

The seasons



Physics

Light & Optics

Dispersion of light



Difficulty level

easy



Group size

1



Preparation time

10 minutes



Execution time

10 minutes

This content can also be found online at:



<http://localhost:1337/c/5f4e8ef238db8d0003265b68>

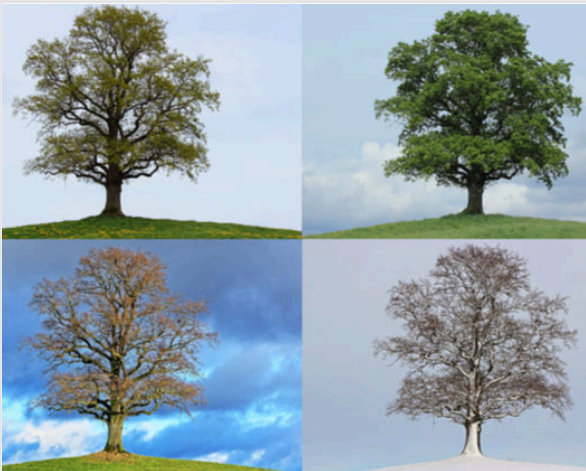
PHYWE



Teacher information

Application

PHYWE



A tree through the seasons

Spring, summer, autumn and winter - that they, our seasons. They influence us and our lives. But how do they actually come about?

The aim of this experiment is to explain this.

Other teacher information (1/3)

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Prior knowledge



The students should first know the basics of the linear propagation of light and be able to handle a light box.

Scientific principle



A rotating earth-moon model is used on the optical profile bench. When the model is illuminated, the shadow formation on the Earth is observed.

Other teacher information (2/3)

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Learning objective



The aim of the experiment is to illustrate and understand the origin of the seasons on earth.

Tasks



Investigating the formation of seasons on Earth using the Earth-Moon model.

Other teacher information (3/3)

The students will not have any technical difficulties in carrying out the experiment. But they will be strongly challenged in their ability to concentrate and observe. The instructions for carrying out the experiment are quite extensive, but justified by the fact that the students can gain the essential knowledge independently.

A quarter of the experiment, which dealt with the conditions at the beginning of autumn, was deliberately omitted. It can be treated in connection with the evaluation.



Safety instructions

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- Halogen lamps become warm during prolonged use
- Avoid looking directly into the light source

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Student Information

Motivation

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Day and night:

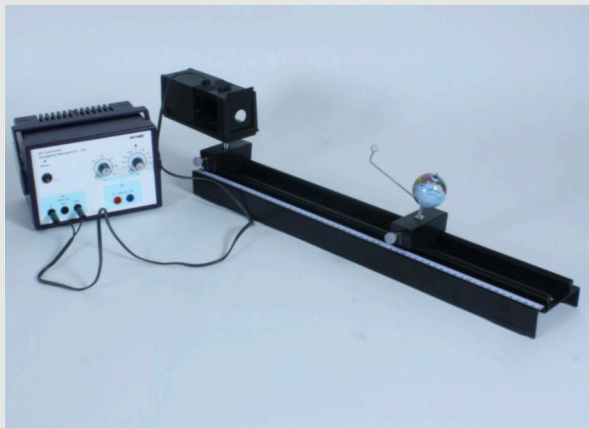
The eternal cycle. It is repeated within 24 hours.

But why is that? And why is there a sunrise every morning and a sunset every evening? Does the sun really go down?

In this experiment you will find answers to these questions.

Tasks

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Experiment set-up

How are the seasons created on earth?

1. Investigate with the Earth-Moon model how the seasons on Earth are formed.

Equipment

| Position | Material | Item No. | Quantity |
|----------|---|----------|----------|
| 1 | Light box, halogen 12V/20 W | 09801-00 | 1 |
| 2 | Bottom with stem for light box | 09802-20 | 1 |
| 3 | Optical profile-bench for student experiments, l = 600 mm | 08376-00 | 1 |
| 4 | Diaphragm with hole, d=20mm | 09816-01 | 1 |
| 5 | Slide mount for optical bench | 09822-00 | 1 |
| 6 | Model earth/moon | 09825-00 | 1 |
| 7 | PHYWE Power supply, 230 V, DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A | 13506-93 | 1 |

Set-up (1/4)

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Assembly of the optical bench

Build the optical bench from the two tripod rods and the variable tripod foot.

