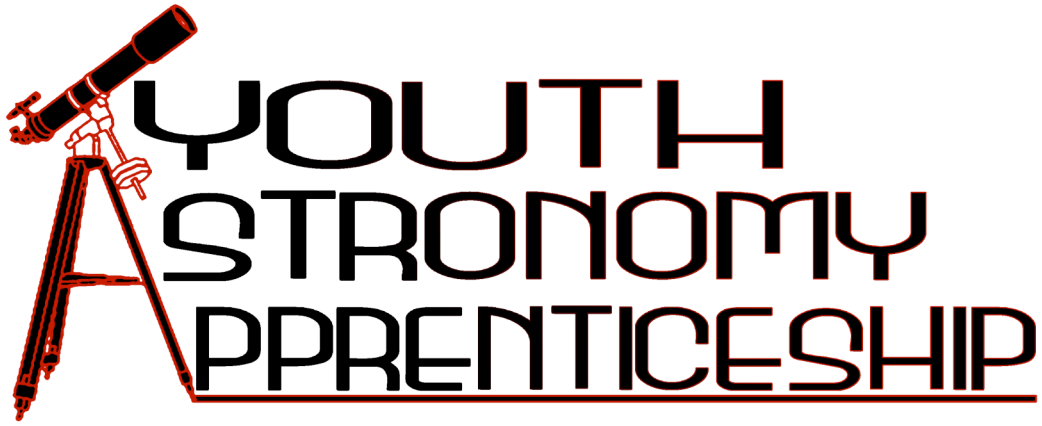

Observing Projects

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Observing Project #1: Overview

Note: This is the description of the first observing project. It should last 3-4 sessions.

Goals

- Understand that doing science is driven by asking well-defined questions based on observations
- Learn how to make detailed observations
- Learn the difference between an observation and an inference
- Clearly communicate their findings to others in oral and written form

Activity Overview

This is the first in a series of observing projects which introduce the participants to the skills required to make observations, keep detailed observation journals, analyze data and draw conclusions. Participants gain observing skills as they carefully view the Moon over several days, or even weeks. They also begin to keep a journal of observations and thoughts that mimics the action of scientists engaged in research. The focus of the first project is to focus on the beginning stages of any scientific research question – making observations and posing answerable questions. The participants publish their work from each project online, through the MicroObservatory website's "lounge".

Background

The observed phase of the Moon is determined by its position relative to Earth and the Sun. The changing portion of the Moon's sunlit side that we see throughout the month creates for us the phases of the Moon. In a 28-day period, the Moon swells from the new Moon, through the crescent, to the first quarter, the "gibbous," and then the full Moon, before waning to the new Moon again. The Moon's orbit takes it from a position between Earth and the Sun—the new Moon—to the opposite side of Earth from the Sun—the full Moon.

The most common misconceptions that students and adults alike have about the moon phases—such as clouds block the Moon as well as Earth's shadow covers the Moon—are reasonable, but don't hold up under careful observation of the Moon.

MOON PHASES AND TIME OF DAY

Phase	Rises	In Eastern Sky	Highest in Sky	In Western Sky	Sets
New	[~sunrise]	[morning]	[noon]	[afternoon]	[~sunset]
Waxing Crescent	[just after sunrise]	[morning]	[just after noon]	[afternoon]	just after sunset
First Quarter	~noon	afternoon	~sunset	night (pm)	~midnight
Waxing Gibbous	afternoon	~sunset	night (pm)	~midnight	night (am)
Full	~sunset	night (pm)	~midnight	night (am)	~sunrise
Waning Gibbous	night (pm)	~midnight	night (am)	~sunrise	morning
Third Quarter	~midnight	night (am)	~sunrise	morning	noon
Waning Crescent	just before sunrise	[morning]	[just before noon]	[afternoon]	[just before sunset]

[ ] Means moon is not actually visible during this time
~ Approximate time estimate

Preparation

Space Required:

You will need a room with enough seating and writing space for all of your participants. At certain points, use of computers will be needed – the best scenario is one computer per participant.

Materials:

- ❑ Small notebooks, which you can provide or ask your participants to bring.
- ❑ Computer lab for taking images of the Moon with MicroObservatory

Preparation time: 🕐 🕐

Activity time: 2 weeks (4 sessions)

Gathering of materials and final preparations:

Make sure each participant has a journal. Participants should not use a section in another notebook or the backs of other pieces of paper—this should be a dedicated space for all their observations for the duration of the after-school program. Before beginning this observing project, make sure to check on the rise and set times of the Moon, in order to have the first session land on a day when the Moon will be visible **during** the after-school session.

Procedure

The following activities will be done over the course of 2 weeks, either one session right after another, or with one or two small coordinated activities mixed in (See the list of cluster for suggestions of possible activities.). Most sessions have a separate write-up, following this overview.

1. **First session:** "Did You Notice?" (30 min)

2. **Second session:** "Observation or Inference?" (25 min)

3. **Third session:** Check in with participants about project. Make sure everyone has begun observations. Take image of Moon with MicroObservatory. (15 min) *This check-in and image taking session may be added onto the end of the second session, if time allows, and there have been opportunities for data collection.*

4. **Fourth session: "**Sharing and Publishing" (60 min)

Follow up

Observing Project #2. Participants will conduct another observing project in which they will look at astronomical images and build upon the skills of observing they learned during this activity.

Watch out for...

Refer to each individual activity.

Vocabulary

Refer to each individual activity.

Useful Websites

The Moon: It's Just a Phase It's Going Through...:
http://www.astrosociety.org/education/publications/tnl/12/12.html from ASP's "The Universe in the Classroom" No. 12 - Winter 1988-89

Observing Project #1: Did You Notice?

Note: This is the write-up of the first session of Observing Project #1.

Goals

- ❑ Learn how to make, and record detailed observations
- ❑ Brainstorm ideas for their first observing project

Activity Overview

This is an introductory activity to familiarize the participants with the Observing Projects, which they will be engaged with during the program. The youth observe small changes in each other's appearances in order to prepare them for making observations about the Moon over the course of the next week. It is important to start this project when the Moon is visible during the hours of the after-school session.

Background

By conducting a simple observing project based on the Moon, participants can gain observing skills and data analysis skills while investigating a topic of their choosing. Keeping a journal of observations and thoughts mimics the action of scientists engaged in research. The journal may be online or on paper, based on preference and/or access to resources.

Preparation

Space Required:

You will need a room with enough seating and writing space for all of your participants.

Materials:

- ❑ Small notebooks for each participant (or access to an online forum)
- ❑ Chart paper

Preparation time: 🕐

Activity time: 25 minutes

Gathering of materials and final preparations:

- ❑ Gather small notebooks, one for each participant.
- ❑ Check on the current rise and set times for the Moon. It is useful to start this project with a large group observing session of the Moon.

Procedure

Discussion lead-in:

We are about to do an icebreaker called, "Did You Notice" to focus on making observations of details.

