Globisens
Lab classes with sensors
Labdisc

Applied Sciences

Temperature variation between day and night

Measuring thermal oscillation and luminosity during a full day

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USA Standards Correlation

FRAMEWORK FOR K-12 SCIENCE EDUCATION © 2012

The Dimension I practices listed below are called out as **bold** words throughout the activity.

Dimension 1 Science and Engineering Practices	✓	Asking questions (for science) and defining problems (for engineering)		Use mathematics and computational thinking
	✓	Developing and using models		Constructing explanations (for science) and designing solutions (for engineering)
	✓	Planning and carrying out investigations	✓	Engaging in argument from evidence
	✓	Analyzing and interpreting data	✓	Obtaining, evaluating, and communicating information

Dimension 2 Cross Cutting Concepts	✓	Patterns	✓	Energy and matter: Flows, cycles, and conservation
	✓	Cause and effect: Mechanism and explanation		Structure and function
		Scale, proportion, and quantity		Stability and change
	✓	Systems and system models		

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	Discipline	Core Idea Focus
Dimension 3 Core Concepts	Earth and Space Science	ESS1: Earth's Place in the Universe
		ESS1.B: Earth and the Solar System
		ESS2: Earth's Systems
		ESS2.A: Earth Materials and Systems
		ESS2.D: Weather and Climate

	Middle School Standards Covered	High School Standards Covered
NGSS Standards	MS.ESS-SS: Space Systems	HS.ESS-SS: Space Systems
	MS.ESS-HE: The History of Earth	HS.ESS-ES: Earth Systems
	MS.ESS-EIP: Earth's Interior Processes	HS.ESS-CC: Climate Change
	MS.ESS-ESP: Earth's Surface Processes	
	MS.ESS-WC: Weather and Climate Systems	

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Labdisc

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Content Standards (K-12)			
✓	Systems, order, and organization		Evolution and equilibrium
✓	Evidence, models, and explanation	✓	Form and Function
✓	Constancy, change, and measurement		

Earth and Space Science Standards Middle School		Earth and Space Science Standards High School	
✓	Structure of the Earth System	✓	Energy in the Earth System
	Earth's History		Geochemical Cycles
✓	Earth in the Solar System		Origin and Evolution of the Earth System
			Origin and Evolution of the Universe

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Labdisc

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USA Standards Correlation

LEARNING OBJECTIVES

Core Objectives (National Standards):

- Develop the ability to refine ill-defined questions and direct to phenomena that can be described, explained, or predicted through scientific means.
- Develop the ability to observe, measure accurately, identify and control variables.
- Decide what evidence can be used to support or refute a hypothesis.
- Gather, store, retrieve, and analyze data.
- Become confident at communicating methods, instructions, observations and results with others.

Activity Objectives:

The purpose of this activity is to study the temperature and luminosity changes produced during the day and night in a given area, by formulating a hypothesis and proceeding to check it using the Globisens Labdisc light and temperature sensors.

Time Requirement:

20 – 30 minutes to set up, 24 hours to collect data, 30-45 minutes to analyze dataminutes

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Labdisc

Applied Sciences

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Objective

To study the temperature and luminosity changes produced during the day and night in a given area, by formulating a hypothesis and proceeding to check it using the Labdisc light and temperature sensors.

Globisens
Lab classes with sensors
Labdisc

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Introduction and theory

The aim of the introduction is to focus students on the lesson subject by refreshing acquired knowledge and asking questions which encourage research development. Key concepts from the theoretical framework, applied by the students during the lesson, are taught.

Introduction

During the day we can observe different changes in the environment: humidity, atmospheric pressure, noise, luminosity and other factors are constantly changing as the hours pass, and we can even predict how some of them will change during a full day. Thus we can say, for example, that temperature at 7 am is lower than at 3 pm, and as night approaches, temperature falls again.

? **Why do you think fluctuations in temperature during a full day occur? Explain.**

? **Thermal oscillations cause us to wrap up or uncover, according to how we feel, but have you ever thought how animals and plants adapt to daily temperature fluctuations? Explain.**

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Lab classes with sensors
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Applied Sciences

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Introduction and theory

Carry out the experiment activity with your class so that at the end you'll be able to answer the following question:

What differences in temperature and luminosity are produced between day and night in the area where you live?