Set-up (2/4)

PHYWE



Using the light box with base and handle

- Place the base with handle under the light box.

Set-up (3/4)

PHYWE

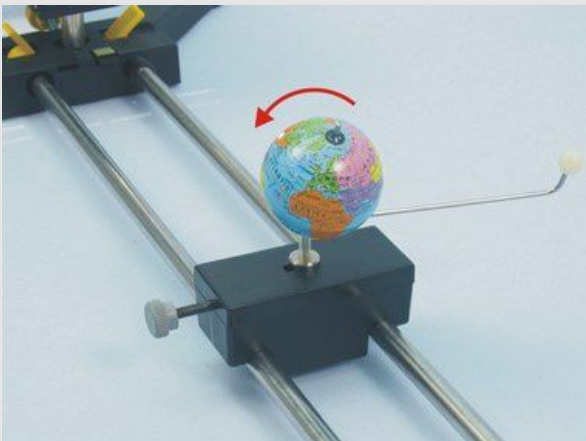


Positioning of the light box

- Clamp it into the left part of the tripod base with the lens side facing away from the optical bench.
- Slide an opaque diaphragm in front of the lens and the pinhole diaphragm into the shaft at the other end of the lamp.

Set-up (4/4)

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Positioning of the Earth-Moon model

- Mount the Earth-Moon model on the rider and place it approximately in the middle of the optical bench.
- Turn the moon to the back and ignore it in the following.

Procedure (1/7)

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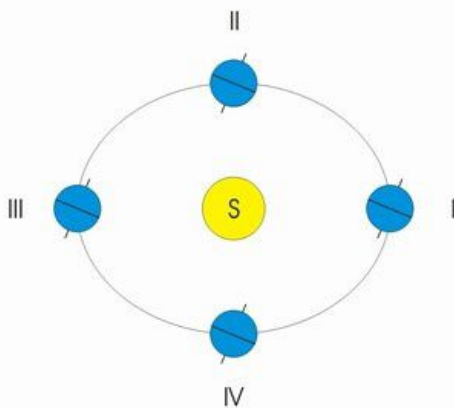


Connecting the light box

- Connect the lamp to the power supply unit (12 V~) and switch it on.

Procedure (2/7)

PHYWE



Positions of earth and sun

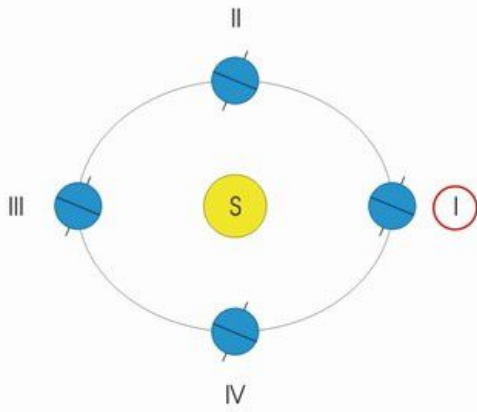
first try

The yellow circle represents the sun, the blue circles are the earth in different positions, which the earth takes during the year in relation to the sun. Position 1 in the figure corresponds to the position that the Earth model occupies on the optical bench in relation to the model of the Sun.

- Use the Earth model to think about where the North and South Poles of the Earth are and make it clear which part is the northern and which is the southern hemisphere.

