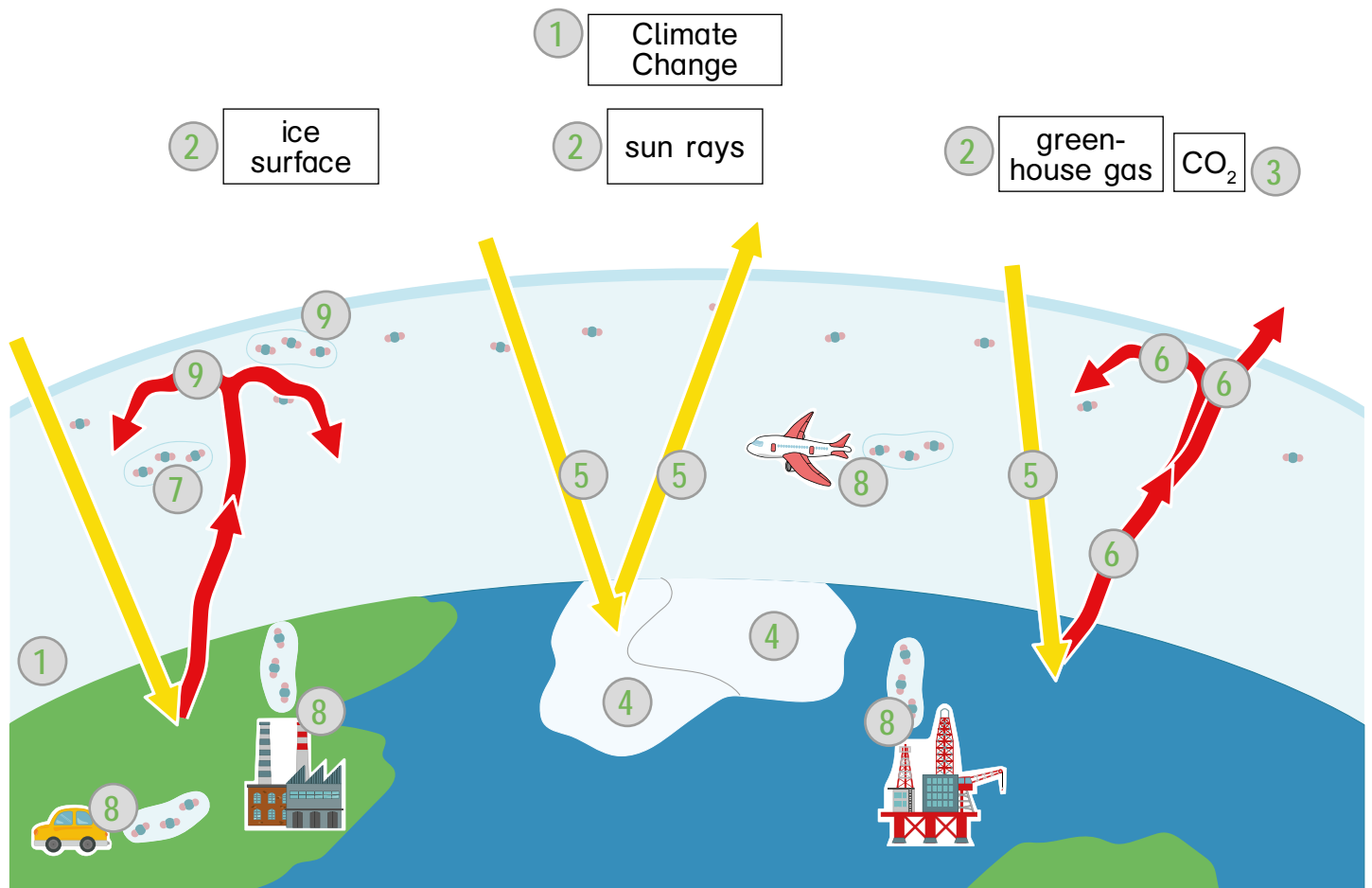


On the track of the climate change

The magnetic blackboard material: Assembly and explanation



Assembly

- 1 Hang up a picture of the earth on the blackboard, apply the word sign "climate change" above.

