DEMO GUIDE
for the Solar System Collaboratory

Version 1.0.1

http://SolarSystem.colorado.edu/demo
mirror site: http://callisto.colorado.edu/demo
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I. Setting Up
   a. Hardware and software requirements

To ensure that your tour of the Solar System Collaboratory proceeds as smoothly as possible, we would like to take a few minutes to review your hardware and software setup.

Operating System
Since the particular project for which this site was developed was funded for the purpose of teaching specific classes at specific institutions, the site was designed to work best with the equipment available to the students at the participating schools. Therefore, although most of the site can be viewed with other systems, we can only guarantee that everything will work properly with
Microsoft Windows (95, 98, and NT 4.0), with
Netscape Navigator 4.5 or MS INTERNET EXPLORER 4.0
If you do not have Navigator 4.5 or Internet Explorer 4.0 installed on your system, a link from our "Technical Guide" page (click on the "Technical Guide" link on the demo site's opening page at http://SolarSystem.colorado.edu/demo) will direct you to the appropriate Netscape or Microsoft website from where you can download and install a free copy.
If you have an older version of Navigator it might also work, but Java support (in particular support for JDK 1.1) is not integrated into all versions of the browser. As a result, trying to make an older version of Navigator compatible with JDK 1.1 can become a long and involved exercise. By contrast, upgrading to Navigator 4.5 is quick and painless.
Versions of Internet Explorer older than 4.0 will not work properly.

Processor and Memory
Because this site makes extensive use of java applets, you will need a relatively fast processor with an adequate amount of memory. We recommend
200MHz PentiumPro or higher, with 64MB of RAM
A slower processor will still work, of course, but the performance can sometimes be frustratingly slow, especially with some of the more demanding applets (the space weather applet for instance typically integrates six coupled differential equations for 30,000 timesteps).

Video
The pages were developed for screens with a resolution and color depth of
1024x768 with 24-bit color ("millions of colors")
This is the typical resolution of 17" monitors. Monitors with resolution lower than 1024x768 cannot display entire applets, resulting in extensive scrolling and frustrating performance.
A shallower, 16-bit color depth ("thousands of colors") will give lower quality but still acceptable results.
8-bit color ("256 colors") will render some of the graphics unintelligible.

Additional Software
Some of the teaching resources (lab worksheets for instance) that have been developed by the participating faculty are available for downloading in PDF format (as is this demo guide by the way, the latest version of which can be downloaded from the demo site's front page). Other teaching resources include QuickTime 3.0 video clips.
If you do not have Adobe Acrobat Reader or Apple QuickTime 3.0, you can download free copies using the links in our "Technical Guide" page (click on the "Technical Guide" link on the demo site's opening page at http://SolarSystem.colorado.edu/demo).
b. Browser configuration

Although most of the browser settings that we recommend are the default settings, a quick review will ensure a smooth tour of the site.

Font Size
The default font size used by Navigator 4.5 is Times New Roman 12 (Times New Roman "Medium" for IE 4.0). If you have difficulty reading the text, you can change the default font for your browser. You can choose a bigger font size, or choose a different font altogether. Be warned however that considerable effort has gone into designing the site to look best with the default font (pagination, paragraph length, size of applets, etc). Changing the font will change the 'look' of the pages in this site. Since they were designed for the default font, using any other font will make some pages look ungainly.
In Navigator 4.5, you choose the default font in the Edit/Preferences/Appearance/Fonts menu.
In IE 4.0, you choose the default font in the View/Internet Options/Font menu.

Java and JavaScript
This site makes heavy use of Java and JavaScript, both in the applets, and in the "look and feel" of the entire site. For Java and JavaScript to work they must be enabled on your browser.
In Navigator 4.5, you do so in the Edit/Preferences/Advanced menu.
In IE 4.0, you do so in the Edit/Internet Options/Advanced menu.

