MARS STUDENT IMAGING PROJECT

Data Analysis Practice Guide

2001 MARS ODYSSEY

Mars Education Program
Arizona State University

MARS STUDENT IMAGING PROJECT

Data Analysis Practice Guide

This set of activities is designed to help you organize data you collect so that you are able to graph and analyze it. The data table provided in this guide is a sample example only. Keep in mind that most data tables put together by researchers will have more data than what is shown on this sample table. For example, many data tables will include additional columns of information. This may include qualitative data written about observations of features being studied. There may also be a column for stating observations of the surrounding area (the context) of where an image was taken. A column for sketches can also be useful. These qualitative observations can be as important as the quantitative data represented in this sample. Additionally, five data points are too few to make valid conclusions of the data.

Goals of Activities: After completing these activities you will be able to:

- Use Excel to input any data you collect

- Use Excel to select and graph any pair of data you collect

- Make observations of data you graphed

- Make interpretations based on your observations

The four activities you will complete in this guide are as follows:

Activity 1: Using Excel to Create Graphs

Activity 2: Observations and Interpretations

Activity 3: Graphing Pairs of Data for Your Research Project

Activity 4: Graphing Latitude versus Longitude

MARS STUDENT IMAGING PROJECT

Activity 1: Using Excel to Create Graphs

Presenting the information or data you gather from images can be done several different ways. Having your information in a data table is the first step and is extremely important. This will allow you to have an organized view of your data. This can also help you decide what to graph. Additionally, it will help you analyze your data. For this exercise, you will be asked to look at some sample data taken of channels. For this example, a number of channel widths and depths have been determined and are being compared. This information, along with other important information is presented in a data table. The information organized in a data table alone would make it difficult to make observations to analyze that data. It is important to illustrate your data in a way that makes it easier for you to interpret.

Below is a data table that shows channel data from five Thermal Emission Imaging System (THEMIS) images. Please note that the THEMIS Image ID's are not real. Follow the instructions given below to graph this data:

	A	B	C	D	E
1	THEMIS Image ID#	Longitude (E)	Latitude (N)	Channel Width (meters)	Channel Depth (meters)
2	V11111111	288.2	17.1	720	43
3	V22222222	177.6	-17.3	16952	926
4	V33333333	136	26.6	3626	301
5	V44444444	41.6	11.5	12836	658
6	V55555555	106.5	-41.4	4291	661

1. Open Excel by clicking on the green Excel icon on your computer. ( )

2. Choose a new Excel workbook.

3. Type in all the data from the table above into your new Excel workbook. Make sure to enter the data from **columns A through E** from the white boxes only.

4. Click and drag your mouse over all the cells below **columns D** and **E**, including their titles ("Channel Width" and "Channel Depth").

5. Choose **Insert ▶ Chart.**

6. Choose a **XY (Scatter)** chart in the left-hand menu and click **Next.**

MARS STUDENT IMAGING PROJECT

Activity 1: Using Excel to Create Graphs (cont.)

7.   Make sure your chart looks alright in the preview box. Then click **Next**.

8.   In the Chart Options dialog box click on the *Titles* tab and enter a title for your chart. Then enter the titles for each X and Y axes in the "Value" boxes. For example, the "Channel Width (meters)" would be the X-axis title. Also, be sure to include the correct channel dimension for your Y-axis. Each axis title should include the unit of measure being represented.

