

TEACHER OVERVIEW AND IMPLEMENTATION GUIDE

The Heat Is On: Understanding Local Climate Change is a curriculum "module" composed of a 5 day unit and 1-2 day performance assessment. The module supplements instruction about the differences between weather variability and climate change, the concept of microclimates, the urban heat island effects, and human influences on the greenhouse effect and global warming. Hence, depending on the course syllabus, it may be relevant in courses devoted to Earth, Physical, or Environmental Science. The purpose of the unit is to prompt students to think critically about what challenges accompany the use of real publicly available data sets, with all of their limitations, for drawing evidence-based conclusions about the complex phenomenon of climate change. You are encouraged to provide other instructional time to teach students about the focal topics mentioned above.

Students do "case studies" about local climate change that introduce them to a range of appropriate inquiry tasks. They develop greater understanding of the types of critical thinking that real scientists practice when called upon to make judgments and render advice on complex scientific phenomena that do not have easy answers or easy solutions.

In the unit, the students investigate changes to Phoenix's microclimate. They examine recent air temperature trends, compare what monthly minimum and maximum temperature data reveal, then look at data about changing human-induced conditions in the Phoenix area (carbon emissions, pollutant emissions regulated by the Environmental Protection Agency under the Clean Air Act, population growth, and urban development). In the process of examining these data, they apply to their investigation what they know about greenhouse gas-induced warming, about the aerosol-induced dimming effect, and about urban heat island effects, so that they draw conclusions about why Phoenix's climate may be warming. They follow up these conclusions with scientifically-reasoned recommendations for local actions and with suggestions for follow-up research in order to examine if their recommended policies may be having a positive effect. There are also components at the end that prompt them to think critically about the complexities of climate science and speculate about possible alternate explanations. There are core materials and extra materials that go with the unit. They are identified as such on the web site. Be prepared to allot extra time if you want to use the extra materials through homework assignments or additional class periods.

Answers to the unit activities are not supplied. Be familiar and comfortable with the content before administering the unit. Go through all the unit tasks yourself before giving them to your students.

In the assessment, students are given an opportunity to transfer their thinking about Phoenix to a new city, Chicago, that has some similarities but also some differences with Phoenix. The table below summarizes the similarities and differences in the years covered by the data in the module.

	Phoenix	Chicago
Warming of the temperature	evident in mean temperature increases and most dramatically in minimum monthly temperature increases	evident slightly in mean temperature increases only

CO2 emissions in the city compared to the rest of its state	big difference between the amount being emitted in the greater Phoenix area compared to other parts of Arizona	little difference between the amount being emitted in the greater Chicago area compared to other parts of Illinois
Population change	dramatic growth	overall, yet inconsistent decline
Physical size of its developed land area	dramatic growth	slight growth

Many of the activities in the assessment are very similar to those in the unit. Yet, the unit activities are more open-ended than those in the assessment, which are more constrained. They were designed this way because the unit is meant to be thought-provoking and generate collaborative thinking among students whereas the assessment is designed to provide valid and reliable evidence about what they individually learned in the unit.

Technical requirements

All components of the unit can be carried out online but only the "A" Parts are critical to do online because they involve students generating graphs in Excel. Part D has an option for students to answer the questions using a PowerPoint template rather than simply on a paper answer sheet. You need a way to save (or at least print out) the student-produced files (e.g., on the school server or on a storage device such as a hard drive, floppy disk, or memory stick). All other parts can be completed off-line. However, using the materials online saves the need to print out materials that the students need to complete the tasks. If computer time is difficult to schedule however, students can write their answers on paper printouts.

Prerequisites

- A. Before doing the unit, student should already have some basic understanding about:
- what defines a climate and a microclimate
 - what natural and human factors impact climate change
 - what the differences are between weather and climate
 - what the greenhouse effect is
 - what are the key climate science issues surrounding global warming

If the students do not have this basic information, they can read the Background Readings posted on the web site before they do the unit.

- B. To complete Part A of the unit, students need to know how to create graphs from data on data tables in Excel, label them, insert them into a Word file, and resize them. if they do not possess the skills already, they should do the Excel tutorial available on the web site.

You can administer the entire unit to your students as an independent study because all the introductions, directions, and questions are written into the materials. However, we recommend that you use a variety of methods to deliver the unit content to your students, such as independent work on the easier activities and small-group collaboration on the more challenging and thought-provoking ones. Familiarize yourself with the activities and their varying levels of challenge, and then decide how you want to deliver them. We also recommend that you allot time at the

beginning of class to introduce each new activity and reserve time at the end of class to give the students the opportunity to debrief in a large group discussion.

We recommend however that you deliver the assessment as an independent student activity so that you can obtain the most accurate information about how much each individual student has gained from the unit.

The unit materials are posted on the DIGS Climate Unit and Assessment web sites. The materials include:

- a directions file
- a unit response sheet on which students should key their answers
- a template for student slide presentations
- data sets used in the unit
- readings

The web site for the unit also contains:

- A file of tables showing alignments between the different unit and assessment tasks and national standards.
- A "specification shell" which provides brief synopses of what the students do in the different segments of the unit and assessment, where there is parallelism between the unit activities and the assessment activities, and which standards are addressed by the tasks.
- A guide for scoring the items on the assessment, which includes each item, aligned standards, a scoring rubric per item, and examples of student responses per score.

The assessment materials are posted on a separate web site in the same manner as are the unit materials. The assessment instrument presents a similar case study about a different city, Chicago. The purpose of the assessment instrument is to see if individual students are capable of applying what they learned in the unit to a "near-transfer" task. In order to yield valid and reliable evidence of student outcomes, the assessment tasks are more constrained than those in the unit. However, for each item, students are asked to express their reasoning. The assessment web site is not linked directly to the unit web site so that students cannot easily go from one to the other. Both however are accessible from the teacher web site.