1. Ask for 1 volunteer to stand in front of the group. The group studies the volunteer for 1 minute. The group then turns around, so the group members cannot see the volunteer while she changes 1 small thing about her appearance. When she is ready, the group turns around again and has to try to notice what changed. Repeat this with a new volunteer.

2. Discuss what was easy and/or difficult about this. Were there certain types of changes that were easier to notice than others?

3. Lead a discussion about observing, and be sure to highlight the importance of DETAILED observations. Questions that may help facilitate discussion:
   - ❑ Why is it important to be able to make good observations?
   - ❑ Think of a situation in which not being observant could be a problem.
   - ❑ Scientists have to be able to make very detailed observations. Why do you think this is?

4. Hand out journals and explain that these journals will be used to record ALL observations and thoughts as participants conduct this, and other observing projects. Suggest that they use their own vocabulary, expressions, and personal codes when recording entries to their journals. They will not need to share what is written, but they will need to understand what they wrote!

5. Introduce the first project – **Observing Project #1**. This project is a simple observing project aimed at getting participants used to the act of making, and recording, detailed observations, as well as an introduction to how scientists conduct research.

6. Explain that each of them will be observing the Moon over the course of the next week or two.

7. As a group, go outside and look at the Moon. Ask for observations from the participants. After every one has given at least 1 observation, go back inside and lead a brainstorm on what sorts of things they could make ongoing observations about.

8. Write the ideas on chart paper, if desired. Have youth choose 1 of these as their own.

9. As they are leaving for the day, remind them to make those observations over the next couple of days.

Follow up

Second session – "Observation or Inference?"

Watch out for…

- ❑ Remind participants to bring the notebook with them to each session for the next three weeks.

Useful Websites

The Moon: It's Just a Phase It's Going Through…:
http://www.astrosociety.org/education/publications/tnl/12/12.html from ASP's "The Universe in the Classroom" No. 12 - Winter 1988-89

Observing Project #1: Observation or Inference?

Note: This is the write-up of the second session of Observing Project #1.

Goals

- Practice making and writing detailed observations
- Learn the difference between an observation and an inference
- Understand the relationship between observations and inferences

Activity Overview

Participants spend a small amount of time looking at objects and writing observations. Group discussion follows wherein the participants reflect on the difference between observations and inferences.

Background

Scientists need to be able to make observations and draw conclusions based on data. This means having the ability to distinguish between facts and inferences. This activity gets at the tendency of most people to make small inferences when attempting to report their observations. Observation is the process of gathering objective data, and inference is the process of making some decisions about what the data means. Observation is contact with the world through the use of the senses and provides us with the material for thought, reflection and judgment. One can be trained to be a more effective observer.

Moreover, we draw inferences on the basis of observations. Inference is the interpretation of facts. (A statement of fact is an observation statement that can be verified by the use of the senses.) Valid inferences are based on sufficient and relevant evidence. Our training and background provide a basis for our inferences. Inferences enable us to assess and evaluate conditions and make predictions.

Preparation

Space Required:

You will need a room with enough seating and writing space for all of your participants.

Materials:

- ❑ Small notebooks for each participant
- ❑ Chart paper and/or a board
- ❑ Items you wish to observed

Preparation time: 🕛 🕛

Activity time: 15 minutes

Gathering of materials and final preparations:

Make sure you have a few different kinds of objects for them to observe.

Procedure

Discussion lead-in:

1. Have 2 or 3 objects on a table. Have participants gather around the table with pen and paper. Good objects are ones about which inferences are easily drawn:
   - ❑ Film camera from the 70s – easy for participants to think that it is an old camera. – Old is actually an inference; there is no direct observation of age. Observations such as the type of material, style, number of scratches, or date of manufacture lead to the inference of the camera being old.
   - ❑ A photograph taken outdoors. Some participants may be able to deduce what season it was when the photo was taken and then put "taken in winter" as an observation.

2. Instruct them to write down detailed observations about the objects. A good way to elicit detailed observations is to suggest they imagine they are describing the object to someone on the phone. This person is not in the room and cannot see the object, but should be able to have a clear mental image of it when they are done describing it. Give about 5 minutes for this.

3. Have them share their observations. Someone should make a list of all the observations either on the board or on chart paper.

4. After everyone has shared observations, take a moment to define both observation and inference.

5. Go back to the list of observations. Ask participants to look for inferences in the list. Example of list, generated from the two example objects above (a film camera and a photograph of people, standing outside) with inferences underlined:
    - Camera: black and silver, 3 round knobs on top, threaded hole on bottom, old, one knob has numbers, doesn't have film in it, black lens, no digital parts
    - Picture: 3 people standing, picture of a family, taken in winter, lots of trees in background, snow on ground, people are happy, it was cold, sky is blue with a few clouds

6. Discuss why some of the participants' observations are actually inferences.
    - Old – no date of manufacture, a few observations combined would lead to that thought
    - Doesn't have film – film counter was set at 0 might be the observation, or participant opened it
    - No digital parts – can't see inside to confirm – no screen/digital display
    - Picture of family – assumption based on the people in the photo's variation of gender and age and perhaps some resemblance to each other.
    - Taken in winter - assumption based on snow and perhaps type of clothing
    - People are happy – smiling = observation happy = inference
    - It was cold – type of clothing suggests temperature, but it's not a direct observation.

7. Finish with a discussion of why it is important to know the difference between observations and inferences. Asking the question, "What did you notice/see that lead you to think that?" is a good way to get at observations rather than inferences. **Points to make:** Scientists need to look at data without a bias. Inferences are more like the conclusion and conclusions need to be backed up with evidence.

8. Have participants take images of the Moon using either the Guest Portal or the Main Telescope control page (depending on their experience with MicroObservatory).

9. Inform the youth that, as part of the Observing Project, they will be sharing their thoughts, images and observations with the group and then ultimately online through the MicroObservatory **Users' Lounge**.

Follow up

In the next session of this project (or in this session, if there is time), check in with the participants to make sure they are observing the Moon and have them take more images of the Moon with MicroObservatory. It is best to have the participants take images of the Moon more than once, so there is a greater chance each of them will have at least 1 good image to use with their report.

Watch out for...

- ❑ Participants talking to one another rather than writing down their observations.

- ❑ When sharing, be sure to ask them to read from the lists they made.

Vocabulary

observation: A piece of data gathered by looking at a subject.
inference: A conclusion based on observations.

Observing Project #1: Sharing & Publishing

Note: This is the write-up of the fourth session of Observing Project #1.

Goals

- ❑ Generate a list of possible questions that can be answered by observing the Moon
- ❑ Learn how to turn "I wonder…" statements generated from observations into an observing project
- ❑ Publish thoughts and images online

Activity Overview

In this session, participants share their questions and thoughts generated by their observations of the Moon. After a group discussion, a list of answerable questions is generated. Each participant chooses one question and brainstorms how they could answer it through further observations. The final step of this project is to publish their thoughts and images on the MicroObservatory website.

Background

WHAT MAKES A "GOOD QUESTION" IN SCIENCE? is a reference available to help. See the Useful Websites section for the link to the document.