Procedure (3/7)

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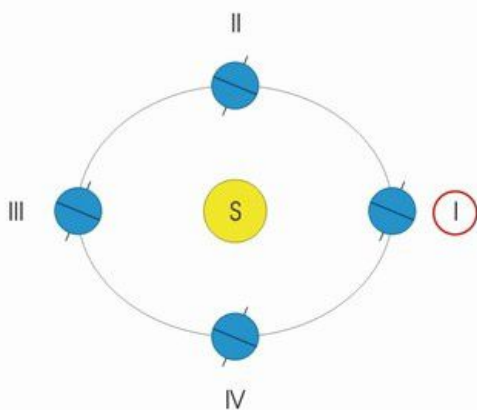
Season in position I

Rotate the Earth model smoothly and slowly around its axis and compare the length of the "days" in the northern and southern hemispheres.

- What do you find?
- Note your observations in the minutes.

Procedure (4/7)

PHYWE



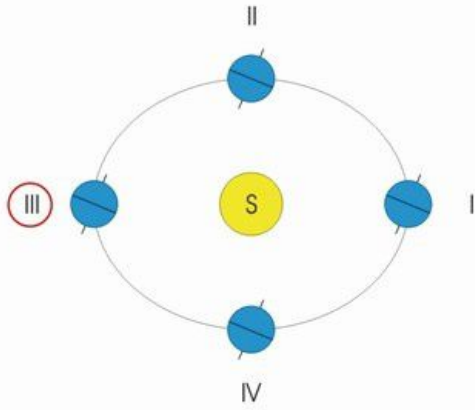
Season in position I

Where the sun's rays hit the earth vertically or very steeply, they heat the earth more than where they hit the earth very obliquely.

- Which hemisphere of the earth is warming more than the other?
- What time of year is it in the northern or southern hemisphere?
- Rotate the Earth model again slowly and observe the areas around the poles. What do you notice?

Procedure (5/7)

PHYWE



Season in position III

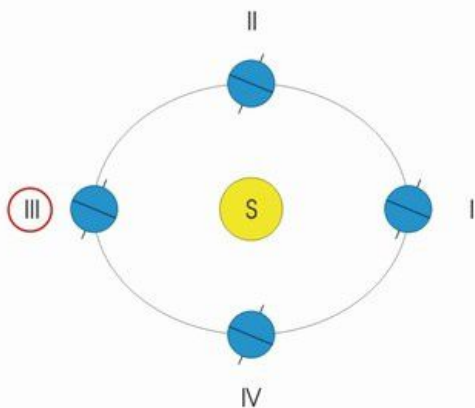
second try

Now clamp the lamp into the right part of the tripod base with the lens side facing away from the optical bench and do not change the position of the earth model.

It is now in a position that corresponds to position III of the earth in the figure. Convince yourself of this.

Procedure (6/7)

PHYWE



cardinal points

Turn the earth model again smoothly and slowly around its axis.

Observe closely and answer the following questions in the minutes:

- In which hemisphere are the "days" longer?
- Which hemisphere heats up more?
- What seasons are there in the two hemispheres?
- What is to be determined in relation to the poles of the earth?

Procedure (7/7)

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Sunrise and sunset

3rd experiment

Take the lamp from the optical bench and irradiate the earth model from the front.

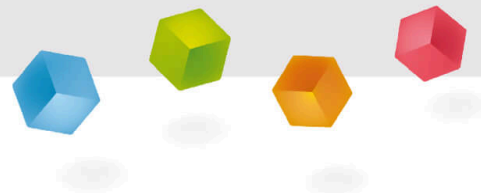
Write down your answers to the following questions:

- Which position of the Earth in the figure corresponds to the current mutual position of the Earth model and the Sun model?
- What can be said about the "days" in the hemispheres?

Switch off the power supply unit.

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Report



Task 1

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1st attempt (earth in position I)
Length of days:

In the hemisphere the days are shorter than in the one.

☒ Check

1st attempt (earth in position I):
Global warming:

The hemisphere of the earth is less heated than the one.

☒ Check

Task 2

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1st attempt (earth in position I)
Seasons in the hemispheres:

On the hemisphere it is late autumn or early winter, on the it is late spring or early summer.

