Globisens
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Applied Sciences

A walk through the city

Measuring environmental temperature and humidity in green areas and around urban areas

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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	Life Science	LS2: Ecosystems: Interactions, Energy and Dynamics
		LS2.A: Interdependent Relationships in Ecosystems
		LS2.B: Cycles of Matter and Energy Transfer in Ecosystems
	Earth and Space Science	ESS2: Earth's Systems
		ESS2.A: Earth Materials and Systems
		ESS2.C: The Role of water in Earth's Surface Processes
		ESS2.D: Weather and Climate
	Engineering, Technology, and Applications of Science	ETS2: Links Among Engineering, Technology, Science, and Society
		ETS2.B: Influence of Engineering, Technology and Science on Society and the Natural World

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	Middle School Standards Covered	High School Standards Covered
NGSS Standards	MS.LS-IRE: Interdependent Relationships in Ecosystems	HS.LS-IRE: Interdependent Relationships in Ecosystems
	MS.LS-MEOE: Matter and Energy in Organisms and Ecosystems	HS.LS-MEOE: Matter and Energy in Organisms and Ecosystems
	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	HS.ETS-ETSS: Links Among Engineering, Technology, Science and Society
	MS.ESS-WC: Weather and Climate Systems	
	MS.ETS-ETSS: Links Among Engineering, Technology, Science and Society	

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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		

Life Science Standards Middle School		Life Science Standards High School	
✓	Structure and Function in Living Systems	✓	The Cell
	Reproduction and Heredity	✓	Molecular Basis of Heredity
✓	Regulation and Behavior		Biological Evolution
	Populations and Ecosystems		Interdependence of Organisms
	Diversity and Adaptations of Organisms	✓	Matter, Energy, and Organization in Living Systems
			Behavior of Organisms

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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 relationship between temperature and humidity in several locations inside and outside school, creating a hypothesis and proceeding to test it using the Globisens Labdisc Relative Humidity, GPS and External Temperature Sensors. The goal is to obtain the values of these variables in urban spaces and in green areas.

Time Requirement:

60 - 90 minutes

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Objective

The purpose of this activity is to study the relationship between temperature and humidity in several locations inside and outside school, creating a hypothesis and proceeding to test it using the Labdisc external temperature, relative humidity and GPS sensors. The goal is to obtain the values of these variables in urban spaces and in green areas.

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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

Trees and green areas generally have a positive influence on the sun's radiation, temperature, winds, environmental humidity, evapotranspiration and precipitations. This is why people usually agree on the importance of taking care of such places, even in city centers where we mostly find buildings and industrial parks.

? **When do you use green areas? Tell us several outdoor activities that you like to take part in.**

? **Have you ever entered a park after walking for a long time in the sun? Describe your experience.**

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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:

How do green areas affect environmental temperature and humidity?

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Introduction and theory

Theoretical

The population of cities grows around two to three times faster than the population of country areas. This means, an increasing number of buildings, industries and roads, while the number of trees and green places in the city can be observed to decrease. This makes for microclimate change, and often affects the quality of life for the city's inhabitants.

There are several possibilities for green areas in a city: Gardens, waterfronts, linear corridors, community gardens, wild areas and traditional parks. In particular, parks significantly change their environment - improving the air quality ventilation, and filtrating large amounts of rain water. Depending of the size of the park, it may also provide a habitat for a variety of fish, birds, insects and other animals, along with protecting the diversity of the flora. In addition, green areas are great places to practice sport and rest, or to just go and have fun with your friends and family.

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Introduction and theory

We can find a great variety of plants and flowers; crawling herbs, tall and short plants, vines, shrubs and trees. We may find varieties of evergreen or deciduous plants, with branches forming foliage. They can be endemic (local wild species) or introduced from other countries. One of the most important plant processes is water transpiration, which contributes to maintaining the ground moisture. This way, plants – most importantly trees – decrease air temperature.

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Introduction and theory

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

In an open space, how would you expect temperature and humidity levels to change as you approach a wide green area? Why do you think this happens?

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Activity description

Students will measure and study the temperature and humidity variations in different environments (open and closed spaces) as they approach green areas, starting from their classroom. They will recognize quantitative qualities that allow them to explain the positive effect of city vegetation.

