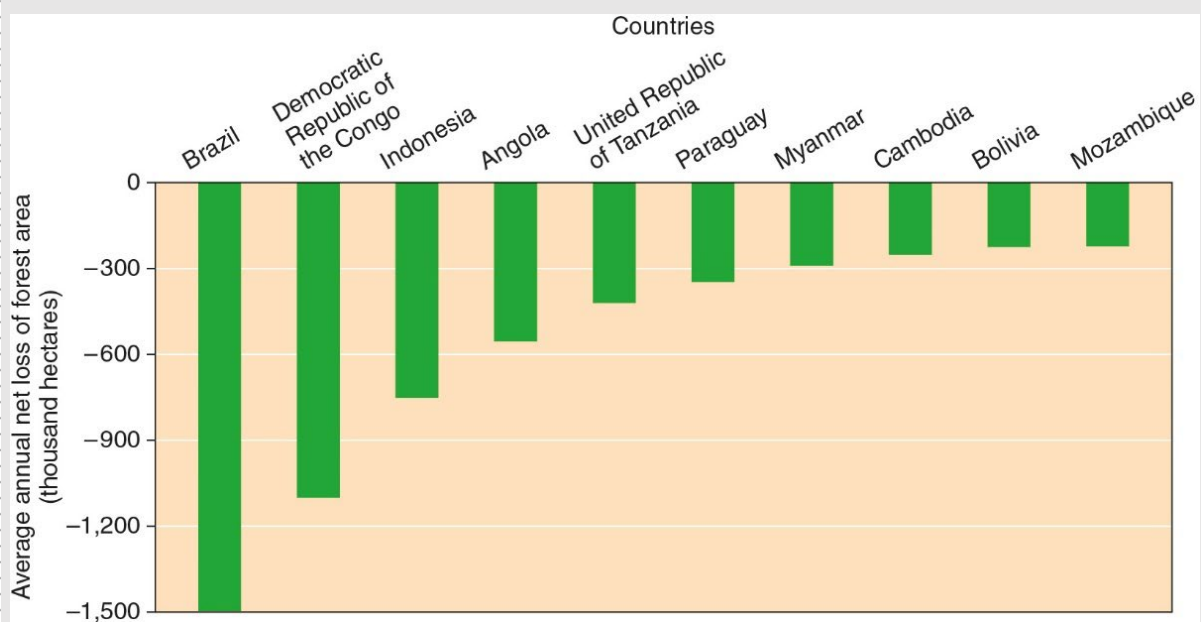
What is the present condition of our tropical rainforests?

Refer to the news clipping below and answer the questions.

The tropical rainforest is disappearing!

Tropical rainforests once covered about 1,800 million hectares, but today only about 900 million hectares are left.

Each year, millions of hectares of tropical rainforests are destroyed. If the rate of destruction remains unchanged, the tropical rainforests will disappear in 110 years.



Note: 100 hectares equals to one square kilometre.

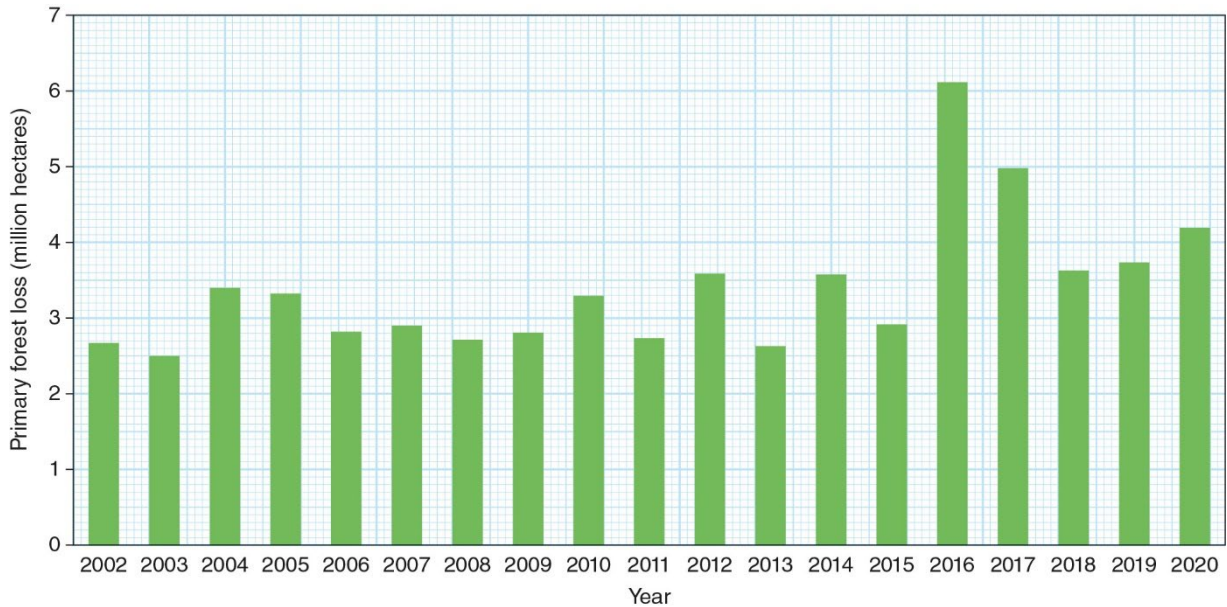
Top ten countries with annual net loss of forest area, 2010–20

Source: *Global Forest Resources Assessment 2020, the FAO*

- 1 What has happened to tropical rainforests?
- 2 Describe the changes of the forest cover in the countries shown.
- 3 Which country had experienced the greatest change?