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Introduction and theory

Theoretical

Thermal oscillation (or thermal range) is the difference between the highest and the lowest temperature registered in a place during a given period of time. Its value is given mainly by the geography of the place and its effect determines many of the activities that living organisms do in a certain territory.
An example is life in the desert, where few clouds are formed, the heat of the sun directly affects the soil, and therefore temperature can reach very high values. However, at night temperature falls abruptly even below 0 ºC, there are extremely big thermal oscillations. For example, in the Arizona desert located in the United States, there can be thermal oscillations of up to 56º C, meaning that the local species must present adaptations in order to withstand the weather.

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Labdisc

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Introduction and theory

Some of the adaptations that plants have generated in order to live in the desert are very small leaves covered with wax, long roots and specialized tissues to accumulate water; all this in order to increase absorption, diminish perspiration and avoid dehydration. Animals also have adaptations which allow them to live in this kind of environment. For example, they increase their internal temperature to avoid losing water through perspiration; these animals excrete very concentrated urine to eliminate waste in the smallest possible volume. They also have habits adapted to weather conditions like hunting at night and hiding during the day.

Now students are encouraged to raise a hypothesis which must be tested with an experiment.

?

If you had to establish a temperature range variation during a complete day in the place where you live, what do you think that variation would be?

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Lab classes with sensors
Labdisc

Applied Sciences

Temperature variation between day and night

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Activity description

Students will perform a measurement of room temperature and luminosity inside their schools over a 24 hour period, using the built-in Labdisc temperature and light sensors. They will then draw a graphic to observe the existing correlation between the thermal oscillation of their areas and the quantity of light in the environment, in order to compare the hypothesis with the results.

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Resources and materials

1. Labdisc
2. USB connector cable

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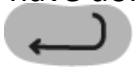
a. Using the Labdisc

To collect measurements with the Labdisc built-in temperature and light sensor, the Labdisc must be configured according to the following steps:

1. Turn on the Labdisc by pushing the  button.
2. Push the  button, and select “SETUP” with the  button.
3. Select “SET SENSORS” option with the  button.
4. Select only the room temperature and light sensors and then push 
5. Once you have done this, push the  button once and select “SAMPLING RATE” with the  button.
6. Select “1/min” with the  button then press the  button.
7. Press the  button and select “NUMBER OF SAMPLES” pushing 

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Lab classes with sensors
Labdisc

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Using the Labdisc

8. Select “10000” with the  button and, then, push the  button.

9. To go back to measuring press three times the  button.

10. Then, push the Labdisc  button to start measuring.

11. Once you have finished measuring, stop the Labdisc. To do this, push the  button (the instruction “Press SCROLL key to STOP” will appear on the screen), then press the  button.

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Lab classes with sensors
Labdisc

Applied Sciences

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Experiment

The following steps explain how to perform the experiment:

1. Find a location in your school where the Labdisc can be placed without danger of interference during a whole day.

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Experiment

2. Put the Labdisc in the previously selected location and activate it to register the temperature data.
3. Register the sensor activation time (be sure it is on the hour so for example, 9:00 am).
4. After measuring for a period of 24 hours stop the sensor.

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Applied Sciences

Temperature variation between day and night

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Results and analysis

The following steps explain how to analyze the experiment results:

1. Connect the Labdisc to the computer using the USB communication cable or via the Bluetooth wireless communication channel.
2. In the top menu click on the  button and select the  button.
3. From the measurements list that will appear, select the last experiment made.
4. Observe the graph building on the screen.
5. Push the  button and put notes on the graph specifying the date and time of data taken.
6. Click on the  button to select points within the graph and choose a representative point for each shift (morning, noon, afternoon, night, midnight, dawn).

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Temperature variation between day and night

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Results and analysis

Did you find differences between what you registered with the Labdisc and what you had predicted in the hypothesis? What were they?

If you compare the place where you live with a desert (like the Arizona desert), what differences exist at the level of thermal range and luminosity? Explain.

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Temperature variation between day and night