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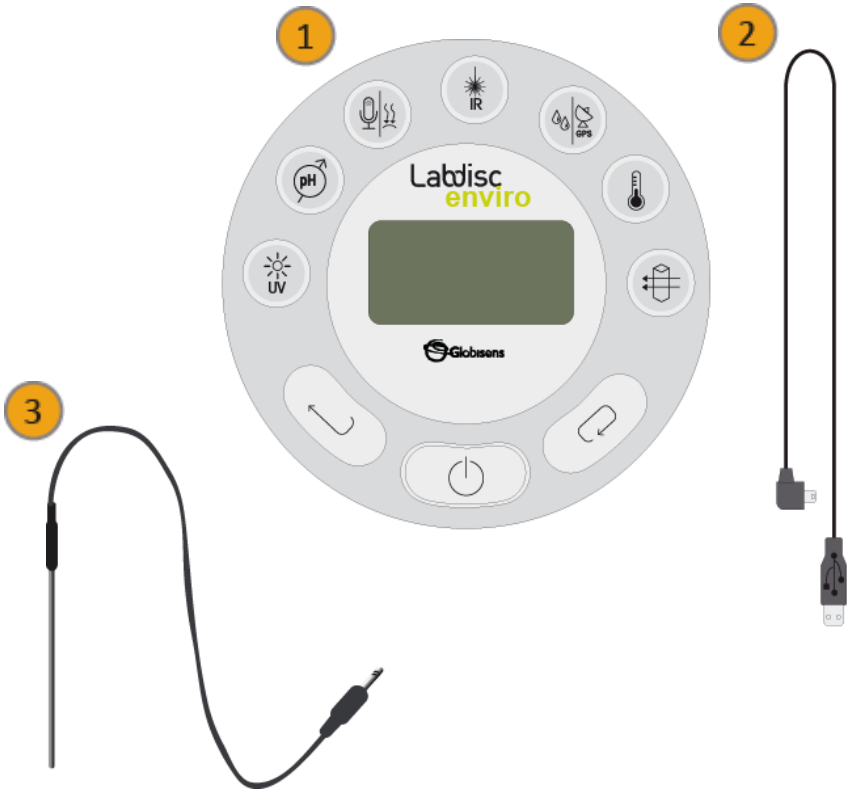
Resources and materials

1. Labdisc
2. USB communication cable
3. Temperature probe



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a. Using the Labdisc

To collect measurements with the Labdisc relative humidity, external temperature and GPS sensors, the Labdisc must be configured according to the following steps:

1. Turn on the Labdisc by pressing 
2. Press  and select “CONFIGURATION” by pressing 
3. Using  go to the GPS Configuration Menu, pressing  to enter and selecting the “Activate GPS” option by pressing 
4. Press  two times to go back to the menu.
5. Go to SETUP using the  button and select it by pressing 
6. Now select the “SET SENSORS” option by pressing 

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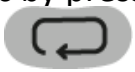
Using the Labdisc

7. Select only the relative humidity, external temperature and GPS sensors and press  three times.
8. Press  to start measuring.
9. Once you have finished measuring stop the Labdisc by pressing  (you will see the instruction “Press SCROLL key to STOP”) and press 

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Experiment

The following steps explain how to perform the experiment:

1. Take the Labdisc and connect the external temperature probe. Start measuring from the classroom door, as you approach a nearby green area.
2. After registering the data in the green area, approach an asphalted area.
3. Register your observations and the exact location in your notebook.
4. Once you have finished measuring turn the Labdisc off.

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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 the  button and select the  button.
3. Select the last experiment on the list.
4. Observe the graph displayed on the screen.
5. Press the  button and write notes on the graph specifying your observations according to the moment you registered the data.
6. Click the  button and select points on the graph. Pick one representative point for each location.

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Results and analysis

7 Fit the graph range according to your measurements, setting the y axis scale.

8 Right click the y axis and set the minimum and maximum value according to your measurements. Round your minimum value down and your maximum value up, and enter these numbers into “minimum” and “maximum”.

9 To see the map, click on the  button which is in the top-right corner of the GlobiLab screen and then click on the  button.

10 In the top-right corner of the map, you´ll see the words “map” and “satellite”.
If you click on map, you´ll see only the name of the streets.
If you click on satellite, you´ll see only the satellite image.
If you click on satellite/label, you´ll see the satellite image with the name of the streets.

11 If you want to see the exact value of each point, put the mouse´s arrow on the point of the map and a label with the values will appear.

12 In the top-left corner of the map, you´ll see the zoom and the cardinal points.

13 On the right side of the map, you´ll see the scale. You can adjust the values (minimum and maximum) with the  button and change them by clicking on the y axis of the map and selecting “set range”.

14 To change the variables of the graph, right click on the y axis and select the variable that you want to see.

15 To move the map, click on it and move the mouse´s arrow.

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Results and analysis

Did you find differences between what you expected and your actual results? Explain.

Did the humidity values at the different locations vary? Explain the differences.

Which place presented the maximum humidity value? Describe it.

Was the temperature recorded constant or variable? Explain.