☒ Check

1st attempt (earth in position I)
Surrounding the poles:

The and its surroundings are not hit by the sun's rays. The and its surroundings are continuously hit by the sun's rays.

☒ Check

Task 3

PHYWE

2nd experiment (earth in position III)
Length of days:

The days are longer in the hemisphere than in the one.

☒ Check

2nd experiment (earth in position III)
Global warming:

The hemisphere of the earth is getting warmer than the one.

☒ Check

Task 4

PHYWE

2nd experiment (earth in position III)
Seasons in the hemispheres:

In the northern hemisphere it is now the end of or the beginning of ,
in the southern hemisphere it is the end of or the beginning of .

☒ Check

2nd experiment (earth in position III)
Surrounding the poles:

The North Pole and its surroundings are hit by the sun's rays. The
South Pole and its surroundings are reached by the Sun's rays.

☒ Check

Task 5

PHYWE

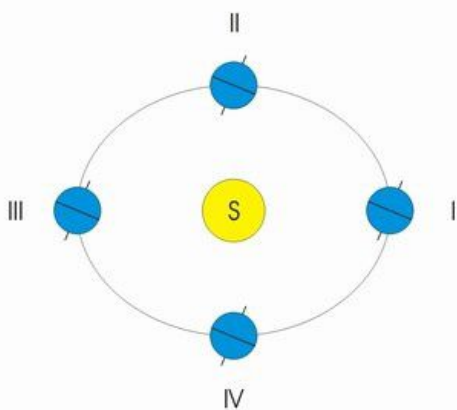
How do the seasons on earth come about?

The seasons are created by the fact that the orbits the and that the of the is constantly inclined in relation to the .

☒ Check

Task 6

PHYWE



Positions of earth and sun

Which days correspond to positions I, II, III and IV of the earth in the figure?

I:

II:

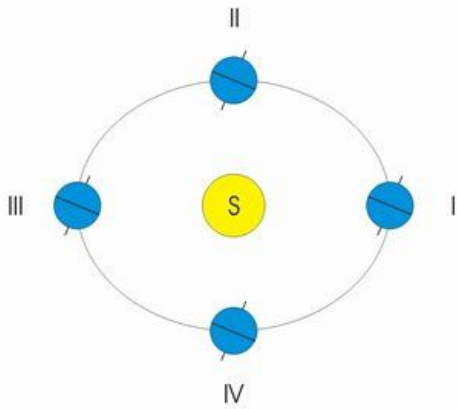
III:

IV:

☒ Check

Task 7

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Positions of earth and sun

Between which positions of the figure must the earth be located when the calendar shows spring, summer, autumn or winter?

Between I and II:

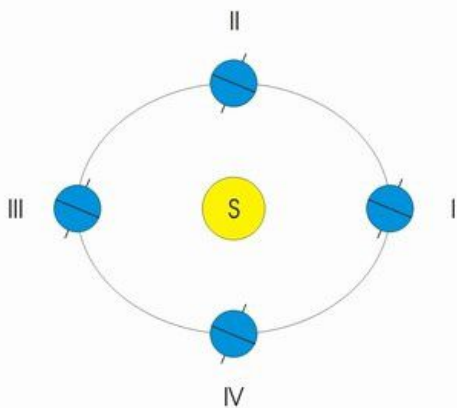
Between II and III:

Between III and IV:

Between IV and I:

Task 8

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Positions of earth and sun

What observations would you have made if you had also set up the Earth model according to position IV of the figure?

Complete the text.

It would have been the same observations as in position

| Slide | Score / Total |
|--------------------------------|---------------|
| Slide 23: Multiple tasks | 0/4 |
| Slide 24: Multiple tasks | 0/4 |
| Slide 25: Multiple tasks | 0/4 |
| Slide 26: Multiple tasks | 0/6 |
| Slide 27: Seasons | 0/5 |
| Slide 28: Days and position | 0/4 |
| Slide 29: Seasons and position | 0/4 |
| Slide 30: Earth Model | 0/1 |

Total amount  0/32

 Solutions

 Repeat