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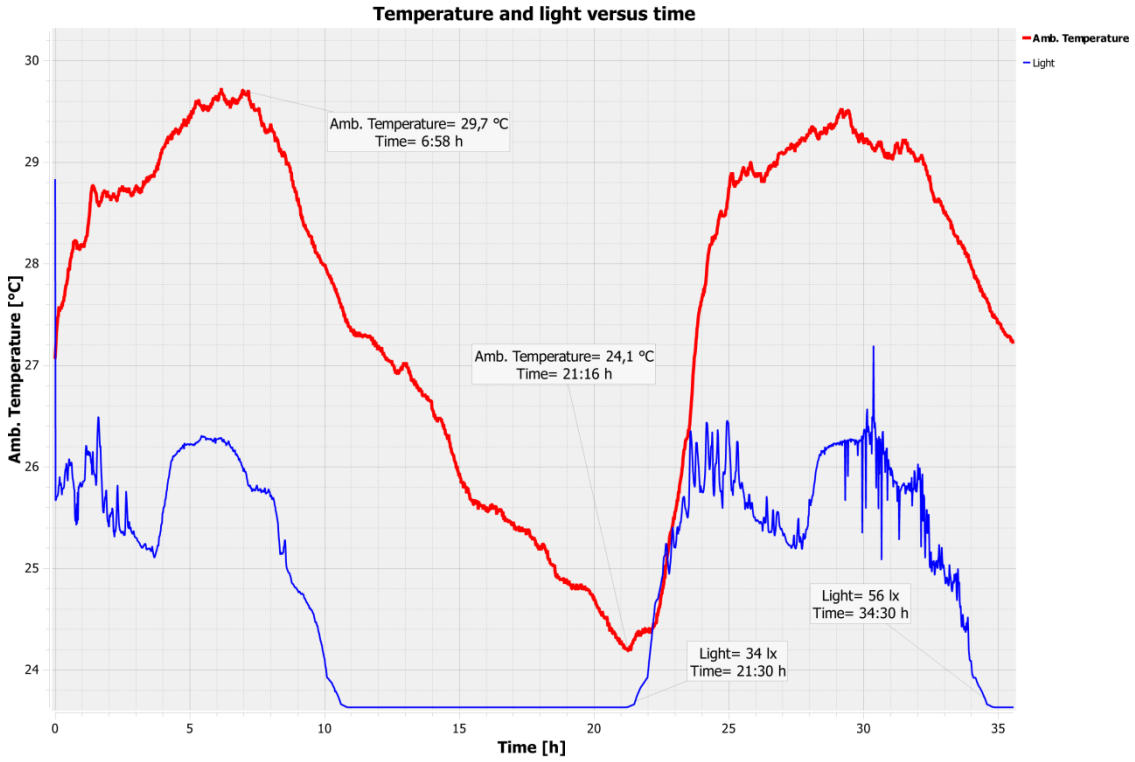
Results and analysis

The graph below should be similar to the one the students came up with.



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Conclusions

Following are some questions and answers which should be developed by students in order to elaborate on their conclusions.

Did you observe temperature differences during the different shifts of the day? Which ones?

It is intended that students interpret the graph and observe that in fact room temperature changes as a full day passes.

Did you observe any relation between luminosity and room temperature? What was it?

It is intended that students observe and analyze the graph, and from this establish that there is a correlation between luminosity and temperature, and that the higher luminosity, the higher temperature.

Conclusions

If you had to classify the thermal oscillation of the place where you live into high, medium or low, how would you do it and why?

Students should classify the thermal oscillation obtained in their schools. They should indicate why and according to which factors they made this classification.

Do you think it is important to know the weather forecast of the highest and lowest temperature registered in a day? Why?

It is intended that students use their experience and indicate if at any moment they have given importance to highest and lowest temperature predictions from their areas, for example at the moment of choosing what to wear the following day.

Conclusions

What environmental and geographical factors do you think are involved in the thermal variations found in your area?

Students should analyze the place where they are and mention the factors they believe could be important at the moment of establishing a thermal oscillation of a given place, like the presence of mountains or hills, water masses, clouds, etc.

It is intended that students achieve the following conclusions.

To establish that the difference between the highest and the lowest temperature registered in a full day corresponds to the thermal range and it is given by the geography of the place, season of the year, etc. Between day and night there are differences in temperature, thus, during the day the sunlight shines directly on the area, increasing the ambient temperature, while at night, when the sun rays fall on the opposite face of the earth, temperature is lower. Therefore, there is a correlation between the luminosity of a place and the temperature it presents.

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Activities for further application

The aim of this section is for students to extrapolate the acquired knowledge during this class through its application in different contexts and situations. Furthermore, it is intended that students question and present possible explanations to the experimentally observed phenomena.

Further questions:

Do you believe that at the Poles there is a big thermal range? Justify.

It is intended that students understand that there should not be a big thermal range at the Poles, because there is not a big difference between the highest and the lowest temperature registered in a day, due to the earth's positioning regarding the sun.

Activities for further application

If you had to forecast the weather, what factors would you consider to make the prediction?

Students should point out that factors such as humidity, geography, height, presence or absence of water, atmospheric pressure, season of the year, etc., should be considered.

Do you believe there are places on the earth where it is hotter at night than during the day?

It is intended that students answer that in general there should not be places on the earth where it is hotter at night than in the day, because during the day the sun heats the atmosphere.

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