Good questions are ones that:

- ❑ Lead easily to a procedure to gather data to answer the question
  - How does the phase of the Moon affect when it rises and sets?
- ❑ Are NOT yes or no questions
  - Does the phase of the Moon affect when it rises and sets?
- ❑ Are simple, with only one variable being addressed
  - How does the phase of the Moon affect its appearance to an observer on Earth?
  - **(NOT)** What makes the Moon change appearance?

Procedure

Discussion lead-in:

Have each person share their observations and perhaps any sort of pattern they may have noticed. It is not necessary for patterns to have emerged, but they should be able to generate a good list of questions that came up as they made their observations, or ones that were generated as they listen to others' observations.

1. Write the questions down on chart paper.

2. Discuss which of the questions are **answerable**, - which of these questions can be answered through taking observations and analyzing the data.

3. Identify those questions that are answerable and have each participant choose one.

4. They should brainstorm a way to answer the question using some sort of observing/gathering data. Stress the use of MicroObservatory images, as well as good-old night-sky observing.

5. Once they have an idea of how they might carry out an experiment, they should begin to write up the project using the prompts below.

Part 1

- ❑ Introduce yourself with a few sentences. What would you want someone to know about you?
- ❑ Similarly, describe what your project is about. What did you do?

Part 2

- ❑ Participants post their images of the Moon (in GIF format)

Part 3

- ❑ How did you make your observations? What did you notice that was interesting?

Part 4

- ❑ When doing science, we often find more questions than answers. Over the course of your project, what were some of the things you found yourself wondering about?
- ❑ What question did you choose to further investigate?
- ❑ What do you think you could do to answer it? Describe how you would do it.

6. After they are done, they will copy and paste each part into the input fields on the MicroObservatory website (Refer to the following write-up "Observing Projects: Publishing the Project Report" for detailed instructions to publish the report to the website). The headings may not

match exactly with the content for each part, so just instruct them to copy them as follows:

- **Part 1 – Introduction**
- **Part 2 – Images & Data**
- **Part 3 – Explanation of Observations & Data**
- **Part 4 – Conclusions, Questions, Recommendations**

Watch out for…

- Chosen questions need to be able to be answerable. Sometimes questions can be interesting and creative, but make sure their chosen questions are answerable.

Useful Websites

What Makes a "Good Question" in Science?
http://misclab.umeoce.maine.edu/boss/classes/SMS_491_2007/GoodQuestionSci.pdf

Observing Projects:
Publishing the Project Report

Goals

- Publish observing project reports to the MicroObservatory website

Activity Overview

In this session, participants share their projects with the rest of the group and other MicroObservatory users online.

Background

One of the most interesting features of the MicroObservatory website is the tool that allows registered users to post images and text on a bulletin board. Any registered user in the world can then view and read about the work that someone is doing with the telescopes. This activity introduces your group to the Project Report feature of the MicroObservatory website.

There are many purposes to science writing; the following list provides many examples that you may want to use as the basis for a short discussion with your group:

- To display knowledge and understanding of a topic; or to expose misconceptions so that they can be corrected.
- To demonstrate that a task has been completed effectively.
- To present a convincing case.
- To stimulate a controversy.
- To explain an unfamiliar idea.
- To inspire interest and excitement about a particular topic in science.

Procedure

1. When participants have filled out all sections of the Word document related to the observing project they are currently working on, they should spell-check and proofread their work for errors.

2. Then instruct participants to go to the MicroObservatory website, and navigate to the "Publish Observers' Project Reports" screen:

   - ❑ Go to the MicroObservatory home page.
   - ❑ Click on the lounge selection from the menu on the left.
   - ❑ Click on publish data from the menu on the left.
   - ❑ Click on Publish Observers' Project Reports - you will find yourself at the opening screen.

   Note: If ever the youth need to edit or make changes to their reports after initially submitting their report online, they must substitute the last bullet above and instead click on **Edit Your Observers' Project Reports**.

3. Once on the page with the empty input fields, participants should copy and paste each part of the Word document into the input fields on the MicroObservatory website. The headings may not match exactly with the content for each part, so just instruct them to copy them as follows:
   - ❑ **Part 1 – Introduction**
   - ❑ **Part 2 – Images & Data**
   - ❑ **Part 3 – Explanation of Observations & Data**
   - ❑ **Part 4 – Conclusions, Questions, Recommendations**

Watch out for...

- ❑ Only .GIF image files can be uploaded to the website and published in a report. Be sure that all of the participants' images are saved with a .GIF attached to the end of the filename. Filenames cannot be longer than 15 characters in all so longer filenames will have to be changed before they can be posted.

- ❑ Users without a guest code and using the Guest Observer Portal are encouraged to post their images and report on their personal website or blog.

Observing Project #2: Overview

Note: This is the description of the second observing project. It should last 5 sessions.

Goals

- Develop a question or topic to be the basis for the second observing project
- Develop a data collection plan and learn how to make sense of observational data
- Understand that professional science is driven by asking well-defined questions that are based on observations
- Learn to use MicroObservatory FITS images (info and headers) as data sources
- Reinforce the difference between observations and inferences
- Become comfortable giving and receiving feedback from fellow participants
- Improve oral and written communication skills by completing a project report to be published online and presenting project to others

Activity Overview

This is the second observing project in which participants choose a topic or question to be the focus of the project, reinforce the observing skills from "Observing Project #1", analyze data and draw conclusions. They also keep a journal of observations and thoughts that mimics the action of scientists engaged in research. They can make use of their small notebooks to do night-sky observing, but the digital journal will be the primary means of keeping track of work for this project (Prompts for the journal are made explicit as part of each activity to follow). The participants publish their work from each project online, through the MicroObservatory website's "lounge". There is a separate write-up for many of the activities associated with this project to be done over the course of 5 sessions.

Background

When doing science asking good questions is often just as important as finding the answers. We must collect data, make observations, and analyze

the data to make meaning of it, to then find answers and generate new questions. The emphasis of this project is on the youth developing a plan to answer a question of their own or one they have selected from a list. Be sure to follow the same process of making observations and journaling as modeled in "Observing Project #1". This time around however, the youth are pressed to think critically and analyze their data to come up with a conclusion.

Preparation

Space Required:

You will need a room with enough seating and writing space for all of your participants. At certain points, use of computers will be needed – the best scenario is one computer per participant.

Materials:

- ❑ Small notebooks, which participants should have already.
- ❑ Word processing document—digital journal
- ❑ Computer lab

Preparation time: 🕐 🕐

Activity time: 5 sessions

Gathering of materials and final preparations:

Return to the list of good questions that came out at the end of "Observing Project #1". The youth that had asked those questions should be encouraged to use those questions as the basis for this second observing project. Encourage the youth that do not have a lingering question, which would make a good research question, to select a project concept from the list below. The following list of potential projects should be written on a whiteboard or chart paper:

- ❑ Why does the Moon look different night after night?
- ❑ What are the objects surrounding Jupiter and how do they behave?
- ❑ How can we classify galaxies according to their shape?
- ❑ How can we classify nebulae?
- ❑ How can we organize galaxies or nebulae based on their size?
- ❑ Is there color in the Universe? How do we create full color images?
- ❑ How does the image of my favorite astronomical object change when taken with different exposure times?
- ❑ Why are some objects only up in the sky during certain times of year? Compare an object inside our galaxy vs. one outside of our galaxy.