Question: How does the climate change caused by human beings take place?

- 2 Also apply three word signs on the blackboard.

Explanation: These 3 factors determine the climate on our earth.

- 3 Apply the word sign "CO₂" beside the word sign "greenhouse gases".

Explanation: CO₂ is the greenhouse gas, which is mainly responsible for this climate change.

- 4 Apply two pictures "ice surface" on the sea.

- 5 Apply three yellow rays of light (they impinge on land, water and ice).
Have the fourth ray of light reflect from the ice in direction of the space.

Explanation: The rays of light of the sun impinge on the land, water and ice surfaces. The ice reflects rays of light and will be reflected into the space.

- 6 Apply one to two red straight and one curved ray of heat nearby the yellow rays of light which impinge on the land and water. (One straight and one curved have to remain.)

Explanation: The other rays of light will be transformed to invisible rays of heat and can no longer readily leave the atmosphere.

- 7 Apply a picture "greenhouse gases" in the atmosphere.

Explanation: Greenhouse gases in the atmosphere of the earth avoid the reflection of heat into the space. I.e. the CO_2 absorbs the rays of heat and reflects them to the earth (greenhouse effect).

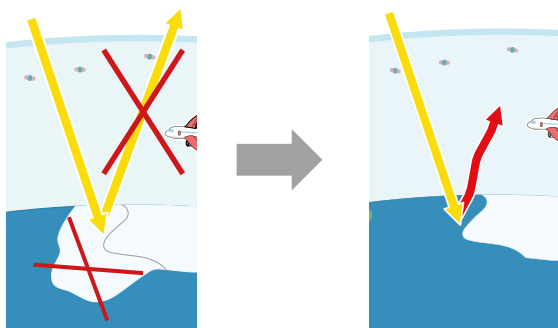
- 8 Apply the pictures "car", "aeroplane", "oil rig" and "factory". Each time a picture " CO_2 " with it.

Explanation: Human beings excavate the natural carbon reservoirs and consume them. Energy production, industry and traffic blow more and more CO_2 into the air.

- 9 Shift a picture " CO_2 " into the upper atmosphere. Put a sign with reflected thermal radiation on a ray of heat.

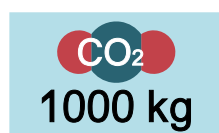
Explanation: It is becoming warmer and the ice is melting.

- 10 Take away an ice surface, take away the applied, reflecting ray of light and apply a ray of heat instead.



Explanation: If the ice surface disappears, the ray of light impinges onto the water surface and will not be reflected, but transformed into a ray of heat.

- 11 Apply the CO_2 footprint and the four formula signs on the blackboard.



Explanation: The more energy and raw materials are consumed and the more waste is produced, the larger is the CO_2 footprint. It is possible to calculate a CO_2 footprint for a person, a company and even for a banana.

I.e. there is a direct correlation between the release of carbon dioxide and the melting of sea ice. Scientists have established the following rule of thumb: If 1000 kg of CO_2 are emitted, about 3 m^2 sea ice will disappear. 1000 kg of CO_2 will be emitted, if a car drives about 6000 km or per person, who travels by air for 5 hours.

The subject matter

1. What does climate mean in general?

The difference between weather and climate

- Weather is what you see when you look outside. Is it windy, does it rain or is the sun shining? Is it hot or cold? You can directly experience and feel the weather.
How was the weather this morning and how is it at the moment?
Do you know anybody who is living further away? Call this person and ask how the weather is in his place.
The weather can change several times a day. We take a look at it short term and at one place.
- For the climate, we refer to a much longer period of time (in particular at least 30 years). Scientists observe and record, how the weather has been on one single day within this long period of time. This means that the climate describes the weather over a long period of time.