Window Placement
When you click on the "ENTER WEBSITE" button in the opening page of the demo site, two new windows are created. In the course of the demo a number of additional windows will also be created to display information ancillary to your current activity. This includes "help", "hint", and "math" pages, references, applets, etc. We recommend that you refrain from moving these windows. Extensive care has gone into designing the placement of the windows to provide easy "one-click" access to any window in the website no matter what other windows are open at the time. Consequently, if you try to move a window you will most likely end up making you life more difficult.
As a consequence of the care with which the window placement was chosen, we strongly suggest that you do not use a maximized browser window to view the site, as this will play havoc with the careful placement of all the ancillary windows.
Figure 1, on the next page, shows a screen shot of the four principal windows on the site. Notice that no matter how the windows are layered, a part of every window is visible at all times, so you can bring that window to focus with one click of the mouse. When you first enter the site only the MAIN and the HELP windows will open. We will talk about additional windows as they are needed during the tour.
Although we recommend that you do not move or maximize the windows, you can close any ancillary window at any time. The window will pop up again at the right place whenever the information in it is called for.

Toolbars
Finally, for Navigator 4.5, we recommend that you use the "text only" option for the toolbar (you can choose this option in the Edit/Preferences/Appearance menu) and that you hide the "personal" toolbar (you can do this under the View menu). For IE 4.0, we recommend that you hide the "Explorer Bar" (in the View/Explorer Bar menu). This will maximize the screen space available to your browser window, and reduce the need to scroll. Your MAIN window should now look like the MAIN window in Figure 1.
Figure 1. Screenshot of four of the windows of the Solar System Collaboratory site. Notice how a small part of any window is visible at all times no matter how the windows are layered, facilitating access to the information they contain with one click of the mouse.
II. General Outline of the Tour

a. Overview of the website layout

Before we talk about the science content, it may be helpful to become familiar with the general layout of the website.

Launch Navigator, go to the Collaboratory demo site, and click on the "ENTER WEBSITE" button. Figure 2 below shows the two windows that appear (you may want to minimize the entry window now, so it doesn’t get in the way). The gray strip on the left of the MAIN WINDOW is the QUICK NAVIGATION panel. It contains shortcuts to often used pages such as "HELP" (which gives technical help: which buttons to push and which sliders to slide), "give me a HINT" (which provides hints on the science content), and "show me the MATH".

HOME, is essentially the "panic" button. It will always get you back to this point, so you can always find your way back to the start. The applets will appear mostly in the MAIN window. The HELP, HINT, and MATH buttons in the quick navigation strip are context sensitive, meaning that they "know" which page is displayed in the MAIN window, and they display the appropriate HELP, HINT, or MATH page in the help window.

Figure 2. The MAIN window, and the HELP/HINT/MATH window.
If you now click on the MODULES link in the quick navigation panel, and then click on the link to the EARTH/VENUS/MARS module, you will see that the quick navigation bar changes to show shortcuts to pages that you are likely to use frequently while working on that module (cf. Figure 3 below). In particular, there are three new shortcuts. The PHYSICS PAGE contains a textbook exposition of the physics (you can see short descriptions of the function of each link in the quick navigation panel by placing -not clicking- the mouse over the text). The FACT SHEET will display a list of relevant facts about the planets (temperature, atmospheric composition, etc), while the EXTRA WINDOW link will pop up an additional window, so that you can have two applets running at the same time (you sometimes need to use the output of one applet as input for another). With all four windows up, your screen will look like the screenshot in Figure 1.

![Figure 3. The MAIN and HELP windows for the EARTH/VENUS/MARS module. The quick navigation panel on the left has changed to provide access to the appropriate PHYSICS PAGE, FACT SHEET, and EXTRA WINDOW. With all four windows up your screen should look like the screenshot in Figure 1.](image-url)
b. Pedagogical goals

We have now reviewed enough of the general structure of the website to be able to proceed with the tour of the science content in Part III. The tour is designed to demonstrate how we use the technology to attain our pedagogical objective of allowing non-science majors to concentrate on the "prose" of science, and engaging them in quantitatively rigorous scientific inquiry that would be impossible to duplicate without the applets. We will also attempt to show how the modules can help us teach the scientific method (build a model and compare to observations), and how they can help us demonstrate why scientists accord different levels of certainty to different theories (textbook truth, consensual truth, and the scientific frontier). We will review one of the modules, EARTH/VENUS/MARS The Greenhouse Effect, in detail, and we will show short examples of the other two modules developed so far, on Kepler's Laws, and Space Weather.