People have been clearing tropical rainforests on a large scale at a very rapid rate (Figure 3 on p. 6). This is known as **deforestation**. This phenomenon is **particularly serious in South-east Asia and the Amazon Basin** (Figure 4 on p. 6).

Angola 安哥拉 United Republic of Tanzania 坦桑尼亞聯合共和國 Myanmar 緬甸 Cambodia 柬埔寨 Mozambique 莫桑比克
deforestation 濫伐林木



Source: Global forest watch, World Resources Institute

Figure 3 Tropical primary forest loss in the world, 2002–20

? Describe the loss of tropical primary forest in the following periods:

- 1 Between 2002 and 2015;
- 2 After 2016.



Credit: Paralaxis/Alamy Stock Photo

Figure 4 A deforested area in the Amazon rainforest

Checkpoint 1

- | | |
|--|--|
| <p>1 Tropical rainforests are found</p> <p>1 near the Equator.</p> <p>2 in South-east Asia.</p> <p>3 in the Congo Basin.</p> <p>A 1 and 2 only C 2 and 3 only</p> <p>B 1 and 3 only D 1, 2 and 3 <input type="checkbox"/></p> | <p>2 The largest area of tropical rainforests is in the _____ Basin in Brazil. It is in _____ (continent).</p> <p>3 Due to large-scale _____, tropical rainforests have been reducing rapidly in size each year.</p> |
|--|--|

Learn these words

tropical rainforest 熱帶雨林	3	native peoples 土著	4
Amazon Basin 亞馬遜盆地	3	deforestation 濫伐林木	5
Congo Basin 剛果盆地	3		

Unit summary

- Tropical rainforests are large forests in _____ areas where temperatures are _____ and there is a lot of _____ all year round.
- Figure 5 shows the distribution of tropical rainforests. Identify A–D.

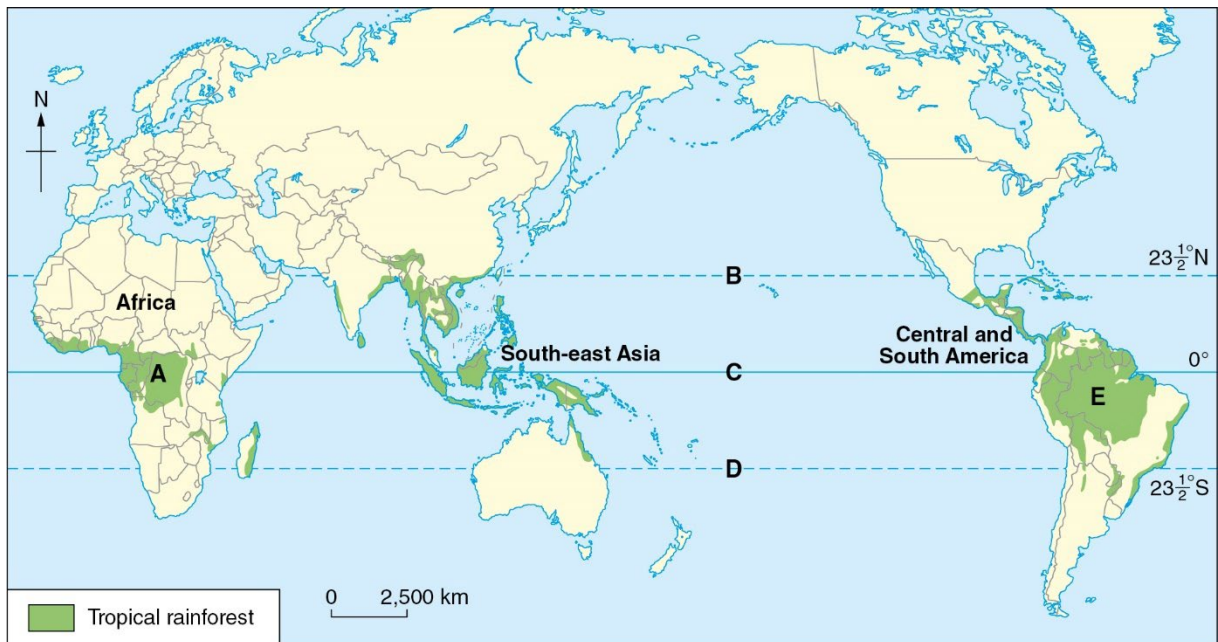


Figure 5

- | | |
|----------|----------|
| A: _____ | D: _____ |
| B: _____ | E: _____ |
| C: _____ | |

- _____ is the clearing of forests on a large scale.
- The tropical rainforest is being cleared at a fast rate, particularly in South-east Asia and the _____ Basin.