9.   Under the *Legend* tab, uncheck **Show Legends**, then click **Next.**

10.   Choose to place your chart "as new sheet" and click **Finish**. Your chart should look similar to the one below.

Comparing Channel Width to Channel Depth
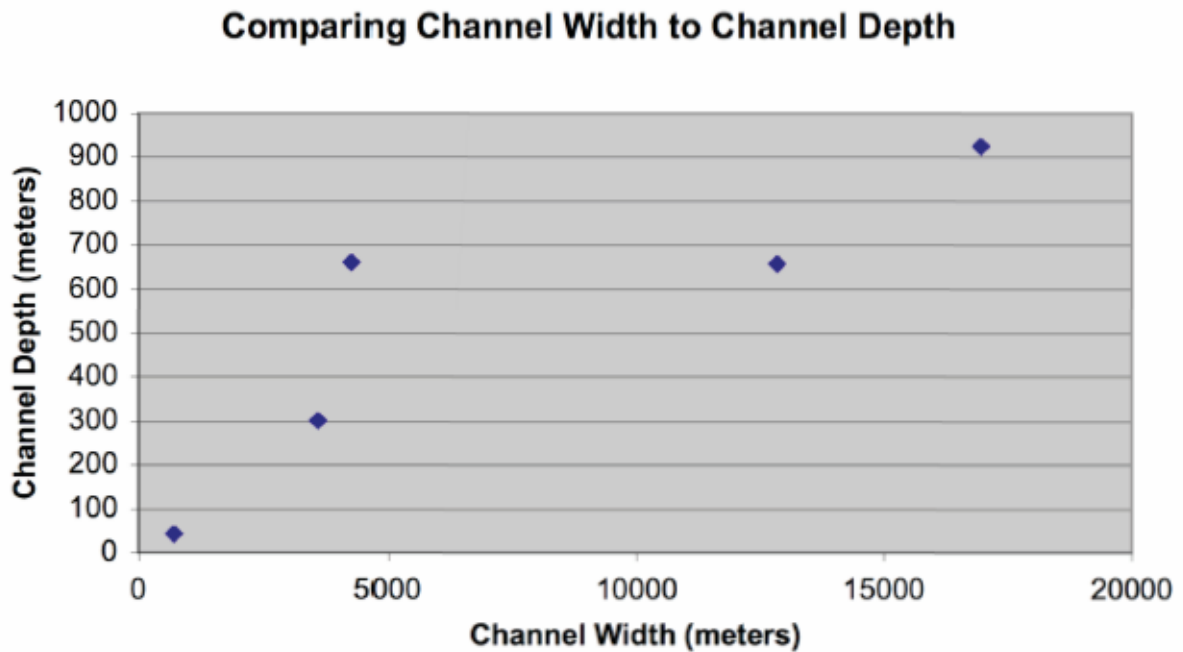
MARS STUDENT IMAGING PROJECT

Activity 2: Observations and Interpretations

Now that you have graphed channel width versus channel depth from the data table, it's important to determine what these data mean scientifically. This can be done in two important steps: 1) making **observations** of your data, and 2) using these observations to make **interpretations**.

<u>Observations</u> are made by looking at data and stating their general characteristics, including any patterns or trends. Here are two examples:

> <u>Observation #1:</u> This graph shows that channels with greater widths are generally deeper.

> <u>Observation #2:</u> There is one point on the graph that doesn't seem to follow the same trend as the other data point (referred to as an outlier). There are two channels that are about 4000 meters wide (3626m and 4291m) but the channel that is 4291 meters seems to be a lot deeper. According to the trend, one would expect the width of a channel that is almost 700 meters deep to be somewhere between 5000 – 1000 meters.

<u>Interpretations</u> are made by taking observations and explaining what they may mean scientifically. Interpretations allow you to infer how a specific process(es) may work, in this case, on Mars. Here are two interpretations of the above observations:

> <u>Interpretation of Observation #1:</u> Since wider channels appear to be deeper, that probably means that the wider channels were formed by greater amounts of water. Channels that *don't* follow this trend may indicate that there are other processes at work on Mars that need to be considered.

> <u>Interpretation of Observation #2:</u> The deeper channel, the one that is 4291 meters wide, must have a greater amount of water that flowed through it. Another possibility is that this channel is not as long as the other channels. Therefore, the same amount of water flowed through the shorter channel with greater force.

Keep in mind that you can make one interpretation (or multiple possible interpretations) of a single observation or your set of observations.

To review:
- Observations state general characteristics, trends, or patterns that you may notice about the data.
- Interpretations explain what those trends, patterns and observations may mean about how a particular process may be working.

MARS STUDENT IMAGING PROJECT

Activity 2: Observations and Interpretations (cont.)