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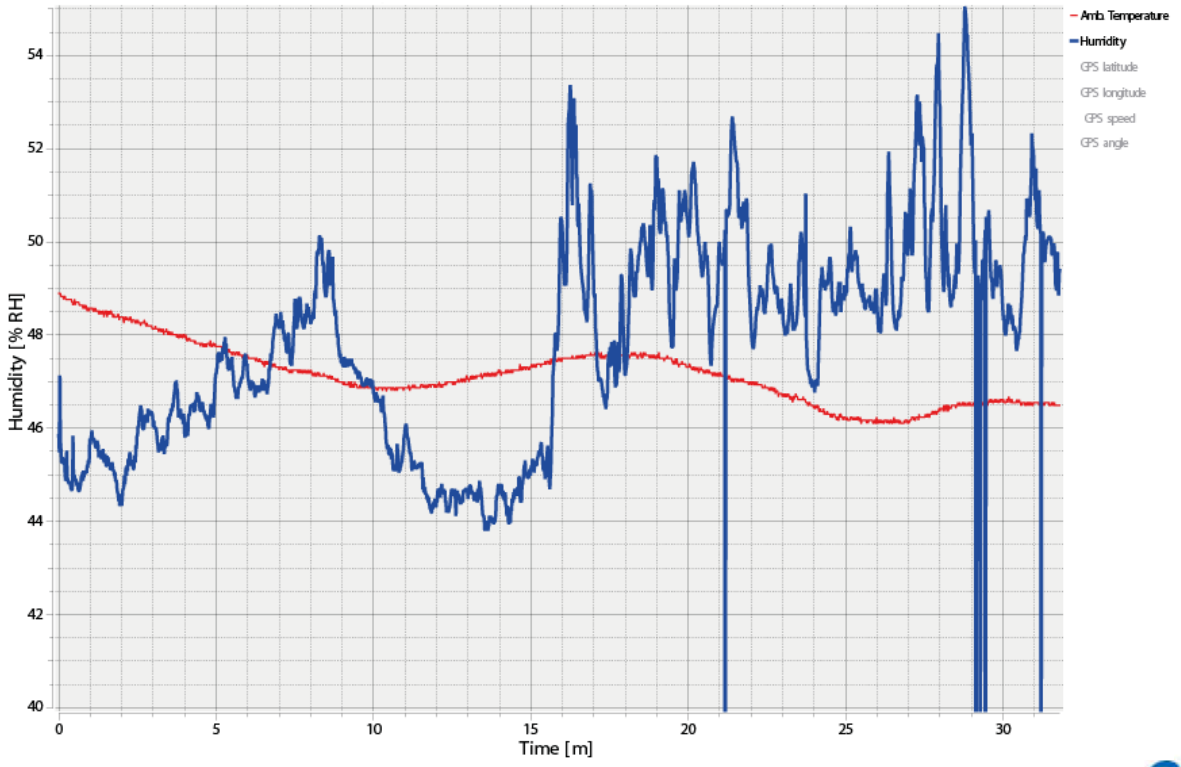
Results and analysis

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



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Results and analysis

Temperature versus time

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Results and analysis

Humidity versus time

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Conclusions

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

According to your results, how do green areas affect humidity? Explain.

Students should understand the conservation of humidity due to foliage. The leaf surface maintains a certain humidity level, intercepting the moist air coming from the evaporation of water from the ground. It also provides a condensation surface and transpires water as part of the life process of the tree.

What kind of green area is most effective in maintaining humidity?

The results should show that wider green areas with more percentage of tall trees are damper and so best maintain humidity.

Did you observe a relationship between the type of vegetation and the humidity values? Describe.

Students should find a relationship between the data obtained in the experiment and the type of vegetation in each place by analyzing the map.

What relationship can be identified between humidity and temperature by analyzing the graph? Explain.

Students should find an inverse relationship between humidity and temperature by analyzing the slopes of the graph and the observations made during the measurement. They should also compare the color scales of the maps.

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Conclusions

Students should reach the following conclusions:

They should conclude that humidity levels are very different between certain locations in the same area, depending on the vegetation: The more trees, bushes and plants growing in a place, the more humidity and the lower the temperature.

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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 think green areas and trees are somehow related to energy consumption during the summer? Describe and explain.

Due to the temperature decrease caused by trees, the shadows cast on buildings and the ability to halt the wind - green areas contribute to a reduction in energy consumption. Therefore, they reduce pollution caused by the process of energy generation. Students should think of other ways in which these elements can reduce energy consumption, then discuss and reflect upon the topic of energy saving.

What are the benefits of green spaces? Describe and explain.

Students may point out many positive qualities of green spaces. For example, they provide habitat for fauna, cooling in summer, environmental teaching space, aesthetics, recreational activities, control of pollution, oxygen generation, protect from erosion, and of course temperature and humidity regulation.

How would you improve the humidity and temperature conditions in your classroom? Explain.

Students should discuss possible ways to improve their daily environment. Some possibilities are growing indoor plants, improving the means of ventilation, using curtains that prevent the transfer of heat but let the light pass and more.

Suggest how you could increase the amount of green spaces in your school? Explain.

Students should make suggestions to improve their school facilities. For example, they may think how to take care and preserve the existing green areas, grow plants inside the classrooms, organize and regularly take care of a school garden and plant some deciduous trees (they cast shadow in the summer and let the sunlight pass in the winter). In addition, endemic trees and bushes can be planted (that don't consume too much water) to act as a windbreak; replace some asphalted areas with green places; plant on the roof; or design vertical gardens and plant walls.

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