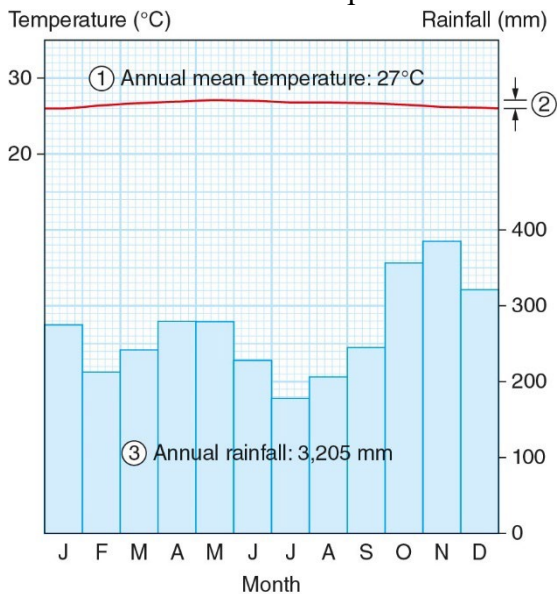
What are the characteristics of tropical rainforests?

2.1 Why are tropical rainforests there?

Let's explore 3

What is the climate of tropical rainforest areas?

Place A is located in the tropical rainforest in Indonesia. Study its climatic graph in Figure 1.



Reading tips

- ① Annual mean temperature: Average of the monthly mean temperatures in a year
- ② Annual range of temperature: Highest monthly mean temperature – Lowest monthly mean temperature
- ③ Annual rainfall: Sum of monthly rainfall in a year

Figure 1

Describe the climate of Place A in Table 1.

Table 1

Annual mean temperature	(High / Low), about _____ °C
Annual range of temperature	(Large / Small), only about _____ °C
Annual rainfall	(High / Low), over _____ mm

The climate of Place A represents a typical climate for tropical rainforests:

- 1 **hot all year round** with temperatures above 27°C most of the time;
- 2 **small annual range of temperature**, only about 2 to 4°C;
- 3 **wet**, with **high annual rainfall** of over 2,000 mm; and
- 4 **no distinct dry season**.

A hot and wet climate is very suitable for plant growth. As there is no dry season, trees grow continuously. Such climate also favours the growth of a rich variety of plants. This produces a dense forest.

annual mean temperature 年平均氣溫 annual range of temperature 年溫差 annual rainfall 年雨量

2.2 What are the characteristics of the vegetation in tropical rainforests?

Let's explore 4

How does a tropical rainforest look like?

Refer to Figure 2 which shows the tropical rainforest in the Congo Basin. Complete Table 2 about the plant characteristics of the rainforest.



Credit: guenterguni/istock.com

Figure 2

Table 2

Density of trees	(High / Low)
Types of plants	(Many / Few)
Number of plant layers	4-5
Trunks of most trees	(Straight, with branches concentrating at the top / Branching along the whole trunk)

Tropical rainforests have the following characteristics.

A Evergreen

Tropical rainforests **grow luxuriantly**. They grow throughout the year. The forests are **evergreen**.



Luxuriant growth of tropical rainforests

B A large number of species

Tropical rainforests have **the greatest number of plant species** among all types of forests. With the support of plants, there are also **many animal species**. Have you ever seen the plants and animals in tropical rainforests as shown in Figure 3?



Credit: Katja Schulz/Flickr

a Orchids



Credit: Michel Arnault/Alamy Stock Photo

b Pitcher plant



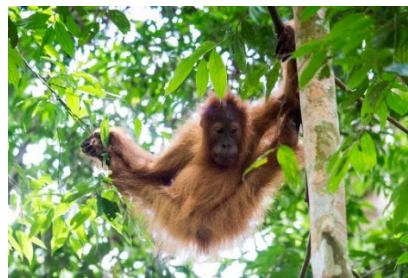
Credit: K.D. Leperi/Alamy Stock Photo

c Bromelaides



Credit: Daniel Borman/Flickr

d Toucan



Credit: Andrew H/Flickr

e Orang-utan



Credit: Kurayba/Flickr

f Red-eyed green tree frog

Figure 3 Some plants and animals found in tropical rainforests

luxuriantly 茂密地 evergreen 常綠 species 品種 orchid 蘭花 pitcher plant 豬籠草/瓶子草 bromelaides 鳳梨花
toucan 巨嘴鳥 orang-utan 紅毛猩猩

C The five-layer structure

Tropical rainforests can be divided into five layers.