Now that you know the difference between observations and interpretations, let's give you some practice. Here is a different graph of another set of data. This graph is comparing the diameter of a crater to it's depth. Look at the graph and list at least one observation and one interpretation of the data.

Comparing Crater Diameter to Crater Depth
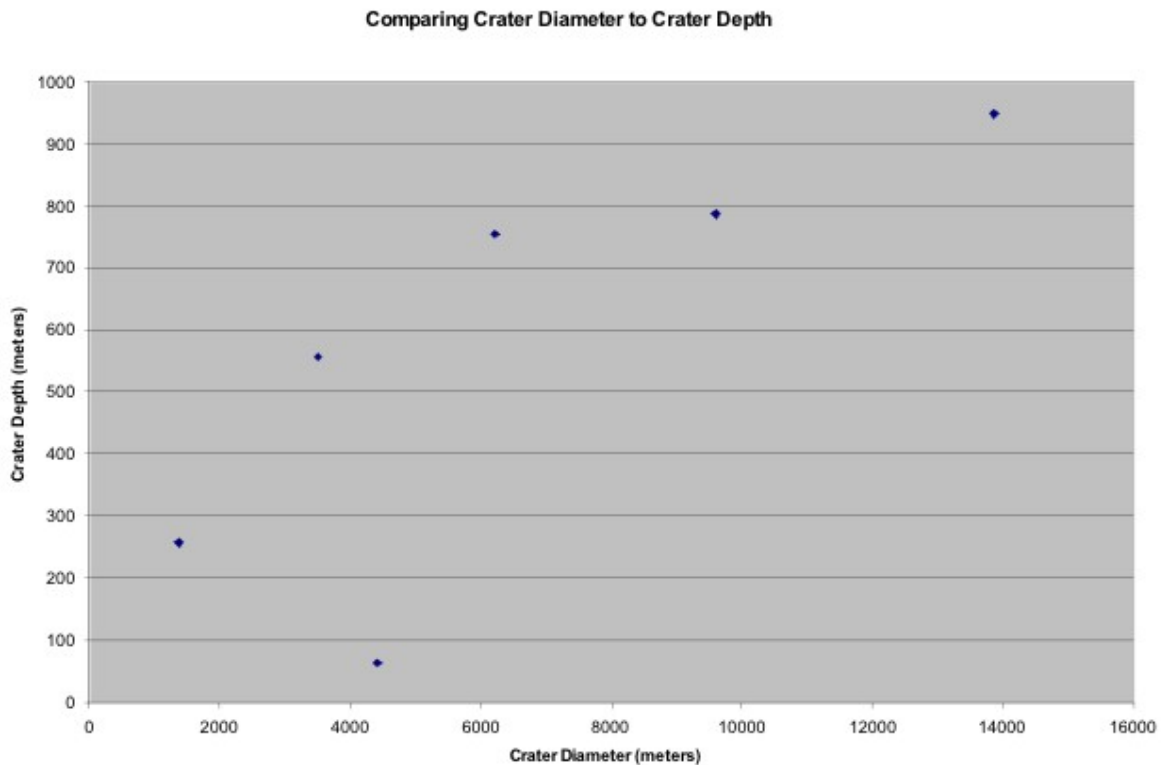
A. List at least two <u>observations</u> of the crater data in the graph:

Observation #1: _____

_____

Observation #2: _____

_____

B. List your <u>interpretations</u> of what each individual or set of observations may mean:

_____

_____

_____

_____

MARS STUDENT IMAGING PROJECT

Activity 3: Graphing Pairs of Data for Your Research Project

For <u>your science project and question</u>, you should organize your data in order to graph and analyze that data. Think about what data you will collect for your project and list three specific pairs of data you could graph. Include what the graph could tell you about these data. (For the first example it was channel width versus channel depth. This told us if there was a relationship between the width and depth of channels - which there was.)