2. Why does the climate change?

- There have always been climate changes on earth: Warm and cold periods alternate on earth. This is due to the elliptical orbit of the earth around the sun, due to the changing activities of the sun and the inclination of the earth axis.
- The climate can also change due to other events: e.g. by asteroid impacts or volcanic eruptions.
- For about 10,000 years, we have a rather unchanged climate. In the past 100 years, our climate heated up again, but for the past few years the temperatures have increased more than ever before in the in human history. Scientists found out that this warming up has been caused by humans. How can it be?

3. How does the climate change happen?

- There are 3 factors, which determine the climate on earth: the quantity of the solar radiation, the size of the ice surface on earth and the quantity of greenhouse gases.
- You certainly already know what are solar radiation and ice surfaces. In order to explain the climate change, you also need to know what are greenhouse gases. Greenhouse gases avoid the reflection of heat into space. They are in the atmosphere. This is the atmosphere of our earth. There are different greenhouse gases. For instance, carbon dioxide, also called CO₂ is such a greenhouse gas.
- A part of the sunlight impinges the ice surface of the earth and will from there be directly reflected into space. Another part of the sunlight will also be transformed into invisible thermal radiation and can no longer readily leave the atmosphere. Greenhouse gases will intercept them and reflect them to the earth. We also talk about the greenhouse effect.
- If the balance between the three factors sunlight, ice surfaces on the earth and greenhouse gases are being disturbed, the climate change will take place.

4. How do human beings cause the climate change?

- There is a natural CO₂ cycle on our earth. Plants, animals and soil-dwelling organisms, seas, clouds and rain ensure that the carbon balance of the earth is almost balanced.
- Human beings excavate these natural carbon resources (natural gas, coal, oil). We consume within one year what the earth has stored over 1 million years, and blow more and more CO₂ into the atmosphere.
- Due to the increased quantity of CO₂ more and more invisible heat rays stay in the atmosphere. It is becoming warmer and the ice surfaces of the earth start melting. At the poles of the earth the consequences of the climate change can no longer be ignored. The pack ice on the North Pole starts to crack and to melt. Today, there is only one quarter of the sea ice which existed in the summer 30 years ago. The habitat for the arctic animals disappears and a new ocean comes into being.
- I.e. there is a direct correlation between the release of carbon dioxide and the melting of sea ice.

5. Consequences of the climate change caused by human beings

- Increase of temperatures in the atmosphere
- Disappearing of mountain glaciers
- More and more heat waves and record temperatures
- Increase of heavy storms with floods
- Warming of the oceans
- Melting of the polar ice caps
- Decline of the land mass due to the increase of the sea level
- Increase of natural disasters
- Threat to the flora and fauna

6. Interesting details about the climate change (dated 2019)

- The average temperature increased in the past 100 years by 1 degree Celcius. Scientists fear that it might even increase to 5 degrees Celcius until the end of the century. It must not be more than 2 degrees in order to avoid serious consequences.
- There will be no more pack ice at the North Pole if we emit another 800 billion tons of CO₂. If we continue as we did up to now, it would maybe take only another 20 years.
- Rule of thumb: When emitting 1000 kg of CO₂ the sea ice surface will shrink by 3 m².
- What is the CO₂ footprint? It is the CO₂ trace, which each individual leaves behind in the environment. The more energy and raw materials are consumed and the more waste is produced, the larger is the CO₂ footprint. A CO₂ footprint can not only be calculated for human beings, but also for companies and each product.
- The CO₂ footprint of an individual in Germany is more than 10 tons per year. In particular electricity, heating and consumer behaviour are responsible for it. Each of us makes more than 30 m² of sea ice surface disappear due to his behaviours. This is about half a classroom.
- Driving a car for 6000 km means about 1000 kg of CO₂ emittance, i.e. 3 m² less ice.
- Travels by air: 1 hour travelling by air means about 250 kg of CO₂ emittance per person.

It is right: One individual on its own cannot stop the climate change. However, we all contribute by our behaviour. Every human being is responsible to play its part in this.