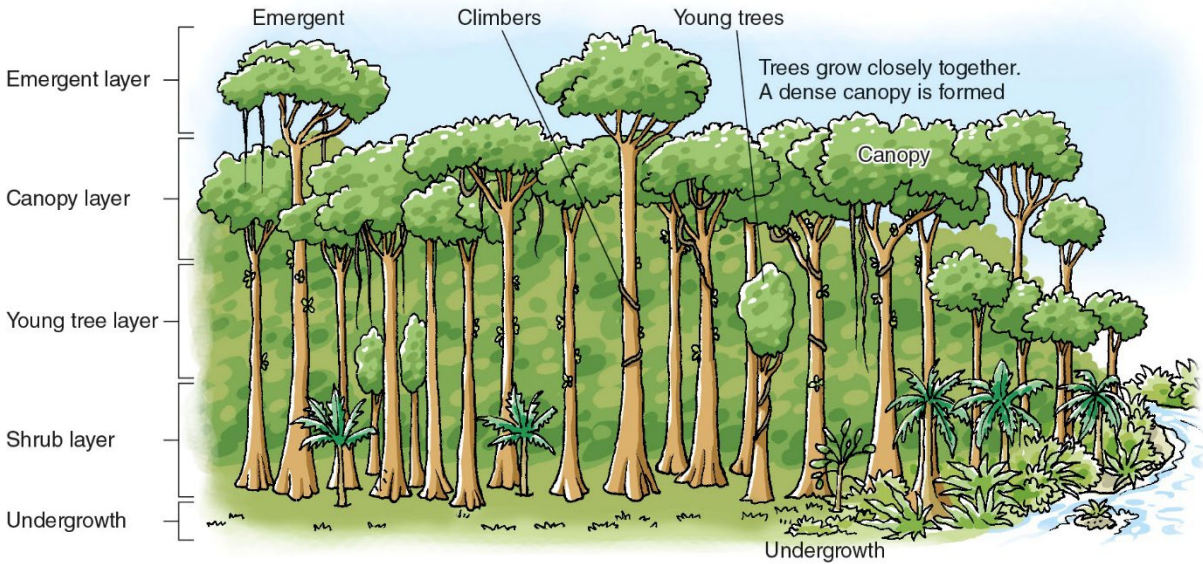


Figure 4 The layered structure of a tropical rainforest

Table 3 Characteristics of the five layers of a tropical rainforest

Layer	Characteristic
1 Emergent layer (Trees in this top layer are known as emergents)	<ul style="list-style-type: none"> Widely spaced, up to 50 metres tall With broad and umbrella-shaped crowns Straight tree trunks and buttress roots (refer to Figure 5 on p. 12)
2 Canopy layer	<ul style="list-style-type: none"> Grow closely together and their crowns overlap. This forms a dense canopy Straight tree trunks and buttress roots
3 Young tree layer	<ul style="list-style-type: none"> Sparse Slender trunks With conical crowns Grow in the shade of the canopy layer
4 Shrub layer	<ul style="list-style-type: none"> Sparse, consisting of short shrubs, ferns and other plants Most plants there do not need much sunlight <div data-bbox="954 1536 1254 1731" data-label="Image"> </div> <p>Credit: llee_wu/Flickr</p> <p>Fern on the rainforest floor</p>
5 Undergrowth	<ul style="list-style-type: none"> The trees above block much sunlight. The forest floor is fairly dark With little sunlight, there is little undergrowth at the ground level

emergent layer 露生植物層 canopy layer 冠層 young tree layer 幼樹層 shrub layer 灌木層 undergrowth 樹林底層植物
buttress root 板根 fern 羊齒類植物

D With special adaptation to the environment

Plants in tropical rainforests have developed special features to adapt to the physical environment.

a Trees

- For the tall and thick trees of the emergent and canopy layers, strong **buttress roots** grow out from them to **support the weight of the trees** (Figure 5).
- The leaves of trees usually:
 - are **broad**, in order to **absorb the maximum amount of sunlight**; and
 - have **thick waxy surfaces and drip-tips** (Figure 6), in order to **shed excess water quickly** and prevent the leaves from becoming rotten.



Credit: Goddard_Photography/istock.com

Figure 5 Buttress root



Credit: Jimmytst/Dreamstime.com

Figure 6 Drip-tip

b Other plants

Besides trees, there are **climbers**, **epiphytes** and **parasites** (Figure 7).

