MARS STUDENT IMAGING PROJECT (MSIP)
Suggested 3-Week Archived Schedule

This schedule is intended to provide a set of activities to be implemented in your classroom as a three-week MSIP archived format. Each session is intended to fit a classroom period of about 45 minutes. This format/schedule can also be used as a 'primer' for your students to put together a formal proposal and project for use of the THEMIS camera. You can implement this format with students in small groups of 3-5 students or with an entire class.

Here is an overview of each meeting/session:

Week 1: Sessions 1 - 5

SESSION 1: Earth / Mars Comparisons and an Introduction to MSIP and THEMIS Images

SESSIONS 2 and 3: Mars Uncovered

SESSION 4: Mars Image Analysis Activity

SESSION 5: Question Mars Activity

Week 2: Sessions 6 – 10

SESSION 6: Question Mars Activity (continued)

SESSION 7: Question Mars – Refining Your Experiment and Data Collection Methods

SESSION 8: Data Analysis Practice

SESSIONS 9: MSIP Proposal Overview

SESSION 10: MSIP Proposal Discussion and Initial Data Gathering

Week 3: Sessions 11 - 15

SESSIONS 11 – 12: Gathering Additional Data

SESSION 13: Graphing and Data Analysis

SESSION 14: Drawing Conclusions

SESSION 15: Writing up your Final Conclusions

RESOURCES THAT CORRESPOND TO EACH MEETING ARE AVAILABLE AT :

- http://marsed.asu.edu/upload/MSIP_Archived

This includes the MSIP ARCHIVED STUDENT MANUAL. (This manual is a compilation of all the materials and activities. If possible, it is recommended that each student have their own manual.)

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SESSION 1: *EARTH / MARS COMPARISONS AND AN INTRODUCTION TO MSIP AND THEMIS IMAGES*

Having your students become familiar with similarities and differences between geologic features found on both Earth and Mars can allow them to begin thinking about what may be interesting for them to research.

1. Show the MSIP Intro Video: A video link to this presentation is available at

   - **http://breeze2.is.asu.edu/p93588777/**

2. Have students follow along and take notes using the Earth/Mars comparison outline. This outline is available at:

   - http://marsed.asu.edu/upload/MSIP_Archived (Look for Session 1 folder)

Homework Recommendation: Assign Chapter 3 (pp. 13-18) as reading from the MSIP Resource Manual. (Students can read other parts of the Resource Manual, but Chapter 3 is the highly recommended.) This chapter will continue to increase student's background knowledge about comparisons between features found on both Earth and Mars. This will allow them to potentially narrow down their interests towards a particular topic. The MSIP Resource Manual is available at either of the following links:

- http://msip.asu.edu/pages/pdfs/MSIPResourceManualv200.pdf OR
- http://marsed.asu.edu/upload/MSIP_Archived (Look for Session 1 folder)

SESSIONS 2 AND 3: *MARS UNCOVERED: Revealing the Geologic History Through Mapping*

This activity will guide students through an inquiry-based and critical thinking approach of studying the surface of Mars in a similar way scientists do. This lesson will teach students to create a geologic feature map of a planetary surface and use relative age dating techniques to analyze the information and interpret the geologic history of that region.

You will find the Mars Uncovered Teacher Guide, Student Guide and three possible images to map at either of the following links:

- http://marsed.asu.edu/upload/MarsUncovered OR
- http://marsed.asu.edu/upload/MSIP_Archived (Look for Session 2 and 3 folder)

Students can simply follow the guide with the teacher leading necessary discussions as recommended in the Mars Uncovered Teacher Guide. If students are going to map one image, the Chryse Planitia image is recommended.

Homework Recommendation: Whatever students do not finish in class with the Mars Uncovered Activity, they should finish for homework.