The EARTH/VENUS/MARS module is itself a good example of the "pyramid" structure of the material. The applets used in the module cover the range of scientific certainty from "textbook truth" (for the blackbody radiation applet which calculates the radiation curve of a body with a given temperature) to "consensual truth" (for the three-gas radiative transfer model, which makes several assumptions about atmospheric dynamics and composition). The "scientific frontier" is demonstrated by the Magnetospheric Indices applet of the Space Weather module. Space weather is the subject of an ongoing, vigorous research effort with dozens of scientists and many national agencies around the world participating in the research. As you will see however when you work with the applet, the models used to study the magnetosphere offer nothing like the accuracy of the more established atmospheric models, let alone the accuracy and confidence of established theories, like blackbody radiation.

We should emphasize here that, although the main objective of the Collaboratory is to teach the scientific method, rather than facts or theories that can be treated as facts, we devote at least as much (if not more) effort to learning the facts. The facts (a.k.a. "measurements" and "observations") are, of course, indispensable to the scientific method, and we will review the tools we use to teach them (worksheets and homework assignments) in part IV below, when we discuss the teaching resources that we are currently developing for the Collaboratory participants.
III. Tour of the Science Modules

We can now walk through a quick tour of the science modules. If you have any Navigator windows open please close them all and re-launch Navigator, so we can have a fresh start. Go to the Collaboratory demo site (SolarSystem.colorado.edu/demo), and click the ENTER WEBSITE link.

Things to remember:
1) The HELP, HINT, and MATH links in the quick navigation bar will display information pertinent to the contents of the MAIN window. If you ask for help (or a hint) and the text seems to be referring to something other than what you're looking at, chances are that you are looking at an applet in the EXTRA WINDOW. Bring up the applet you want on the MAIN window, and then click on HELP (or HINT).
2) When you enter numbers in the text-input areas (e.g. the albedo, or greenhouse strength) remember to hit the return key. If you do not, the model will continue to calculate with the old value, resulting in an apparent inconsistency.
3) When the applet takes its input from the position of the mouse on the screen (as for instance the first applet we will discuss below) the precision of the input is, of course, limited by the resolution of the monitor (the range of possible values has to be divided by the limited number of pixels available). This can lead to apparent inconsistencies (the mouse is at the same place, but the numbers are different). When the precision of the input becomes important to the argument (as it does at one of the Kepler applets for instance) we have included text input fields for precise numerical input. Otherwise we are inclined to let students struggle with the idea of imprecise measurements.

a. EARTH/VENUS/MARS, The Greenhouse Effect

Click on the MODULES link in the quick navigation strip, then click on the EARTH/VENUS/MARS link in the list of modules that appears on the main window. Your screen should now look like the screen shot in Figure 3.

Click on the PLANET TEMPERATURE link. This will launch java (this might take a few minutes, especially on older systems; once java is launched however subsequent applets will start considerably faster). The first applet is now shown on your MAIN window. By clicking on the applet, you position PLANET-X at different distances from the sun. The applet then uses a model to calculate the temperature of PLANET-X at that distance from the sun, and displays the result on the thermometer on the right (there is a text window at the top of the thermometer that displays a numerical value for the temperature). The applet can use three different models to do this calculation, and you can select the model you want from the "Model:" choice field at the bottom of the applet.

Click on the "give me a HINT" link, and follow the instructions that appear in the "help" window. The "hints" are designed to show that, although simple models (like the "fast rotating dark planet" model for instance) can do an adequate job modeling the temperature of Mars and even Earth (especially if one includes the planet's albedo in the model) simple models fail spectacularly for Venus. Notice that at every step, students are encouraged to look up the relevant physics explanations in the PHYSICS PAGE (which gives essentially the typical textbook explanation of the physics), and to always compare the model predictions with the data in the PLANETARY FACTS page. In addition, although this is a course for non-science majors (i.e. no Math), the full mathematical treatment for the models that are used in the applets is included in the "show me the MATH" page.