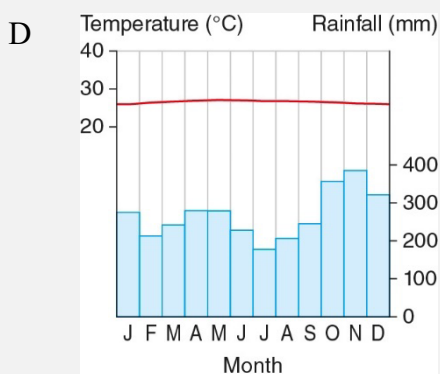
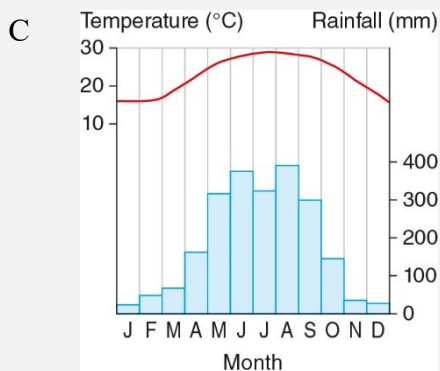
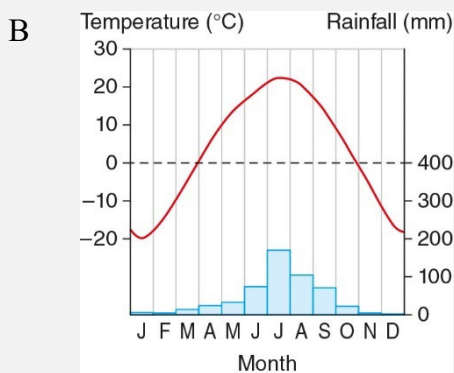
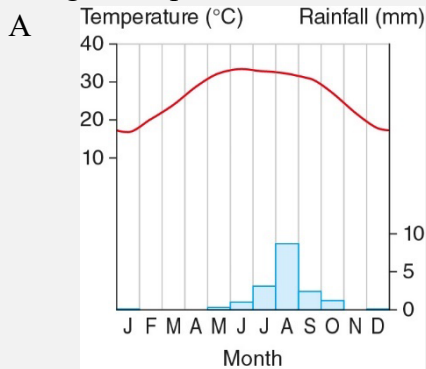
<p>Credit: Christine Warner/Flickr</p>	<p>Credit: sookie/Flickr</p>	<p>Credit: ma_suska/Wikimedia commons</p>
<p>Climbers climb up to the treetop to get sunlight for growth</p>	<p>Epiphytes grow on the trees for support (e.g. orchids)</p>	<p>Parasites grow on trees and take nutrients from the trees for their own use (e.g. corpse flower)</p>

Figure 7 Climbers, epiphytes and parasites

drip-tip 滴水葉尖 climber 攀緣植物 epiphyte 附生植物 parasite 寄生物 corpse flower 屍花

Checkpoint 2

1 Which of the following climatic graphs belongs to tropical rainforest?



2 Which of the following are the characteristics of the plants in tropical rainforests?

- 1 Trees in the emergent layer grow closely together.
- 2 The canopy layer shuts out much sunlight.
- 3 There is a lot of undergrowth.

A 2 only C 1 and 2 only

B 3 only D 1 and 3 only

3 Study Figure 8. Which of the following descriptions about the feature shown is/are correct?

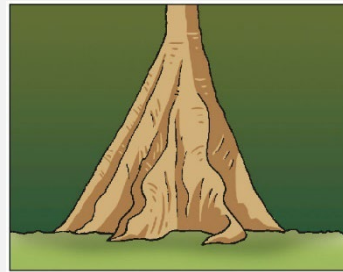


Figure 8

- 1 It provides support for tall trees.
- 2 It sheds water to prevent roots from becoming rotten.
- 3 It is a kind of adaptation for the wet environment in the rainforest.

A 1 only C 1 and 3 only

B 2 only D 2 and 3 only

4 Refer to the following statements. Write 'T' for a true statement and 'F' for a false one.

a The canopy layer is the uppermost layer in the tropical rainforest.

b There is little undergrowth in the tropical rainforests because little sunlight can reach the forest floor.

c Climbers grow on trees for support.

d Parasites grow on trees for nutrients.

e Hot and wet climate in the tropical rainforest favours the growth of plants.

2.3 What is the tropical rainforest ecosystem?

Let's explore 5

Are there linkages between the living and non-living things?

Refer to Figure 9 and answer the questions.

