

Data Analysis and Generalizations

A Different Perspective

TEACHER GUIDE

BACKGROUND INFORMATION

The *National Science Education Standards* "Assessment" standards call for "authentic assessment," which is described as "exercises [that] require students to apply scientific knowledge and reasoning to situations...that approximate how scientists do their work." The *NSES* "Science as inquiry" standards state that:

- "Students often have trouble dealing with data that seem anomalous," and
- They "need to learn how to analyze evidence and data."

Analysis of the real-time data being collected by the Genesis electron monitor, processed on board the Genesis spacecraft, and found on the Los Alamos National Laboratory (LANL) Genesis data Web site, provides an authentic assessment activity that incorporates all of these requirements into this Data Analysis Module.



Los Alamos National Laboratory

Genesis Electron Monitor (GEM)

This activity concludes with six questions that should help you assess your students' ability to interpret the presented data, to deal with data that can be interpreted in more than one way, and to develop new questions that could be the basis of further scientific investigation.

Solar Wind Electrons

In "A First Look" and "A Closer Look," students observed the changes and trends in **proton** speed, temperature, and density, and the ratio of helium ions/ hydrogen ions (alpha particles/protons) in solar wind plasma streams, using the Genesis Summary Data Plot. The solar wind also contains enough negatively charged **electrons** to counteract these positively charged alpha particles and protons. In this assessment activity, students will be using the Genesis Electron Spin-Angle Distribution Plots as well as the Genesis Summary Data Plots to analyze and interpret electron characteristics shown from two perspectives.

You will find it helpful to examine the Electron Spin-Angle Distribution Plots using the instructions given for access in the "A Look from a Different Perspective" student activity procedures prior to using the assessment activity with your students. You may wish to call students' attention to the fact that the latter format is the one that they have used throughout this module and that the *process* that they used to analyze the data from these data plots will be useful as they complete this assessment activity.

Scientific Terminology

The text from "A Look from a Different Perspective" student activity introduces and defines new terminology. You will need to be prepared to help students further understand the meanings of terms such as flux, spacecraft spin angle, relative electron flux, ecliptic, supra-thermal electrons, eV (electron volts), uni-directional electron streaming, bi-directional electron streaming, solar energetic particle events, and algorithm.



NATIONAL SCIENCE STANDARDS ADDRESSED

[Assessment Standard C](#)

Assessment tasks are authentic

Grades 9-12

[Science As Inquiry](#)

Abilities necessary to do scientific inquiry
Understandings about scientific inquiry

(View a full text of the [National Science Education Standards](#).)

PRINCIPLES AND STANDARDS FOR SCHOOL MATHEMATICS

Grades 9-12

[Data Analysis and Probability](#)

Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them
Develop and evaluate inferences and predictions that are based on data

(View a full text of the [Principles and Standards for School Mathematics](#).)

MATERIALS

- Student Activity, "[A Look from a Different Perspective](#)"
- Computer access to the [LANL Web site](#) or appropriate data printouts of Electron Spin Angle Distribution Plots
- Solar Wind Summary Plots from the [LANL Web site](#)

PROCEDURE

1. If computer access is not available, make copies of the data printouts of **Electron Spin Angle Distribution Plots** for the following dates:
 - February 7, 2003
 - January 27, 2003
 - January 3, 2003
 - February 11, 12, and 13, 2003

Also make copies of data printouts of the **Solar Wind Summary Plots** for February 11, 12, and 13, 2003.

2. Make sure that students understand the intent of this assessment activity. It is desirable to make this activity an individual assignment, since Parts 4 and 5 involve reading graphic data and recording it in data tables. Part 6 requires the comparison of two representations of the same data.
3. Allow at least one period for the completion of Parts 1 through 3. Students should not be rushed through these procedures since there is new scientific content to be assimilated and a new graphic data representation to be studied. During the completion of these procedures, circulate around the room and answer questions regarding new terminology or graphic representation, being careful not to actually interpret the data for the students, since this is part of the assessment.

An additional period will be necessary for the completion of Parts 4 through 6.

4. You may initiate this activity in one of two ways:
 - a) You may distribute copies of Parts 1 through 3 of the Student Activity, "[A Look from a Different Perspective](#)," and let students explore the three sets of data for February 7, January 27, and January 3, 2003, along with their descriptions and explanations in groups of 3-4 students.



Provide computer access for students. Students should access Electron Spin Angle Distribution Plots for the following dates: February 7, 2003, January 27, 2003, and January 3, 2003. If computer access is not available, distribute copies of the data printouts of Electron Spin Angle Distribution Plots.

Bring students back together as a class and answer any questions that they may have regarding the new information and concepts involved.

Distribute copies of Part 4 of the Student Activity, "[A Look from a Different Perspective](#)," and let students work through the assignment on their own. If computer access is not available, distribute copies of the data printouts of Electron Spin Angle Distribution Plots for February 11, 12, and 13, 2003.

Distribute copies of Part 5 to individual students when they show you their completed Part 4 data tables. If computer access is not available, distribute copies of the data printouts of the Solar Wind Data Summaries for February 11, 12, and 13, 2003.

Either distribute copies of the Part 6 questions to individual students as they complete Part 5, or wait until the next class period and start all students on Part 6 at the same time. Remind them that they should have all of their work for Parts 1 through 5 available as they answer the questions.

- b) You may choose to distribute copies of Parts 1 through 4 of the Student Activity, "[A Look from a Different Perspective](#)," and let students work through the assignment on their own.

Provide computer access for students. Students should access Electron Spin Angle Distribution Plots for the following dates: February 7, 2003, January 27, 2003, and January 3, 2003. If computer access is not available, distribute copies of the data printouts of Electron Spin Angle Distribution Plots.

Distribute copies of Part 5 to individual students when they show you their completed Part 4 data tables. If computer access is not available, distribute copies of the data printouts of the Solar Wind Data Summaries for February 11, 12, and 13, 2003.

Either distribute copies of the Part 6 questions to individual students as they complete Part 5, or wait until the next class period and start all students on Part 6 at the same time. Remind them that they should have all of their work for Parts 1 through 5 available as they answer the questions.

5. Optional: After students complete the answers to the assessment questions, bring the class together for a feedback session where students may present their ideas for further investigation questions. These questions can include questions from this assessment as well as from other sections of this module. They may also be used as extension activities.