Teacher Sheet 1

MATH APPLICATION ACTIVITY:
SUNSPOTS AND CLIMATE CHANGE

OBJECTIVES: Students will:

- ❖ Plot the locations of sunspots by latitude and longitude
- ❖ Recognize the pattern in sunspot location that occurs as a result of heat transfer and the rotation of the Sun.

MATERIALS:

- ✓ **Student Activity Sheets**
- ✓ **Data Table of Sunspot Locations**
- ✓ **Sunspot Location Grid**
- ✓ Paper and pencil

PROCEDURE:

1. Read the text for **PART 1** carefully with the class.
   - ✓ Review latitude and longitude.
   - ✓ Be sure students understand what a "cycle" is.

2. Students should refer to the data table of sunspot locations.
   - ✓ Locate each of the sunspots on the grid of the Sun's surface and place a dot where it belongs.
   - ✓ When all the dots have been located on the grid, connect the dots with a colored pencil and then color in the area inside the dots.

3. Students should now complete the **ANALYSIS** section for **PART 1**.

PART 2: SUNSPOT CYCLES AND CLIMATE

OBJECTIVES: Students will:

- Identify the relationship of sunspot cycles to the Sun's radiation output;
- Relate the intensity of sunspot activity to global temperatures
- Recognize that changes in solar activity cannot completely explain the persistent change in global temperature increases.

Teacher Sheet 2

PROCEDURE:

1. Galileo studied sunspots, sketching pictures of the changing pattern of spots on the Sun over time. Lead a class discussion about sunspots.]

2. Following the discussion, give each student a copy of the "Plotting the Spots" student handout.

3. Review the definitions for solar minimum and solar maximum. Have them study the sunspot cycles from 1700 to 2015 on the graph found on the student handout. Ask students to look for patterns in the data.

4. Students should graph the data from **DATA TABLES 2-3** in a line graph format.
   - ✓ Label the X-axis "Time in Years."
   - ✓ Label the Y-axis "Sunspot Numbers."
   - ✓ Connect the data points with a continuous solid line.
   - ✓ Observe the resulting pattern in your graph and record your ideas in the space provided.

5. Students should then label the graph with an **M** for each solar maximum and an **m** for each solar minimum.
   - ✓ Have students estimate the year when each cycle started and when it ended, calculate the length of each cycle, and calculate the average length for the nine cycles shown on the graph.
   - ✓ Discuss their results. The average should be approximately 11 years.

6. When students' graphs are complete, discuss their results using the questions on the student handout.

7. Student should then complete the **ANALYSIS** questions for each part of the activity.

8. To really challenge their understanding of the problem presented in this part of the activity, show students a graph of the average global temperature along with the concentration of CO_2 in the atmosphere since the start of the Industrial Revolution.

Teacher Sheet 3

Ask students to work in pairs and develop a statement defending their hypothesis as to what is the driving factor behind the increase in temperature- sunspot activity or CO_2 levels.

EXTENSION:

1. Have students research solar sunspot maximum 24 and determine whether the year it caused any significant disruptions in communications on Earth. Were any abnormal auroras reported? Were any satellites, Earth-bound communications, or power systems influenced by the solar maximum.

2. Have students create a line graph of solar sunspot maximum 24 and predict what conditions in the climate system may be like in the next 10-20 years.

3. Show the NOVA video "Galileo's Battle for the Heavens."