Procedure

What follows is a general overview of each of the five sessions that are a part of this project. The journal prompts are a reference to the prompts that participants will answer in their journal during the suggested session day (Refer to "Observing Project #2: Daily Journal & Project Report" for the prompts). The answers to these daily prompts will be the basis for the project report.

Procedure:

1. **First Session:** "Introduction & Planning" (45 min) The question or topic for the project is developed and a plan for collecting data is spelled out. Data collection begins, scheduling observations, and/or downloading images from the image archive. Journal prompts – 1, 2, 3

2. **Second Session:** Image processing and "What does your data mean?" Participants gain an understanding of how to make sense of the data they have collected and do some image processing. Journal prompts – 4, 5, 6 (State which computer activities they may have already gone through?)

3. **Third Session:** Image processing, data analysis, and begin write-up. Journal prompts – 4, 5, 6 begin 7, 8, 9

4. **Fourth Session:** Data analysis and write-up. Journal prompts – 7, 8, 9, 10

5. **Fifth Session:** "Giving Feedback" (30 min) Participants learn how to effectively give feedback to help one another improve their projects. Participants publish project report (Refer to the previous write-up "Observing Projects: Publishing the Project Report" for detailed instructions).

Follow up

- "Observing Project #3": Based upon their understanding of the astronomy topic of their choosing, participants make a prediction at the start of the process, then follow the same steps as "Observing Project #2" to reach a conclusion. Additionally they will reflect on the entire process and suggest improvements to their methods.

- If there is not enough time following "Observing Project #2" to begin #3, skip ahead and apply the participants' reports to producing and presenting posters in "Observing Project #3: Creating Posters" and "Observing Project #3: Presenting Posters" (part of Session 5 and 6 of "Observing Project #3").

Watch out for…

- "Observing Project #2" and "Observing Project #3" can be lengthy endeavors; it is not recommended that these sessions be structured to consist solely of work on these projects. Many of the youth will start to lose focus after being on the computer for an hour or more. Some potential activities to mix-in to break up the computer time are the modeling activities included towards the end of the Hands-On Activities. "Modeling the Earth-Moon System", "Moon Phases Activity", and "A Journey Through the Universe" are all options to facilitate. Additionally, you may want to then suggest that the youth incorporate aspects of these models, or a model of their own design, into their presentation of the second or third observing project. The addition of a model can add a lot of clarity and explanatory power to a project if done well.

Observing Project #2:
Introduction & Planning

Note: This is the write-up of the first session of Observing Project #2.

Goals

- Develop a question or topic to be the basis for the second observing project
- Develop a data collection plan and learn how to make sense of observational data
- Understand that professional science is driven by asking well-defined questions that are based on observations
- Learn to use MicroObservatory FITS images (info and headers) as data sources

Activity Overview

This is an introductory activity for the second observing project. In this activity, participants develop a research question to be the focus of their second observing project. This question could come from any of the following:

- The good question reached at the conclusion of "Observing Project #1". (Go back and review what the youth had asked as their final question about the Moon. Encourage those with good questions and an interest in continuing with this topic to do so.)
- A new question that the youth have come to as a consequence of engaging in past activities. (Make sure this question is a 'good' question. Review background of "Observing Project #1: Sharing & Publishing" for information about what makes a 'good' question for scientific investigations.
- A question from the suggested list of questions that is interesting and answerable given the tools at hand. (See suggested list below)

Note: If as a facilitator you are not experienced with leading inquiry-based activities, coaching the youth through the process of developing their own project may be exceedingly difficult. It is recommended that the list of questions be used if this is the case.

Participants should write down in their journals any information that they already know about the chosen topic, especially findings from past activities. Second, review and reinforce the observing skills from "Observing Project #1"—explaining how to go about collecting data, recording daily progress in a journal, and making detailed observations. The journal entries should all be dated and log the participant's daily activity, observations, and findings.

Next, go over some potential sources of data—the FITS header for example. Finally, participants develop their plans for collecting their data and record it in their journals. For example, a participant with the question: Do all galaxies look the same? They might decide that, over the course of the next couple sessions, they will take images of many galaxies, and compare their data with images from the MicroObservatory Image Archive.

Background

When doing science asking good questions is often just as important as finding the answers. To be able to do either of these however, we must collect data, make observations, and analyze the data to make meaning of it. In addition to visual observations made by looking at an object in the sky, or from images, a wealth of information is available from the FITS header of an image. This file provides important information about when and how this image was taken and who took it. Some of the information in this file may not be very familiar to you right now. For the time being you can focus on the following important pieces of information:

FILE = name of the file
DATE = when the image was taken
EXPTIME = exposure time
START-OBS and OBS-END = Starting and ending time of the exposure
FILTER = filter used when taking this image
TELESCOP = name of the telescope used to take this image
OBSERVER = who took the image
OBJECT = name of the object in the image

To access this information, find your image on the Latest Image Archive page on the MicroObservatory website and click on "Image Info." Also, opening the FITS image with the MO Image software and clicking on the menu bar under "Window," then clicking on "FITS Header" pulls up the information.

If there has been a considerable amount of time since completing observing project #1, reviewing the background information on how to conduct scientific observations is recommended.

Preparation

Space Required:

You will need a room with enough seating and writing space for all of your participants. At certain points, use of computers will be needed – the best scenario is one computer per participant.

Materials:

- ❑ Small notebooks, which participants should have already.
- ❑ Word processing document—digital journal
- ❑ Computer lab

Preparation time: 🕐

Activity time: 30 hours

Gathering of materials and final preparations:

The following list of potential projects should be written on a whiteboard or chart paper. For their second project many of the youth should use the question they posed at the conclusion of their first observing project. Encourage the youth that do not have a lingering question that would make a good research question to select a project concept from the list below:

- ❑ Why does the Moon look different night after night?
- ❑ What are the objects surrounding Jupiter and how do they behave?
- ❑ How can we classify galaxies according to their shape?
- ❑ How can we classify nebulae?
- ❑ How can we organize galaxies or nebulae based on their size?
- ❑ Is there color in the Universe? How do we create full color images?
- ❑ How does the image of my favorite astronomical object change when taken with different exposure times?
- ❑ Why are some objects only up in the sky during certain times of year? Compare an object inside our galaxy vs. one outside of our galaxy.

Procedure

Discussion lead-in:

Introduce the second observing project as a continuation of the first, in that the youth will be using the observing skills sharpened while working on that project. Also, some may want to now address the final question and data collection plan developed then, as the focus of this project. Explain that the topic or question does not have to be about the Moon and project #1, it could stem from a previous activity that they found particularly engaging and would like to pursue further. For those unsure

about what their topic could be, they may select one from the provided list of potential topics that has been transferred onto the board.