7. Would it still be possible to stop the climate change?

The CO₂ emittance needs to be less than 2000 kg per individual worldwide. Then we can keep the global warming below 2 degrees Celsius, according to the estimations of scientists. Can we achieve this?

| CO ₂ emittance by | national average consumption |
|--|------------------------------|
| Consumption | 4500 kg |
| Traffic | 2000 kg |
| Nutrition | 1700 kg |
| Heating and hot water | 1600 kg |
| Power consumption | 750 kg |
| Public production (e.g. hospitals, etc.) | 750 kg |

8. Think about how you can protect the climate

Here are just a few examples:

- Bicycle instead of car
- Public transport
- Better insulation of houses
- More solar panels to generate electricity
- Environmental-friendly ventilation systems
- Wood-fired oven instead of gas heating
- Drying laundry in the open air
- Changing consumer behaviours
- Buying seasonal foods from the region
- Eating less meat
- Check your actions: Use the CO₂ calculator on the Internet

Each individual can make a difference, but all alone we would be unable to stop the climate change. Cities, industry sectors and countries worldwide need to act jointly.

9. The most important CO₂ polluters worldwide

- China, USA, India, Russia, Japan, Germany, Iran, South Korea, Saudi Arabia, Canada

10. Think about what the most important CO₂ polluters should do

Here are just a few examples:

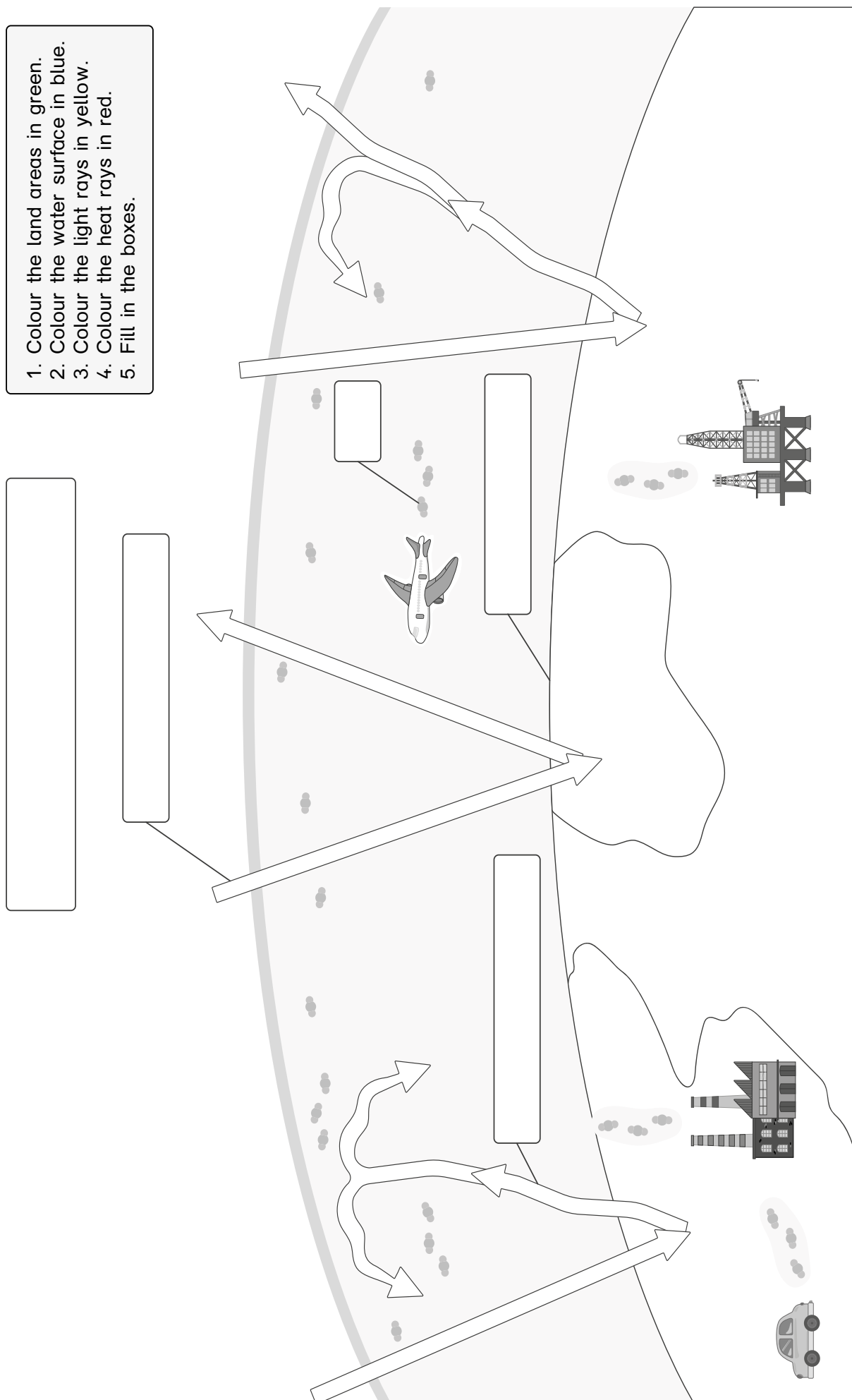
- According to the climate treaty of Paris, the governments of the world would like to limit the climate change to 2 degrees Celsius
- CO₂ laws, taxations
- Promoting alternative technologies
- Filtrating CO₂ from the air and storing it
- No longer supporting or no longer using fossil fuels such as coal or mineral oil