1. _____versus_____

    Can tell you_____

    _____

2. _____versus_____

    Can tell you_____

    _____

3. _____versus_____

    Can tell you_____

    _____

Only once you have made your graphs will you be able to make your observations and interpretations of your data.   Keep in mind that you can make observations and interpretations of both **quantitative data** (measurements or latitude and longitude) <u>AND</u> **qualitative data** that you may have logged regarding visual observations you may have made. Qualitative data can be as equally important as the quantitative data but can not easily be display graphically.

MARS STUDENT IMAGING PROJECT

Activity 4: Graphing Latitude versus Longitude

It may also be helpful when analyzing your data to plot the latitudes and longitudes of your THEMIS images on a map of Mars which will give you a different type of graph! One reason for doing this is to see where your channels (or whatever feature you are studying) are located on the planet, including where they are in relation to each other. You could also see other geologic features present in the region that may have a relationship to the channels you observed. These types of relationships are difficult to see in a data table!

1. Click on the "Sheet" tab at the bottom of your screen to see the table of data you entered in the previous exercise. Once you see your data table, click and drag your mouse over all the cells below columns B and C, including their titles ("Longitude" and "Latitude").

2. Choose **Insert ▶ Chart**.

3. Choose a **XY (Scatter)** chart in the left-hand menu and click **Next**.

4. In the preview box, your graph should look like the example below:
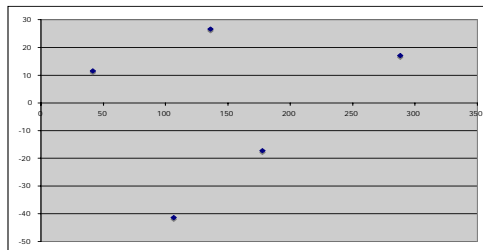
    Then click **Next**.

5. In the next **Chart Options** dialog box, do the following:
    a. Under the *Titles* tab, enter a title for this chart (it should <u>not</u> be "Latitude (N)") and label the X- and Y-axes. Note, the X-axis is Longitude (East), and the Y-axis is Latitude (North).
    b. Under the *Gridlines* tab, uncheck all grid line boxes.
    c. Under the *Legend* tab, uncheck "Show Legend".
    d. Then click **Next**.

6. In the **Chart Location** dialog box, choose to place your chart "as new sheet" and click **Finish**.

MARS STUDENT IMAGING PROJECT

## Activity 4: Graphing Latitude versus Longitude (cont.)

7. You're almost there! Now you will need to set up your graph to look like a map of Mars.

   a. For the lines of latitude (the Y-axis), put the mouse directly over the Y-axis and double-click. Then click on the *Scale* tab and enter the following in the Value (Y) axis scale boxes:
      - Minimum: -90
      - Maximum: 90
      - Major Unit: 30
      - Minor Unit: leave as is
      - Value (X) axis Crosses at: -90
      - Make sure that all boxes are <u>unchecked</u>.
      - Then click **Ok**.

   b. For the lines of longitude (the X-axis), double click on it also, and enter the following in the Value (X) axis scale boxes:
      - Minimum: 0
      - Maximum: 360
      - Major Unit: 90
      - Minor Unit: leave as is
      - Make sure that all boxes are <u>unchecked</u>.
      - Then click **Ok**.

   c. Look at the structure of your graph and check to see that the latitude and longitude data from your table are correctly displayed in the graph. The longitude should range from 0 to 360 degrees East, and the latitude should range from -90 to 90 North.

8. Now, for the final step, to add the color MOLA background map of Mars to your graph.

   a. Double-click on the gray area in your graph to open the **Format Plot Area** box.

   b. Underneath the "Fill" category, click on the **Color** drop down menu and then "Fill Effects". Note: if you are using a PC computer, click on the **Fill Effects** button.

   c. Go to the *Picture* tab. Then click on the **Select Picture** button.

   d. Go to the desktop and click on the file "MOLA_Map_of_Mars.jpg" file. Click **OK** or **Insert**.

   e. Click **OK** on the **Fill Effects** window, and **OK** on the **Format Plot Area** window.

MARS STUDENT IMAGING PROJECT

Activity 4: Graphing Latitude versus Longitude (cont.)