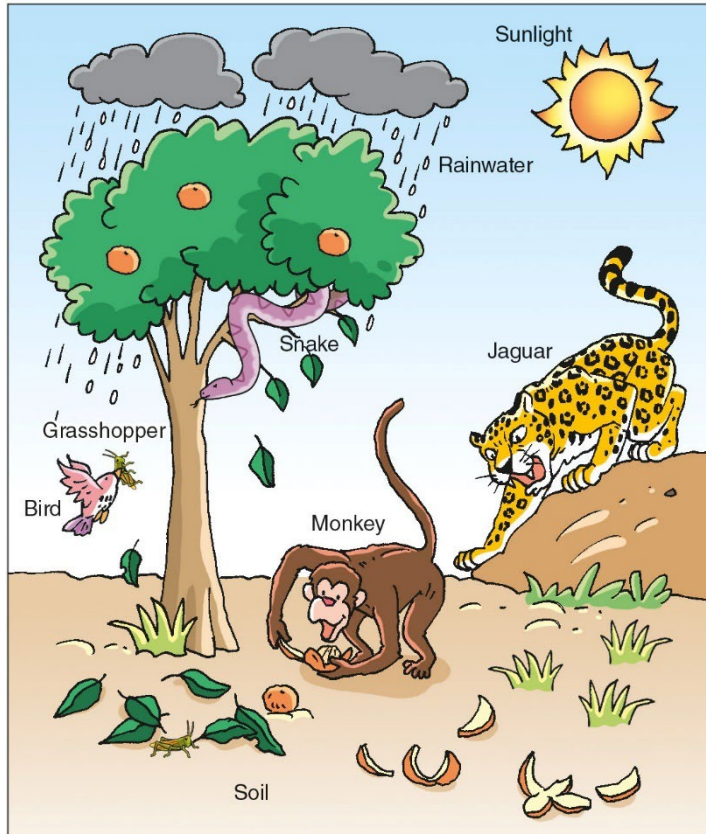


Figure 9

- 1 Identify the living and non-living things in Figure 9.
- 2
 - a What do sunlight and rainwater provide to the tree?
 - b What will the fallen leaves become?
- 3
 - a How does the monkey get its energy?
 - b How does the jaguar get its energy?
 - c What will happen to the body of the monkey after it dies?

ecosystem 生態系統

An ecosystem consists of the plants and animals in an area, together with their surroundings.


In an ecosystem, there are living and non-living things. Plants, animals and insects are examples of living things. Non-living things include sunlight, moisture, soil and air.

Different parts of the ecosystem are linked together by the flow of energy and matter. Before learning this, let's have a look at the roles of different living things in an ecosystem.

A Food chain and food web

Living things are usually classified into three feeding categories: **producers, consumers and decomposers** (Table 4). Producers and consumers form a **food chain** (Figure 10) or a **food web**.

Table 4 The feeding categories in an ecosystem

Producer	All green plants are producers. They can produce their own food through photosynthesis
Consumer	All animals are consumers. They cannot produce their own food . There are three types of consumers: <ul style="list-style-type: none"> • Primary consumers: animals that feed directly on producers • Secondary consumers: animals that feed on consumers at the same and lower levels • Tertiary consumers: animals that feed on other consumers
Decomposer	Fungi, bacteria and some animals (such as earthworms) can break down the dead organic matter on the ground into inorganic matter , that can be readily absorbed by plants <div style="text-align: right;">  <p>Credit: Ian Peacock/Wikimedia commons Fungi feeding on dead wood</p> </div>

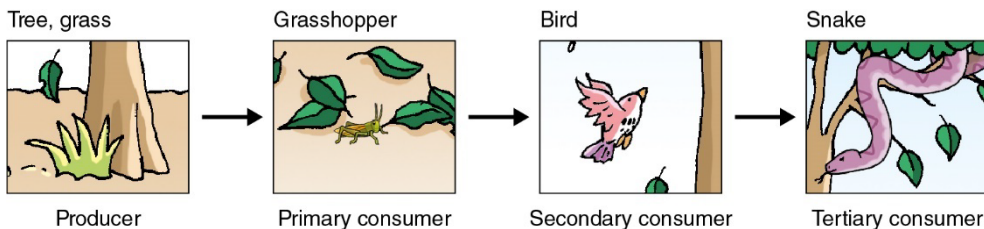


Figure 10 A simple food chain in the ecosystem shown in Figure 9

? Try to draw another food chain based on Figure 9.

food chain 食物鏈 food web 食物網 producer 生產者 consumer 消費者 decomposer 分解者 photosynthesis 光合作用
primary consumer 初級消費者 secondary consumer 二級消費者 tertiary consumer 三級消費者 fungi 真菌 bacteria 細菌
organic matter 有機物

B Energy flow

Every ecosystem needs energy input to function. Where does the energy come from, then?

The sun is the **primary source of energy input** that maintains the ecosystem. It provides **energy for plants (producers)** to carry out photosynthesis and produce their own food. The **energy is then passed to other living things (consumers) through feeding**. This transfer of energy through various living organisms along the food chain or food web creates an **energy flow** (Figure 11).