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SESSION 4: *MARS IMAGE ANALYSIS ACTVITY*

This lesson allows students to use a hands-on approach to get familiar with THEMIS visible images. The lesson asks for students to identify features seen in images, make measurements and/or come up with the "story" of what happened to the area of Mars they are observing. (Lendable materials are available for this activity.) This activity is available at the following link:

- http://marsed.asu.edu/upload/MSIP_Archived (Look for Session 4 folder. Folder includes lesson plan, feature ID charts and a video clip of how to incorporate this lesson into your classroom)

This activity provides experience with what can be seen/resolved in THEMIS images and is recommended to be conducted somewhat informally. Students do not need to write down any information as they participate in the activity. The format recommended to facilitate this activity is as follows:

Give students the following materials:

- One THEMIS Visible image per group of 3-4 students
- The accompanying context image
- An "11 X 17" MOLA map
- Feature ID Charts
- Erasable markers

1. Have students locate the general area of where their THEMIS image is located on the MOLA map.
2. Have students label and identify features on their THEMIS visible image and the context image. They should use the Feature ID Charts for assistance in naming the features.
3. Students should think about and label information about the history of the area using the relative age dating techniques they learned in the Mars Uncovered activity (Relatives age dating of features in the image, classification of craters, what happened to make this area look the way it does today.)
4. Make measurements

You may want to play the video clip to explain each part of the activity with the students.

5. After students have had a chance to label features and make measurements on their initial image, have them rotate from image to image adding additional information and observations to each image they observe. Students should not erase anyone else's observations, but should add additional observations or measurements as they wish.

Homework Recommendation: Assign the background reading (page 1 only) of the Question Mars Activity as homework.

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SESSION 5: *QUESTION MARS ACTIVITY*

This activity is especially useful to help students create a research question that can be answered using THEMIS visible images of Mars. Students should have read page 1 of this activity as homework so you can discuss it during the first part of class.

You will find the Question Mars Teacher Guide, Student Guide, and feature identification charts (these are the same ID Charts that were used with the Mars Image Analysis activity) that go along with this activity at either of the following links:

- http://marsed.asu.edu/upload/QuestionMars OR
- http://marsed.asu.edu/upload/MSIP_Archived (Look for Sessions 5 and 6 folder)

Once you have discussed the background information (page 1), have the students work with the groups they will conduct their research with. Discuss the *Question Mars Student Worksheet I*, questions 1 and 2 with the class and then within their small groups, have them debate and decide what topic their group wants to study. Have them spend approximately 5 minutes individually brainstorming questions they may have about their topic. Some students may not finish creating five complete questions within the time frame provided. They should write down however many complete questions that come to mind in the 5-minutes provided.

Part II of the Question Mars activity has students look at THEMIS images related to their topic (available at http://themis.asu.edu/topic) and has them start making observations. Students should log observations of at least 4 images. Students should ideally work in pairs on the computer, although if necessary, each small group can work from one computer.

Note: If an image does not have the THEMIS Data Releases link in order to find the Image ID number, it is recommended that students do not use that image as part of their observations. Visible image identification numbers are also referred to as V#'s.

Homework Recommendation: Have students log 4 additional observations of images for homework. (Note: If students do not have a computer at home, you can ask them to either try doing this in the library or media center or provide some extra credit for those who can make additional observations outside of class.)

SESSION 6: ***QUESTION MARS ACTIVITY (continued)***

Students should now have at least 4 observations (but hopefully more!) of THEMIS images related to their topic of interest. They should get back into their research groups and work on *Student Worksheet III – Question Development – Refining Questions*. As they get into refining their questions, students should discuss the features they have been able to make observations of and focus their questions on those specific features. Students should brainstorm up to three refined questions.

The *Question Mars Student Worksheet IV* asks the students to focus on ONLY one question they feel, as a team, is best answered by using THEMIS visible images. This part of the activity helps students start thinking about how they would go about answering their question - the experiment design.

Question Mars Student Worksheet IV, question #5 is important for students to discuss carefully as it asks them to formulate up to two hypotheses of what the outcome of their experiment will be. Their hypotheses should be supported by their current observations rather just an unsupported guess. Students need to discuss their observations together in order to come up with the possible outcomes (hypotheses) that are based on the current trends they are observing. Even though they will only have made a few observations each, basing a hypothesis on those observations is essential. The data they collect throughout the project will allow them to either support or refute their hypotheses and help them come to a conclusion about their question.

Once they have answered the questions on the *Question Mars Student Worksheet IV*, have them begin the *Question Mars Student Worksheet V – Experiment Design – Refining Your Experiment* together. This worksheet gives them a pre-made starting list of a step-by-step plan (a more flushed out experiment design) of how they will go about gathering data for their research. This will enable them to think about their experiment design in a more detailed fashion.