Finally, mention that asking a well-defined question, which will be the focus of their project, is critical to the success of their work. Also, asking questions, making careful observations, then arriving at an answer, is what drives professional science.

Procedure:

1. Participants first select their research question or topic for their project. Once this is chosen, have the youth write in their journals any information or ideas they have about this topic.

2. Go around the room and see if any of the youth have selected the same or similar topics for their projects; try and pair up participants by topic (some of their project ideas may be more complimentary topics than similar, but explain to them how they may fit together in these cases).

3. Review the skills needed for scientific observing.
   - ❑ Being well-organized (dating journal entries)
   - ❑ Recording detailed observations
   - ❑ Making sure that observations are not actually inferences

4. Review the idea of an image as a piece of data. Use the information in the FITS Header as examples of the data that can be extracted from an image (See the Background section for more on FITS headers).

5. Direct the youth to the MicroObservatory Image Archive and remind them of the extensive collection of data available there.

6. The youth should now be able to develop a plan for their collection of data. This plan should be recorded in their journals.

7. If there is time participants should begin gathering their data and taking the first steps that they outlined in their plans.

Follow up

- ❑ Most, if not all, of the youth need to take images as part of their data collection plan. Be sure to allow time at the end of the session for them to schedule these observations.

- ❑ "Observing Project #2: What Does Your Data Mean?" Participants make detailed observations of their data and begin to analyze it.

Observing Project #2: What Does Your Data Mean?

Note: This is the write-up of the second session of Observing Project #2.

Goals

- ❑ Learn how to make sense of observational data
- ❑ Revisit the difference between observations and inferences

Activity Overview

This is an activity to familiarize the participants with the difference between an observation and an inference, building on the previous activity on observations and inferences. Participants start to see how to make meaning of data and draw conclusions based on observational data. Before facilitating this activity, give the youth the chance to take a closer look at the images they have taken with the MicroObservatory telescopes or plucked from the image archive for their project. They should record their observations in their journals.

Background

People make inferences and draw conclusions all the time. Scientists need to be more careful about what inferences and conclusions they make and be able to back up each one with evidence. This activity should help participants to link evidence from their data to their conclusions.

Preparation

Space Required:

You will need a room with enough seating and writing space for all of your participants.

Materials:

- ❑ Chart paper

Preparation time: 🕐

Activity time: 20 minutes

Gathering of materials and final preparations:

Come up with a provocative conclusion using everyday observations. Remember to give the youth some time at the start of the session to make observations in their journals of the MicroObservatory images that they are using for their projects if they have not done so already.

Procedure

Discussion lead-in:

Present a provocative conclusion on the board. Example: *People that wear Adidas sneakers are smarter than those that wear Nikes.*

1. Allow participants to react and discuss the conclusion on the board.

2. Lead a discussion about what data might have been gathered that lead to this conclusion. The key point in this discussion is the need for evidence to back up conclusions.

3. Discuss observations vs. inferences. Where in their own data have participants already arrived at their own conclusions? In pairs, have them go through their observations and make sure that if there are inferences being made, that there is evidence in the form of concrete observations to support these statements.

4. By the end of the 20-minute activity, participants should have a solid conclusion, based on their observations.

Watch out for...

- Many people tend to link correlation with causation – meaning that when two events take place at the same time (or in the same place), it is easy to think that one caused the other to happen. A good way to explain this faulty reasoning is to make the claim that "Eating ice cream causes people to commit crimes." Data show that during certain times of the year when ice cream sales are higher, crime rates are also higher. (This is actually true) But what is left out of this equation is the fact that both ice cream sales and crime rates tend to rise in the summer months in most places. So does that mean eating ice cream caused people to commit crimes? Or that when people commit crimes they crave ice cream?

- ❑ Remind participants that they will be putting together posters of their own observation projects at the next session.

Vocabulary

causation: The relationship that results when a change in one variable is not only correlated with but actually produces a change in another variable.

correlation: A measure of how two variables are related.

Useful Websites

Correlation vs. Causation examples:
http://www.statistics-help-online.com/node50.html

Observing Project #2: Giving Feedback

Note: This is the write-up of the fifth session of Observing Project #2.

Goals

- ❑ Become comfortable giving and receiving feedback
- ❑ Reflect on the challenges of communicating effectively and learn how to communicate more clearly

Activity Overview

This is an icebreaker activity, designed to introduce good feedback skills in a non-threatening, non-stressful environment. Youth are broken into pairs. One makes a very simple shape/structure (keep it 2-D for simplicity) behind an upright 3-ring binder. That person then verbally instructs their partner to create the same shape. While receiving the instructions and attempting to recreate the structure, this participant also jots down feedback related to the instructions given (both positive and negative). After, both participants show the finished structure and share thoughts on why or why not they were successful with the receiver of the instructions providing constructive feedback to the initial builder.

Background

Giving and receiving feedback from others is an essential part of completing projects and ending with the best possible product. In a collaborative work environment, possessing the skills to effectively communicate one's feedback to a group without upsetting anyone else's feelings is absolutely essential. This feedback is only useful if it is clearly communicated, and this activity gets the youth to consider and practice these essential skills.

Preparation

Space Required:

You will need a room with enough seating and writing space for all of your participants.

Materials:

- ❑ Small notebooks, which you can provide or ask your participants to bring.
- ❑ 3-ring binders, enough to have 1 for each 2 participants
- ❑ Toothpicks, straws, LEGOS, or another set of materials broken into small baggies – one baggie of 10-16 pieces. If you are using LEGOS, or other possibly non-identical pieces, make sure to have 2 of each piece.

Preparation time: 🕐 🕐

Activity time: 15 minutes

Gathering of materials and final preparations:

- ❑ Make sure to have enough baggies of materials for each pair of participants.
- ❑ If you are using materials that are not necessarily identical (e.g. LEGOS, k-nex, etc.), make sure you have 2 of each one (2 blue short tubes, 2 yellow rectangles, etc) so each person has the same materials to build the shape.

Procedure

Discussion lead-in:

Introduce this as a fun, but educational activity that will help everyone's communication skills, with the emphasis on giving feedback to directions.

1. Pair up the participants. Try to have the pairs be random, this works better with pairs who do not know each other well. Instruct one of them to build a simple 2-D structure out of the materials provided without showing it to their partner.

2. Then the initial builder verbally instructs their partner to build the same shape from the same materials, but without the aid of seeing how their partner is interpreting the instructions.

3. The receiver of the instructions should note any confusing or unclear instructions on paper. This feedback will be shared after the structure is finished being built, during the discussion about communication.

4. After the pair is finished building, instruct them to remove the binder, look at the two structures, and discuss the process of communication with each other. Use the following prompts to facilitate the discussion:
    - ❑ How close to duplicating the initial structure was the second structure?
    - ❑ What aspects of your partner's communication style were helpful in creating the same structure? What aspects needed improvement or clarification?
    - ❑ What would you change about your instructions if you had to do this challenge again? Be specific.

The main issue that will arise is clarity of communication. Describing the orientation of the pieces usually causes confusion ("Hold it flat" can mean completely different things to each person). The focus should be on giving feedback to the person who gave the directions.