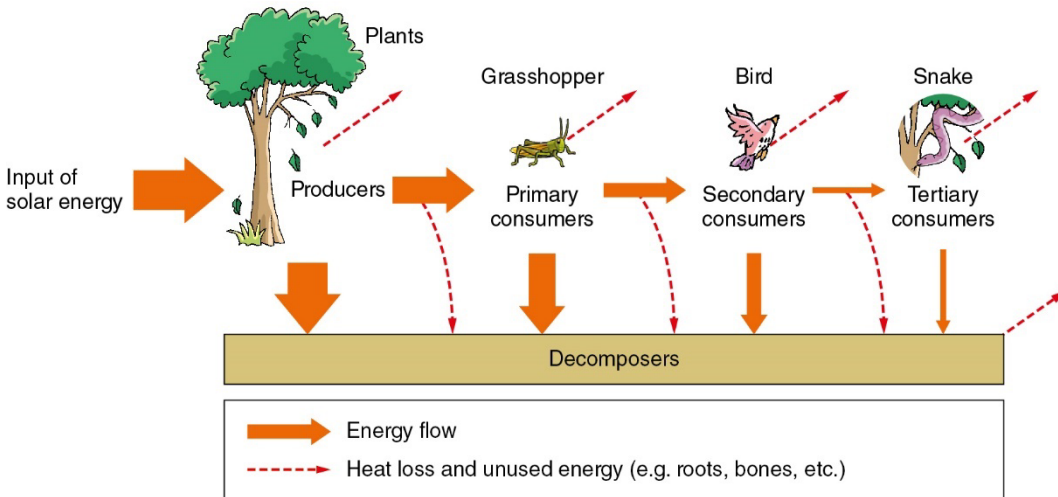
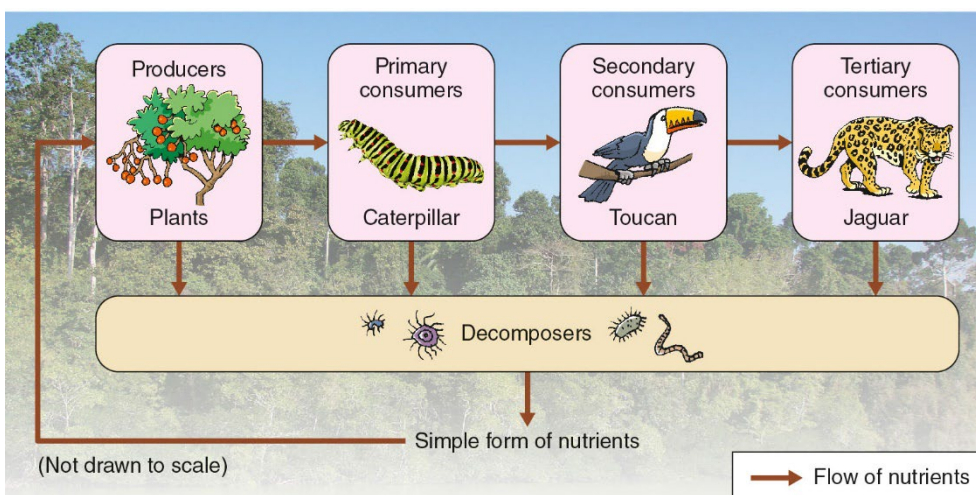


Figure 11 Energy flow in an ecosystem

C Nutrient cycling

Nutrient cycling refers to the **circulation of nutrients** (e.g. nitrogen, phosphorus and potassium) **from the environment** (e.g. air, rainwater and soil) **to living things and back again to the environment**. Figure 12 shows an example in the tropical rainforest ecosystem.



Credit: Sankara
Subramanian/Flickr

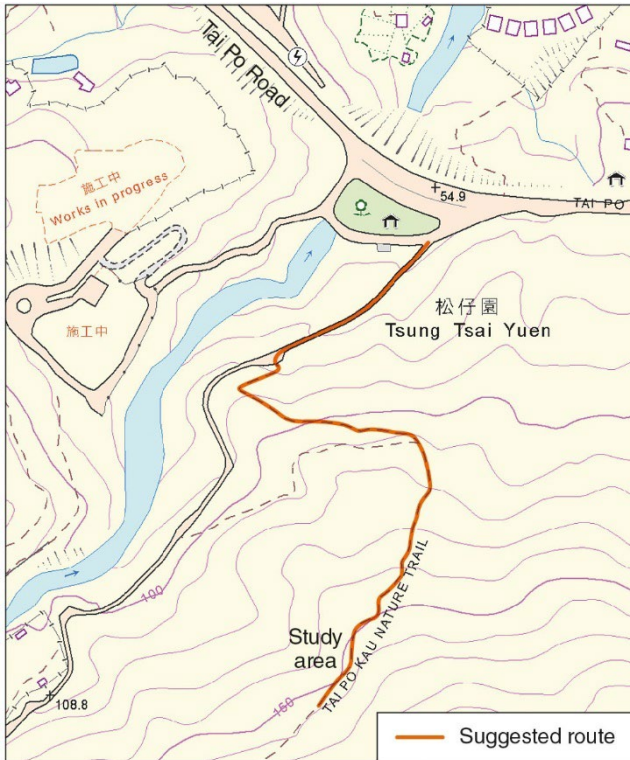
Figure 12
Nutrient cycling
in the tropical
rainforest
ecosystem

energy flow 能量流動 nutrient cycling 養分循環 nitrogen 氮 phosphorus 磷 potassium 鉀

Fieldwork

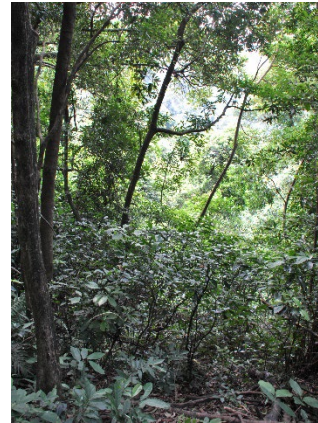
Field trip to Tai Po Kau Nature Reserve

Although there is no tropical rainforest in Hong Kong, Tai Po Kau Nature Reserve is a good site for local forest study, because the forest there is quite mature. Let's arrange a field trip to Tai Po Kau Nature Reserve, and compare the characteristics of tropical rainforests and the forest there.