Once you have convinced yourself that the first two models cannot account for the temperature of Venus, you can click on the "Greenhouse Effect" link at the bottom of the main window. Notice that you
do not need to go back to the main page of the EVM module to go to another applet. Each applet page has links to all other applet pages at the bottom of the page; if your browser is correctly configured, you should be able to see the links without scrolling (yes, we did plan it that way). You might also want at this point to launch an EXTRA WINDOW (click on the corresponding link in the quick navigation bar) so that you have both the Greenhouse applet, and the Planet Temperature applet running at the same time. Following the hints, you can now explore the effect an atmosphere has on the temperature of a planet. As usual, the PHYSICS PAGE has a typical textbook exposition of the physics involved.

The final applet we will visit is the Radative Transfer applet. It uses a succession of three models of increasing sophistication (which can be selected from the choice bar at the bottom of the graph) to calculate the temperature of the Earth. The graph shows the atmospheric absorptivity and the intensity of the incident and radiated energy as a function of the wavelength. Follow the instructions in the HINT page, and explore the effect different compositions of the Earth’s atmosphere have on the average planetary temperature. As always, the MATH page has the full mathematical formulation that is used in the applet. The main point of this applet is that it uses a much more sophisticated model than the Greenhouse Applet (just take a look at the corresponding MATH pages!) but it is just as easy to use. All the student has to do is concentrate on the logic of the arguments, rather than being turned off by the math.

b. Kepler's Laws and Space Weather

After this extensive review of the EVM module, we have only short examples of the other two modules developed so far. Since you are, by now, an old hand at using the site, we will let you explore these examples on your own, using the online resources (hints, math, physics, etc). Here we will only mention that the Ptolemaic Model applet is designed to help students realize the importance of accurate data, by showing that the Ptolemaic model makes remarkably good predictions, although just not good enough. The Magnetospheric Indices applet drives this point even further, and includes the importance of theoretical backing for a model. The predictions of the models it uses are much worse than the predictions of the Ptolemaic model, and yet these are models currently in the running for an explanation of Space Weather, while the Ptolemaic model is definitively discarded.
IV. A Scholars' Community

In addition to using technology to expand the range of science issues/problems that our non-science majors can meaningfully tackle, we are using technology to help create a scholarly community for the teachers. This is especially important for faculty in small, geographically isolated schools, that do not have the enrollment numbers to support an extensive on-campus community of physics teachers. We are therefore developing not only a set of tools to help with the logistics of teaching (eg. exams and lab worksheets) but also a set of tools that facilitate the creation of an online "community of scholars" that science teachers can draw upon whenever and from wherever they need.

a. Related research and online discussion

We are currently developing a database of references to works on both the subject mater and the pedagogy of teaching science, especially the use of collaborative learning techniques. The database is created collectively by the Collaboratory participants, who enter new citations, write abstracts for works they read recently, or comment on the abstracts other participants wrote.

Click on HOME in the quick navigation panel, to return to the home page. Then click on the EXECUTIVE SUMMARY link. This part of the site gives a short description of the Collaboratory, its organization, function, goals, and results we obtained from our testing. Click on the REFERENCES link. This will bring up a list of references. You can add a new reference using the link in the quick navigation panel, or you can view the abstract and comments participants wrote about a specific reference by clicking on the link under the reference.

b. A database of exam questions and lab manuals

In addition to the references, we are developing a database of exam questions, as well as lab manuals and homework assignments that participating teachers are currently using in their classes. Click on MATERIAL in the quick navigation panel to see a list of exam and homework questions. By selecting questions from the database, one can construct an exam or homework assignment very quickly, without having to reinvent the wheel. In addition, some participating faculty have made their entire lab worksheets and essay assignments available, and you can see those under CLASSES. They can be downloaded as PDF files.

c. Dos and Don'ts

In the spirit of developing a community of science teachers, we are also developing a list of do's and don'ts from the collective experience of the participating faculty. This list includes classroom tips on content and pedagogy, as well as explicit advice from the communication experts on implementing collaborative learning in the classroom. In particular, we are currently developing a suite of short videos that illustrate typical collaboration problems that one may be faced with as the students use the modules, as well as videotaped examples of successful and unsuccessful faculty intervention.