Follow up

- ❑ Have the youth switch roles and try the challenge again, or try it again with the same roles but incorporating the feedback supplied by the second builder.

- ❑ The participants who have completed the final conclusions section of the project report write-up should exchange papers and provide each other with feedback on how to improve their report. This feedback should follow a simple what was done well, what needs some work, and what needs to be changed, type of format.

Observing Project #2: Daily Journal & Project Report

Goals

- Develop better organizational skills by keeping track of daily progress and findings in a scientific journal
- Analyze and interpret data to make connections and draw conclusions

Activity Overview

The Daily Journal is an ongoing process used during each session. The journal helps the youth keep their work and progress organized while reflecting on their data. This reflection helps the youth make meaning of their data and reach a conclusion. Refer to the "Observing Project #2: Overview" to see what prompts are to be answered in each of the sessions.

During the final session days for this project, participants should open their word processing document containing their daily journaling. Present them with the task of completing each of the 4 parts of the project report, using their answers to the daily prompts as the basis for each part of the report. Have the youth type their answers into a document that does not include the Project Report Prompts (See separate page titled "Observing Project #2: Project Report"). You may want to print out the Project Report Prompts page or transfer them onto a whiteboard or piece of chart paper for the participants to reference. Additionally, it is not expected that the youth complete the entire project in one session, and so splitting up the report prompts is recommended. That way the number of questions does not overwhelm them. Finally, be sure that the youth answer the questions of the report prompts in complete sentences and are not just copy and pasting from their daily journal.

Follow up

- ❑ The 4 parts of the project report are to be posted online on the MicroObservatory website as part of the published project report. (Refer to the previous write-up "Observing Projects: Publishing the Project Report" for detailed instructions).

Daily Journal Prompts

1. What is my research question? How did I come up with it? What information do I already know about my object or topic?
2. What is the title of my project?
3. How can I answer my question? What is my plan for taking data?
4. Describe the process of collecting and analyzing your data? Are there any new developments to report today?
5. Look at your image and describe what you see, list any observations related to the features of the object, for example, size, shape, color, location.
6. Describe any patterns or changes that occur between the images. Compare and contrast the images.
7. What did I learn? What would I like to teach someone else?
8. What questions do I have now? How would I answer them?
9. Summarize and evaluate your process in doing this project? Was there any part of your method that worked really well? Was there anything that could be improved?
10. Do you have any personal conclusions that in doing this report you came to realize?

Observing Project #2: Project Report

Part 1- Introduction:

Part 2 - Images and Data:

Part 3 - Explanation of Observations & Data

Part 4 - Conclusions, Questions, Recommendations

Project Report Prompts

Part 1- Introduction:

- ❑ What was the question you investigated in your project? How did you come up with it?
- ❑ How did you try to answer your question? Did you have a plan for taking data? What was it?

Part 2 - Images and Data:

(This is the section in which you will place your saved .GIF images)

Part 3 - Explanation of Observations & Data

- ❑ What were the most important and most interesting observations you made? Describe them.
- ❑ Were there any patterns between your images? What stayed the same between some or all of them? What changed?

Part 4 - Conclusions, Questions, Recommendations

- ❑ What was interesting that you found out from this project? What new ideas did you come up with? Do you think that you could convince someone else of your findings?
- ❑ You underwent a process of planning your images with MicroObservatory and making observations. Was there any part of your method that worked really well? Was there anything that could be improved?

Observing Project #3: Overview

Note: This is the description of the first observing project. It should last about 6 sessions.

Goals

- Develop a question or topic to be the basis for the third observing project
- Develop a data collection plan and build upon skills used to make sense of observational data
- Understand that professional science is driven by asking well-defined questions that are based on observations
- Understand how to access MicroObservatory FITS images (info and headers) as data sources
- Reinforce the difference between observations and inferences
- Able to give, receive, and incorporate feedback from fellow participants to produce an improved final product
- Improve oral and written communication skills by completing a project report to be published online and presenting project to others
- Improve oral and written communication skills by organizing project report into a PowerPoint/poster and presenting project to others

Activity Overview

This is the third observing project in which participants choose a topic or question to be the focus of the project, reinforce the observing skills from "Observing Project #1" and "#2", analyze data and draw conclusions. It should be noted that if there is not time enough to complete a brand new project with a new topic, the youth should be encouraged to go deeper into their topic for "Observing Project #2" and then skip ahead to create the PowerPoint presentation and poster (written up as part of the third observing project and called "Observing Project #3: Creating Posters**"**).

During this project, participants, once again, keep a journal of observations and thoughts that mimics the action of scientists engaged in research. The participants publish their work from each project online, through the MicroObservatory website's "lounge". There is a separate write-up for many of the activities associated with this project to be done over the course of 6 sessions.

Background

When doing science asking good questions is often just as important as finding the answers. To be able to do either of these however, we must collect data, make observations, and analyze the data to make meaning of it. In this project, as in "Observing Project #2", the youth develop a plan to answer their own question or one selected from the list below (In the Gathering of materials section). However the expectation this time is that participants, based on what they have learned throughout the program, come up with a prediction of what they expect to find while conducting their report. Be sure to follow the same process of making observations and journaling as modeled in "Observing Project #2". In addition, at the conclusion of the project the youth will be asked to reflect on ways to improve their research methods.

Preparation

Space Required:

You will need a room with enough seating and writing space for all of your participants. At certain points, use of computers will be needed – the best scenario is one computer per participant.

Materials:

- ❑ Small notebooks, which participants should have already.
- ❑ Word processing document digital journal
- ❑ Computer lab

Preparation time: 🕐 🕐

Activity time: 6 sessions

Gathering of materials and final preparations:

If there is time enough to begin an entirely new project separate from "Observing Project #2", encourage participants without already a question to be the basis of the new project to choose one from the list below. The list of potential projects should be written on a whiteboard or chart paper:

- ❑ Why does the Moon look different night after night?
- ❑ What are the objects surrounding Jupiter and how are they moving?
- ❑ How can we classify galaxies according to their shape?
- ❑ How can we classify nebulae?
- ❑ How can we organize galaxies or nebulae based on their size?
- ❑ Is there color in the Universe? How do we create full color images?

- How does the image of my favorite astronomical object change when taken with different exposure times?
- Why are some objects only up in the sky during certain times of year? Compare an object inside our galaxy vs. one outside of our galaxy.

Procedure

Discussion lead-in:

What follows is a general overview of each of the five sessions that are part of this project.

Procedure:

1. **First Session:** "Introduction & Planning" (45 min) The question or topic for the project is developed and a plan for collecting data is spelled out. Data collection begins, scheduling observations, and/or downloading images from the image archive. Journal prompts – 1, 2, 3, 4

2. **Second Session:** Participants begin to make sense of the data they have collected by processing their images, closely examining their images, answering the following journal prompts – 5, 6, 7

3. **Third Session:** Image processing, data analysis, and begin write-up. Journal prompts – 5, 6, 7, begin 8, 9, 10, 11.