Name: _____

Class: _____

Date: _____

1. Colour the land areas in green.
2. Colour the water surface in blue.
3. Colour the light rays in yellow.
4. Colour the heat rays in red.
5. Fill in the boxes.



The Climate Change

1 Right ✓ or wrong ✗ ?

- ☐ The climate describes the weather over a long period of time.
- ☐ The climate warms up since about 10,000 years.
- ☐ Every human being is responsible to play its part in this.
- ☐ There are 2 factors, which determine the climate.
- ☐ CO₂ is among the greenhouse gases.
- ☐ Greenhouse gases avoid the penetration of heat from space.
- ☐ The atmosphere wraps around the earth like an envelope.

2 Fill in the gaps in the text with the words listed below.

There are _____ factors which determine the _____ on earth: the quantity of the solar radiation, the size of the _____ on earth and the quantity of greenhouse gases. A part of the sunlight impinges the ice surface of the earth. It directly _____ the sunlight into _____. Another part of the sunlight will also be transformed into invisible _____ and can no longer readily leave the _____. _____ will intercept them and reflect them to the earth. We also talk about the _____. If the _____ between the three factors _____, ice surfaces on the earth and greenhouse gases are being disturbed, the _____ will take place.

greenhouse gases – climate – greenhouse effect – climate change – three – ice surface – solar radiation – space – balance – reflects – atmosphere – thermal radiation