Homework Recommendation: Have students write down additional information on the *Question Mars Student Worksheet V* to the list of what observations they would need to log from every image in order to make their experiment repeatable and be able to come to a conclusion about their question.

SESSION 7: ***QUESTION MARS – REFINING YOUR EXPERIMENT and DATA COLLECTION METHODS***

Within their research groups, students should discuss the details of what information they need to collect/log from every image they observe in their step-by-step plan or experiment design. Students should discuss the *Question Mars Student Worksheet V* that they completed for homework. They should discuss and come to a decision on what data they will collect.

As they discuss the data they should collect as part of their experiment design, they should fill out the Experiment Design (Data Collection Methods) sheet available at:

- http://marsed.asu.edu/upload/MSIP_Archived (Look for Sessions 7 folder)

Filling out this sheet will allow them to see what information they need to collect, where they will find that information and why that information is important for their project. Students should fill out as many pieces of information they feel will help answer their question. It is not necessary to completely fill out both pages.

Homework Recommendation: Provide copies of the THEMIS Image Data Gathering table. This table is available at:

- http://marsed.asu.edu/upload/MSIP_Archived (Look for Sessions 7 folder)

Based on what student did in class with the Data Collection Methods sheet, have them fill in the information they listed as the headers of the data table. Students should decide the order in which they should fill in the header information as well as divide up column header spaces provided if they need additional columns for the data they plan to collect. Students should NOT YET fill in information from previous observations logged. Prior to inputting any data, students will need to make sure their team data tables are consistent. They will finalize their data tables and start inputting their data during Sessions 9 and 10.

SESSION 8: ***DATA ANALYSIS***

Once students have an idea as to the data they need to collect in order to answer their question and support or refute their hypotheses, they need to have an idea as to how they will be able to analyze their data. For this activity, students will need access to a computer that has Microsoft Excel.

Provide students with access to the Graphing and Data Analysis Practice Guide. This guide and the MOLA map that goes along with it is available at:

- http://marsed.asu.edu/upload/MSIP_Archived (Look for Session 8 folder)

Note: This activity may take more than 1 session to complete. Allow students time during Session 9, if necessary, to complete this activity.

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SESSION 9: *MSIP PROPOSAL OVERVIEW*

The proposal outline should be used in order to have students create an outline of their work to see if they are lacking any information for their project.

- This outline is available at http://marsed.asu.edu/upload/MSIP_Archived (Look for Sessions 9 and 10 folder)

Some important aspects of their project that they will most likely need to work on will be:

1. Gathering background information from books and / or websites and other sources about what is known about the feature(s) they are studying.

- This information can include definitions of the features they are studying, specific knowledge and hypotheses other scientists have about these features. Students should write down information and keep track of references in order to cite sources appropriately in their proposal.

A few suggested resources students can use as they conduct their research are:

- MSIP Resource Manual: This is included in their Student Manual
- Feature ID Charts: This is also included in their Student Manual
- THEMIS website: http://themis.asu.edu
- Other reliable internet sources
- Books, Magazines or Science Journals

2. Gathering specific information from archived THEMIS images (available at http://themis.asu.edu) that relate to their project.

- At this time they should look at their THEMIS Image Data Gathering tables and make sure they all agree on the set up of their data table. Research team data tables should be consistent in every way. They should think about how the headers should be labeled and exactly how they are going to log the information they want to collect from every image. They should not start filling out their data tables with previously recorded data (from the Question Mars Activity) until they are finished discussing the entire proposal outline.

3. For the Analysis Plan section, they should show the headings of their data table (without the actual data included) and think about what graphs they will make. Students should use the activities they completed with the Graphing and Data Analysis activity to think about what graphs they may want to create to display their data.

Homework Recommendation: Have students fill out each section of the MSIP Proposal Outline starting in class. Anything they don't finish in class, they should work on as homework.

SESSION 10: ***MSIP PROPOSAL DISCUSSION and INITIAL DATA GATHERING***

Students should discuss each section of the MSIP Proposal Outline that they finished for homework to ensure that everyone is on the same page with their project. They should share their ideas for each section and come to a consensus on what information is important to include.