4. **Fourth Session:** Data analysis and write-up. Journal prompts – 5, 6, 7, finish 8, 9, 10, 11. Participants publish project report (Refer to the previous write-up "Observing Projects: Publishing the Project Report" for detailed instructions).

5. **Fifth Session:** "Creating Posters" and begin "Presenting Posters"

6. **Sixth Session:** "Presenting Posters"

Follow up

- When all projects are published you may want to print all of the word processing documents of the project reports, complete with images, as a booklet to give to all participants to take home.

Watch out for…

- "Observing Project #2" and "Observing Project #3" can be lengthy endeavors; it is not recommended that these sessions be structured to

consist solely of work on these projects. Many of the youth will start to lose focus after being on the computer for an hour or more. Some potential activities to mix-in to break up the computer time are the modeling activities included towards the end of the Hands-On Activities. “Modeling the Earth-Moon System”, “Moon Phases Activity”, and “A Journey Through the Universe” are all options to facilitate. Additionally, you may want to then suggest that the youth incorporate aspects of these models, or a model of their own design, into their presentation of the second or third observing project. The addition of a model can add a lot of clarity and explanatory power to a project if done well.

Observing Project #3:
Introduction & Planning

Note: This is the write-up of the first session of Observing Project #3.

Goals

- Develop a question or topic to be the basis for the second observing project
- Develop a data collection plan and learn how to make sense of observational data
- Understand that professional science is driven by asking well-defined questions that are based on observations
- Build upon data analysis skills by examining MicroObservatory FITS images and their FITS header files

Activity Overview

This is an introductory activity for the third observing project. In this activity, participants develop a research question to be the focus of their third observing project. This question could come from any of the following:

- A new question that the youth have come to as a consequence of engaging in past activities. (Make sure this question is a 'good' question. Review background of "Observing Project #1: Sharing & Publishing" for information about what makes a 'good' question for scientific investigations).
- A question from the suggested list of questions that is interesting and answerable given the tools at hand. (See suggested list below)

Note: If as a facilitator you are not experienced with leading inquiry-based activities, coaching the youth through the process of developing their own project may be exceedingly difficult. It is recommended that the list of questions be used if this is the case.

Participants should write down in their journals any information that they already know about their chosen topic, especially findings from past activities. Second, review the observing skills from "Observing Project #2" regarding keeping a journal. The journal entries should all be dated

and log the participant's daily activity, observations, and findings. Bring back out their conclusions related to what worked well or did not work well from their second observing project reminding the youth to take their own advice for improving this project.

Ask the participants where and how they will obtain their data. Go over some potential sources of data such as the FITS header if they do not mention it as a source. Finally, participants develop their plans for collecting their data and record it in their journals. For example, a participant with the question: Do all galaxies look the same? They might decide that, over the course of the next couple sessions, they will take images of many galaxies, and compare their data with images from the MicroObservatory Image Archive.

Background

When doing science asking good questions is often just as important as finding the answers. To be able to do either of these however, we must collect data, make observations, and analyze the data to make meaning of it. In addition to visual observations made by looking at an object in the sky, or from images, a wealth of information is available from the FITS header of an image. This file provides important information about when and how this image was taken and who took it. Some of the information in this file may still be unfamiliar to you. Continue to focus on the following vital pieces of information:

FILE = name of the file
DATE = when the image was taken
EXPTIME = exposure time
START-OBS and OBS-END = Starting and ending time of the exposure
FILTER = filter used when taking this image
TELESCOP = name of the telescope used to take this image
OBSERVER = who took the image
OBJECT = name of the object in the image

To access this information, find your image on the Latest Image Archive page on the MicroObservatory website and click on "Image Info." Also, opening the FITS image with the MO Image software and clicking on the menu bar under "Window," then clicking on "FITS Header" pulls up the information.

Preparation

Space Required:

You will need a room with enough seating and writing space for all of your participants. At certain points, use of computers will be needed – the best scenario is one computer per participant.

Materials:

- ❑ Small notebooks, which participants should have already.
- ❑ Word processing document—digital journal
- ❑ Computer lab

Preparation time: 15 min

Activity time: 30 hours

Gathering of materials and final preparations:

The following list of potential projects should be written on a whiteboard or chart paper. For their third project many of the youth might have a question they posed at the conclusion of their second observing project. In this way this third observing project could be a continuation of the second project. Encourage the youth that do not have a lingering question that would make a good research question to select a new project concept from the list below:

- ❑ Why does the Moon look different night after night?
- ❑ What are the objects surrounding Jupiter and how do they behave?
- ❑ How can we classify galaxies according to their shape?
- ❑ How can we classify nebulae?
- ❑ How can we organize galaxies or nebulae based on their size?
- ❑ Is there color in the Universe? How do we create full color images?
- ❑ How does the image of my favorite astronomical object change when taken with different exposure times?
- ❑ Why are some objects only up in the sky during certain times of year? Compare an object inside our galaxy vs. one outside of our galaxy.

Procedure

Discussion lead-in:

Introduce the third observing project as a continuation of the second, in that the youth will be using the observing and analysis skills honed while working on that project. Also, some may want to now address a question developed then, as the focus of this project. For those unsure about what their topic question could be, they may select one from the provided list of potential questions that should be posted.

Finally, remind the participants that asking a well-defined question, which will be the focus of their project, is critical to the success of their work. Also, professional science is driven by asking questions, making careful observations and then arriving at an answer.

Procedure:

1. Participants first select their research question or topic for their project. Once this is chosen, have the youth write in their journals any information or ideas they have about this topic.

2. Go around the room and see if any of the youth have selected the same or similar topics for their projects; try and pair up participants by topic (some of their project ideas may be more complimentary topics than similar, but explain to them how they may fit together in these cases).

3. Review the skills needed for scientific observing.
   - ❑ Being well-organized (dating journal entries)
   - ❑ Recording detailed observations
   - ❑ Making sure that observations are not actually inferences

4. Review the idea of an image as a piece of data. Use the information in the FITS Header as examples of the data that can be extracted from an image (See the Background section for more on FITS headers).

5. Direct the youth to the MicroObservatory Image Archive and remind them of the extensive collection of data available there.

6. The youth should now be able to develop a plan for their collection of data. This plan should be recorded in their journals.

7. If there is time participants should begin gathering their data and taking the first steps that they outlined in their plans.

Follow up

- ❑ Most, if not all, of the youth will need to take images as part of their data collection plan. Be sure to allow time at the end of the session for them to schedule these observations.

Observing Project #3: Daily Journal & Project Report

Goals

- Develop better organizational skills by keeping track of daily progress and findings in a scientific journal
- Analyze and interpret data to make connections and draw conclusions

Activity Overview

The Daily Journal is an ongoing process used during each session. The journal helps the youth keep their work and progress organized while reflecting on their data. This reflection helps the youth make meaning of their data and reach a conclusion. Refer to the "Observing Project #3: Overview" to see what prompts are to be answered in each of the sessions.