9.   Your map of Mars should be underneath your data! Your map may be stretched too much. To adjust the shape of your map, click and drag the black square at the top or bottom center of the plot area. If a "legend" is present at the right side of your chart, you may want to select it (by clicking on it) and delete it. A legend is not necessary if you are plotting simply the location of your data on the map. You may want to change the color and size of your location points. Double click on the points to make changes. Your map should be complete as in the example below:

Locations of Channel Data
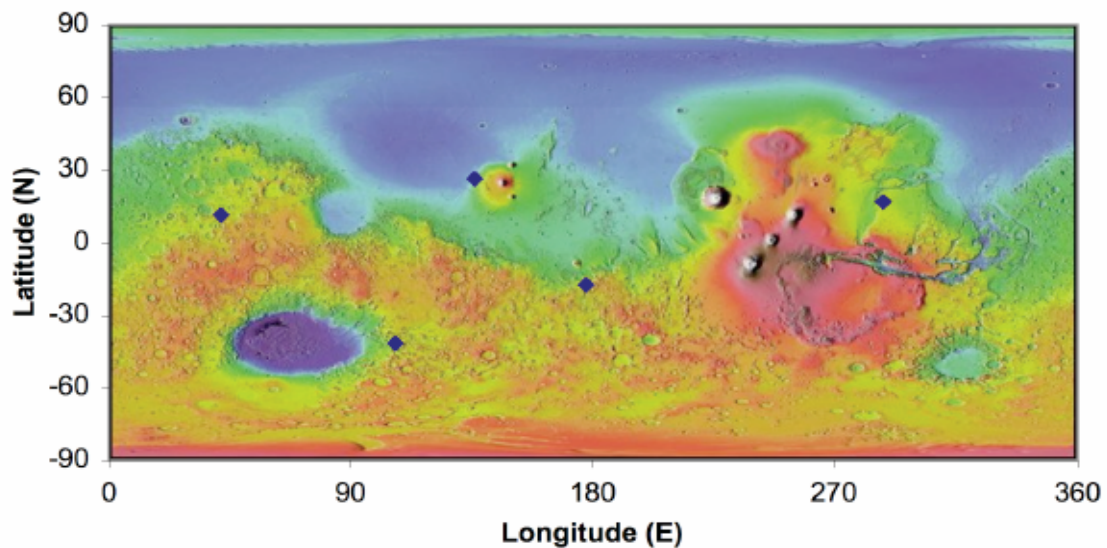
A. Now that you have plotted channel data on a map of Mars, list at least two <u>observations</u> of these data from the graph:

Observation #1: _____

_____

Observation #2: _____

_____

B. List your <u>interpretations</u> of what each individual or set of observations may mean:

_____

_____

_____

_____

MARS STUDENT IMAGING PROJECT

Data Analysis Practice Guide Summary

After completing these activities, you are now able to:

- **Create a Data Table in Excel**
  - o Keep in mind that your data table will have your own data from your own particular research project. It's important that you include all your data on your table.

- **Create a Graph of any Pair of Data**
  - o Remember that each graph needs to have a TITLE that indicates what the graph is illustrating.
  - o You should also be careful to label your X and Y-axes correctly. Always be sure to include the appropriate units. For example: Channel Depth (meters).
  - o Keep in mind that the first column that is selected in the Excel data table will always be the X-axis.
  - o You can graph information based on measurements acquired or information such as latitude versus longitude.

- **Make Observations of Data you Graphed:**
  - o Remember that observations state general characteristics, trends, or patterns. They do not attempt to explain <u>why</u> those trends may (or may not) exist.
  - o You can make observations of quantitative data you graphed AND / OR qualitative data you have logged based on visual observations.

- **Make Interpretations of your Observations**
  - o Keep in mind that interpretations attempt to explain what one or more observation may mean scientifically. Think about what those characteristics, trends, or patterns may tell you about how a process may be working.
  - o You can make interpretations of quantitative data you graphed AND / OR qualitative data you have logged based on visual observations.