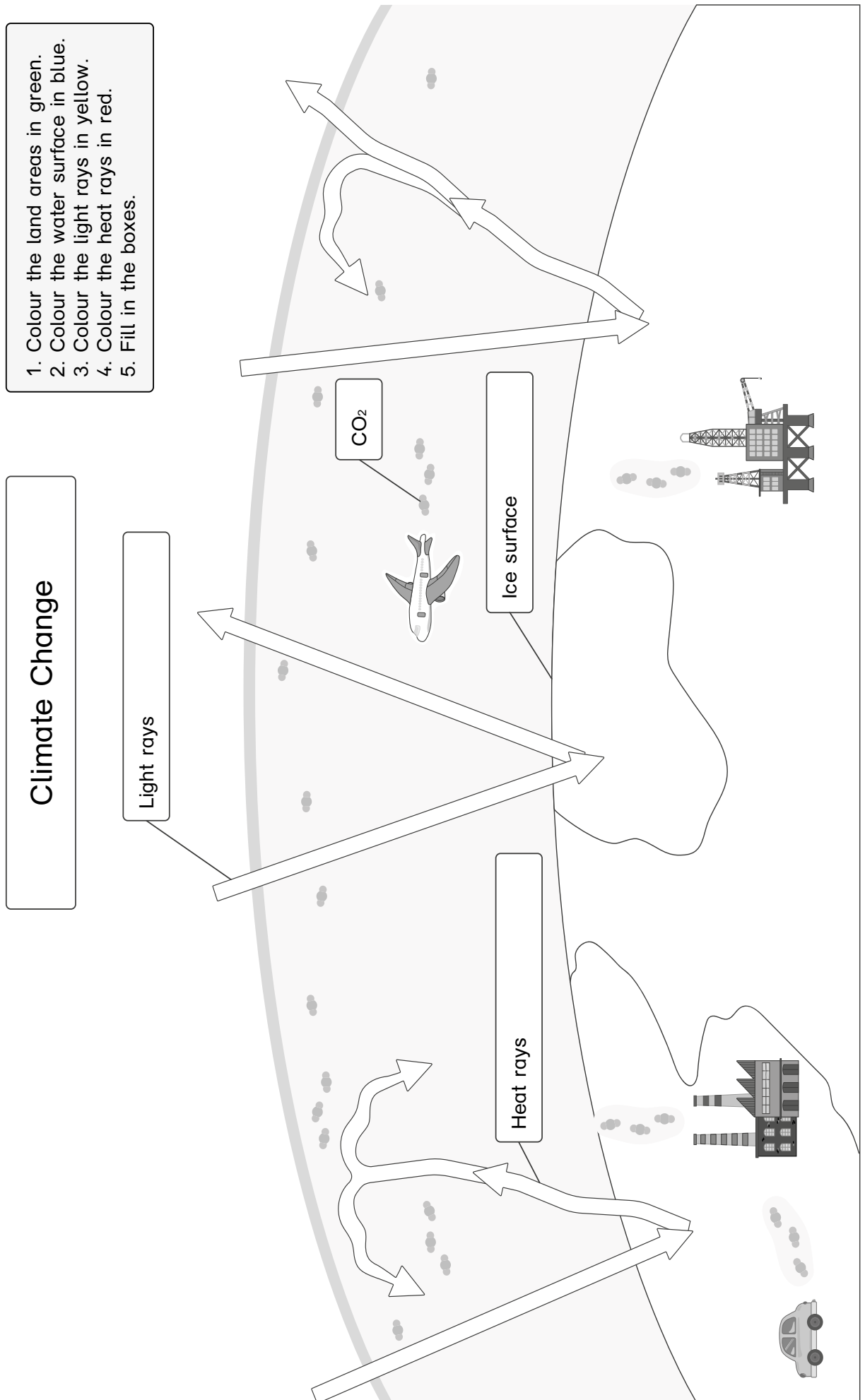
3 Put the text in the right order.

- ☐ It is becoming warmer and the ice surfaces of the earth start melting.
- ☐ That's why more and more invisible heat rays stay in the atmosphere of the earth.
- ☐ Human beings release more and more CO₂ into the atmosphere.

4 Complete the rule of thumb.

When emitting _____ kg CO₂ the ice surface will shrink by ____ m².

5 What is the CO₂ footprint? What can you do in order to reduce your CO₂ footprint?



The Climate Change

1 Right ✓ or wrong ✗?

- ✓ The climate describes the weather over a long period of time.
- ✗ The climate warms up since about 10,000 years.
- ✓ The human beings are jointly responsible for this climate change.
- ✗ There are 2 factors, which determine the climate.
- ✓ CO₂ is among the greenhouse gases.
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3 Put the text in the right order.

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- 2 That's why more and more invisible heat rays stay in the atmosphere of the earth.
- 1 Human beings release more and more CO₂ into the atmosphere.

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When emitting 1000 kg of CO₂ the ice surface will shrink by 3 m².

5 What is the CO₂ footprint? What can you do in order to reduce your CO₂ footprint?

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Use the car less frequently, walk more often, ride your bike or use public transport. Use the heating economically, do not unnecessarily leave the light ON, completely switch OFF the devices and do not leave them switched ON or on stand-by. Buy seasonal foods from the region. Pay attention to where the goods originate from. Buy less, ...