During the final session days for this project, participants should open their word processing document containing their daily journaling. Present them with the task of completing each of the 4 parts of the project report, using their answers to the daily prompts as the basis for each part of the report. Have the youth type their answers into a document that does not include the Project Report Prompts (See separate page titled "Observing Project #3: Project Report"). You may want to print out the Project Report Prompts page or transfer them onto a whiteboard or piece of chart paper for the participants to reference. Additionally, it is not expected that the youth complete the entire project in one session, and so splitting up the report prompts is recommended. That way the number of questions does not overwhelm them. Finally, be sure that the youth answer the questions of the report prompts in complete sentences and are not just copied and pasted from their daily journal.

Follow up

- ❑ The 4 parts of the project report are to be posted online on the MicroObservatory website as part of the published project report. (Refer to the previous write-up "Observing Projects: Publishing the Project Report" for detailed instructions).

Daily Prompts

1. What is my research question? How did I come up with it? What information do I already know about my object or topic?
2. Given what I know about my object or topic, what do I expect to find? What is my prediction?
3. What is the title of my project?
4. How can I answer my question? What is my plan for taking data?
5. Describe the process of collecting and analyzing your data? Are there any new developments to report today?
6. Look at your image and describe what you see, list any observations related to the features of the object, for example, size, shape, color, location.
7. Describe any patterns or changes that occur between the images. Compare and contrast the images.
8. What did I learn? What would I like to teach someone else?
9. What questions do I have now? How would I answer them?
10. Summarize and evaluate your process in doing this project? What would you do again, what would you do differently the next time to improve your process?
11. Do you have any personal conclusions that in doing this report you came to realize?

Observing Project#3: Project Report

Part 1- Introduction:

Part 2 - Images and Data:

Part 3 - Explanation of Observations & Data

Part 4 - Conclusions, Questions, Recommendations

Project Report Prompts

Part 1- Introduction:

- ❑ What was the question you investigated in your project? How did you come up with it?
- ❑ Given what you know about your question topic, what was your prediction about what you would find out?
- ❑ How did you try to answer your question? Did you have a plan for taking data? What was it?

Part 2 - Images and Data:

(This is the section in which you will place your saved .GIF images)

Part 3 - Explanation of Observations & Data

- ❑ What were the most important and most interesting observations you made? Describe them.
- ❑ Were there any patterns between your images? What stayed the same between some or all of them? What changed?

Part 4 - Conclusions, Questions, Recommendations

- ❑ What was interesting that you found out from this project? What new ideas did you come up with? Do you think that you could convince someone else of your findings?
- ❑ You underwent a process of planning your images with MicroObservatory and making observations. Was there any part of your method that worked really well? Was there anything that could be improved?
- ❑ How would you revise or improve your process?

Observing Project #3: Creating Posters

Note: This is the write-up of the fifth session of Observing Project #3.

Goals

- ❑ Improve oral and written communication skills by organizing project report into a PowerPoint/poster and presenting project to others

Activity Overview

In this session give participants the time to bring together all the work they have been doing over the last 5 sessions. Participants work with their partner on their posters. The posters are created by printing out PowerPoint slides as full pages and affixing the print-outs to poster paper. If desired, and your site has the means to project the PowerPoint slides, you may want to have the youth present their work giving a presentation.

Background

During the previous sessions, participants have gathered data, spent time analyzing the data, and come to a conclusion in their journal. This time should be spent solely on putting everything together on their posters in preparation for sharing with the group. It is important to be able to organize new knowledge and communicate that knowledge to others. Without this skill, the value of any learning becomes much less, as the central objectives and topics that are learned can be confused or even forgotten.

Preparation

Space Required:

You will need a room with enough seating and writing space for all of your participants. At certain points, use of computers will be needed – the best scenario is one computer per participant.

Materials:

- ❑ Colored paper, markers, scissors, glue sticks, tape, etc.

- ❑ Chart paper
- ❑ Computer lab for preparation of PowerPoint presentation

Preparation time: 🕛

Activity time: 60 minutes

Gathering of materials and final preparations:

Make sure to have enough craft supplies so youth can decorate their posters, if desired. Also, the computers the youth are working on need to have Microsoft PowerPoint loaded onto them.

Procedure

Discussion lead-in:

Introduce this time as the only time they have to put all their information on the posters. To accomplish this:

1. Have youth gather everything they need for their poster (All of the information should have already been typed up in their journal):
   - ❑ Question - Prediction
   - ❑ Images & Data
   - ❑ Data Analysis & Observations
   - ❑ Conclusion

2. Give participants 30 minutes to prepare the slides for their posters. Instruct them to take their typed up information and summarize each paragraph into a single main idea to be entered into the PowerPoint slide as a separate bullet point. Once they are done entering in the information, print the slides, and print separately their typed up reports.

3. After 30 minutes, announce to the group that there is 15 minutes left to finish putting posters together. Participants should be finished preparing their information and start to glue and tape items to the chart paper.

4. Once their posters are finished, groups that are done can begin to rehearse the oral side of their presentation. They should work out with their partner who is to say which portion of the report, and practice good communication skills (Speaking loudly and clearly, standing up straight, eye contact, and presenting without fidgeting are examples).

5. Gather all the finished posters and keep them in a safe place for the next session, or if there is time, begin presenting the projects right away.

Follow up

Presenting the posters!

Watch out for...

- Participants may attempt to cut and paste entire paragraphs of text on the PowerPoint slides, have them instead print out this information and have it in front of them as they present, but to summarize their paragraphs as bullet points.

Observing Project #3: Presenting Posters

Note: This is the write-up of the sixth session of Observing Project #3.

Goals

- ❑ Improve oral and written communication skills by organizing project report into a PowerPoint/poster and presenting project to others

Activity Overview

During this session, participants share their projects to the large group.

Background

This session allows for the youth to practice their communication skills as they present their projects to each other. Communicating and explaining the questions, process, data and conclusion clearly to others takes practice. Provide time for the project teams to go through their presentations a couple of times among themselves first to feel more comfortable presenting in front of the group.

Preparation

Space Required:

You will need a room with enough seating space for all of your participants.

Materials:

- ❑ Participants' Posters

Preparation time: none

Activity time: 1 hour

Gathering of materials and final preparations:

Arrange room to allow for foot traffic to area where posters will be set up. Think about how and where the individual presentations will take place.

Procedure

Discussion lead-in:

Announce that this is the time to share their work with each other.

1. Bring together 2 pairs to make small groups of 4.

2. In each group, the participants share their projects for 3-5 minutes. Each group member shares one thing that was surprising, interesting or confusing about the other pair's projects. The focus should be on the positive aspects.

3. After 15 minutes or so each group member should have had time to share.

4. Gather everyone for the pairs that volunteer to present their posters/presentations.

5. At the end of those presentations break-up the youth back into their initial small groups and elicit comments and feedback. Possible questions to pose:
   - ❑ What was the most surprising thing you found while conducting your observations?
   - ❑ What was something you learned?
   - ❑ How did doing this project change your views on the scientific process?

Watch out for...

- ❑ Participants may spend time socializing instead of looking at each other's posters.