When they finish discussing their MSIP Proposal Outline, they can begin filling out their data tables (THEMIS Image Data Gathering tables) with data and information they have already collected previously from the *Question Mars Activity Student Worksheets II*. Students should look at their previous observations and ONLY include images that apply to their projects. They may have some observations logged that focus on other aspects of their topic that they decided not to focus on. These observations should not be included in their data table. Additionally, students may not have recorded all the information they now realize they want to collect from each and every image, based on decisions they made with their data collection methods. They can relocate any of the previously observed images by going to the http://themis-data.asu.edu website. If they type in the image ID # (the V#), they will be able to look at that image again and log the other observations and data they may need to obtain for their project.

Each mini group (smaller groups that make up part of the research team) can have their own data recorded on their THEMIS Image Data Gathering tables that will be compiled with other team members data at a later time in an excel spreadsheet. It is again important to stress that their data tables be filled out consistently.

If students finish logging their previously obtained data from the Question Mars Activity into their data tables, they can begin collecting additional data by going to the appropriate THEMIS website.

Homework Recommendation: Data gathering can be continued for homework as well as throughout the project. The more data students collect, the more confident they will be when formulating conclusions and answering their question.

SESSIONS 11 AND 12: *GATHERING ADDITIONAL DATA*

Students should continue to gather data (by going back to the appropriate THEMIS website) for their project as well as background information they may still need to investigate. They should discuss how they should divide up the images available to maximize the number of different data points their team will collect. For example, one group could make observations of the images available on page 1 of the image gallery and another group could look at page 2, and so on. Try to allow students to come up with their own decisions as to how to divide up their efforts.

If students are making measurements, they can make estimated measurements by looking at an image on their computer (knowing the image is 18km across). Another option is to print out images and determine the scale of the image. This would be similar to what they did with the Mars Image Analysis activity. (The printing option depends on your ability to print images.)

By the end of Session 12, students should compile all of the data collected into one team master table in an excel spreadsheet. It is important that students finish their master table by the end of Session 12 so the master table can be provided for them at the beginning of Session 13.

Teacher "Homework" Recommendation: If possible, print out a copy of the compiled master data table for each member of each team for use the following day.

SESSION 13: *GRAPHING AND DATA ANALYSIS*

Based on the students project and analysis plan from their MSIP Proposal Outline, teams should use their compiled master data table and create their graphs and plot out on a map the information from all the images they have looked at and analyzed. They can refer to the Graphing and Data Analysis activity for assistance in making their graphs. Students can make graphs using a computer or "by hand". Students can decide who will be responsible to make what graph. They do not all need to make each graph (unless there is time). The most important aspect of the data analysis will be able to make observations and interpretations of their data.

Once graphs are made, students should use the Data Analysis sheets to write down the observations and interpretations of each graph. The Data Analysis sheets are available at the following link:

- http://marsed.asu.edu/upload/MSIP_Archived (Look for Session 13 folder)

Homework Recommendation: Provide students with a print out of any or all the graphs they have made and have them complete the Data Analysis sheets at home.

SESSION 14: *DRAWING CONCLUSIONS*

As a team, students should discuss what their completed Data Analysis sheets. Together, they should discuss each of their graphs and think about what they mean as they relate to their science question. They should discuss and revise (as necessary) their Data Analysis sheets to record the most pertinent information for their project.

Using the information and data acquired and graphed throughout the project, students should now be able to compile their information into the MSIP Final Report Outline.

An outline to use as a guide for the MSIP Final Report is available at either of the following links:

- http://marsed.asu.edu/upload/MSIPArchivedFinalReportOutlinev1.doc OR
- http://marsed.asu.edu/upload/MSIP_Archived (Look for Session 14 folder)

Homework Recommendation: Students should complete their MSIP Final Report Outline for homework.

SESSION 15: *WRITING UP YOUR FINAL CONCLUSIONS*

Students should discuss their completed MSIP Final Report Outlines in order to ensure they have included all the information that related to the research they have done. It is also important to ensure their information is consistent among each team member.

OPTIONAL: If students wish to potentially publish their results on the MSIP website, they can do so by filling out the MSIP Archived Team Results Form.

This outline is available at either of the following links:

- http://marsed.asu.edu/upload/MSIPArchivedTeamResults_web.doc OR
- http://marsed.asu.edu/upload/MSIP_Archived (Look for Session 15 folder)