Credit: The Map is provided by the Hong Kong GeoData Store and intellectual property rights are owned by the Government of the HKSAR.

Figure 13 Map of Tai Po Kau Nature Reserve



a A view in the nature reserve



b Buttress root



c Undergrowth



d Climbers

Figure 14 Some plants in the nature reserve

Tai Po Kau Nature Reserve 大埔滘自然護理區

Steps

- 1 Walk along the suggested route as shown in Figure 13 (p. 17).
- 2
 - a Stop at the study area as marked.
 - b Observe the characteristics listed in Table 5.
- 3 Compare the differences between the forest in Tai Po Kau Nature Reserve and tropical rainforests in Table 5.

Table 5

	Tai Po Kau Nature Reserve	Tropical rainforest
General characteristic		
a Structure of vegetation	(More / Fewer) layers	(More / Fewer) layers
b Sunlight inside the forest	(More / Less)	(More / Less)
c Number of plant species	(More / Fewer)	(More / Fewer)
Characteristic of the trees		
a Density	(Higher / Lower)	(Higher / Lower)
b Height of trees	(Taller / Shorter)	(Taller / Shorter)
c Shape of leaves (draw in the space provided)		
d Trunk	(Straight, with branches concentrating at the top / Branching along the whole trunk)	(Straight, with branches concentrating at the top / Branching along the whole trunk)
e Shape of roots (draw in the space provided)		
f Density of undergrowth	(Higher / Lower)	(Higher / Lower)

- 4 Remember to take photographs for record.
- 5 Based on the information and data collected and the photographs taken, prepare a field report.

Checkpoint 3

- 1 Which of the following about an ecosystem is correct?
- 1 It consists of living and non-living things.
 - 2 Energy comes from the sun.
 - 3 Decomposer returns nutrients to producers.

A 1 and 2 only C 2 and 3 only
B 1 and 3 only D 1, 2 and 3

- 2 Which of the following matches are correct?

	Producer	Consumer
1	Tree	Frog
2	Grass	Grasshopper
3	Earthworm	Bird

A 1 and 2 only C 2 and 3 only
B 1 and 3 only D 1, 2 and 3

- 3 Which of the following statements is/are correct?

- 1 All green plants are producers.
- 2 All consumers rely on producers for food.
- 3 Epiphytes produce their own food by photosynthesis.

A 1 only C 2 and 3 only
B 1 and 3 only D 1, 2 and 3

- *4 Which of the following statements about energy flow in an ecosystem is correct?

- A There is energy loss from consumers to producers.
- B Energy passes from producers to consumers.
- C Decomposers return energy to producers.
- D Decomposers receive the same amount of energy from producers and consumers.

Learn these words

annual mean temperature 年平均氣溫	8	climber 攀緣植物	12
annual range of temperature 年溫差	8	epiphyte 附生植物	12
annual rainfall 年雨量	8	parasite 寄生物	12
evergreen 常綠	10	ecosystem 生態系統	14
species 品種	10	food chain 食物鏈	15
emergent layer 露生植物層	11	food web 食物網	15
canopy layer 冠層	11	producer 生產者	15
young tree layer 幼樹層	11	consumer 消費者	15
shrub layer 灌木層	11	decomposer 分解者	15
undergrowth 樹林底層植物	11	photosynthesis 光合作用	15
buttress root 板根	11	energy flow 能量流動	16
drip-tip 滴水葉尖	12	nutrient cycling 養分循環	16

Unit summary

1 What are the characteristics of tropical rainforests? Why are they there?

- Tropical rainforests are _____ because they grow throughout the year.
- They have the greatest number of _____ of plants and animals.
- There are _____ layers of plants as below:

Layer	Characteristic of the plants	
a _____ layer	<ul style="list-style-type: none"> • Trees are straight and very tall, up to 50 metres • They are _____ spaced 	<ul style="list-style-type: none"> • Strong _____ roots support the tall trees • Waxy leaves with _____ _____ to let rain run off the leaves
b _____ layer	<ul style="list-style-type: none"> • Trees are straight and tall • Trees grow closely together and form a _____ canopy 	
c Young tree layer	<ul style="list-style-type: none"> • Trees are shorter, and they grow under little sunlight 	
d _____ layer	<ul style="list-style-type: none"> • Few plants can grow on the forest floor because _____ is blocked 	
e _____		

- Besides, climbers, _____ and _____ grow on the trees in tropical rainforests.
- The _____ and _____ climate in the tropical areas is very suitable for plant growth.

- 2 Figure 15 shows some living things in the tropical rainforest. Table 6 shows a food chain of the tropical rainforest ecosystem.



Figure 15

Table 6

Type of living thing		Butterfly		
Role in the food chain	Producer			

- a According to the feeding relationship, fill in the types of living things from Figure 15 in the first row of Table 6.
- b What is the role played by each type of living thing? Complete the second row of the table.
- 3 In what ways are the living and non-living things linked together in a tropical rainforest ecosystem?
 By _____ flow and _____ cycling
- 4 Name the primary source of energy input of the tropical rainforest ecosystem.
-