

A SNAPSHOT GUIDE TO USING THE EXPEDITION EARTH AND BEYOND (EEAB) STUDENT SCIENTIST GUIDEBOOK

Step 1: PRELIMINARY QUESTION Approximate Time Frame: 30-45 minutes

Main Objective(s)	Helpful Hints
Guide individual groups to create a preliminary question to further investigate.	Organize students into small groups of 4-8 students to explore potential research questions the class can investigate. Keep in mind that by the end of Step 2, students will want to convince the rest of the class that their question should be the focus of the team investigation. Make sure students focus on a specific visible aspect or characteristic of a feature(s) that can be observed in astronaut photographs.

Step 2: INITIAL OBSERVATIONS Approximate Time Frame: 3 class periods

Main Objective(s)	Helpful Hints
List sources to find astronaut photos.	Two sources are provided. Students can list others if known.
Decide what data and observations to log.	Help students think about what data they should collect. A sample list is provided.
Create an initial data table.	Have student use the model data table as a guide to create their own. Column headings should reflect the individual pieces of data students will collect/log.
Log initial observations.	Using the table they create, students should log data from 5-10 images. Students can use sources provided or other sources they may be aware of that provide access to astronaut photos. As they log data, they may decide to refine their data table.
Formulate a hypothesis.	Students should base their hypothesis on a discussion of observations logged and/or based it on other knowledge/information they have that may support their hypothesis.
Discuss and debate the team research question.	Individual student groups should try to convince their classmates that their preliminary question should be the question the class focuses on as a team. Once a single team investigation question is selected, make sure all team members discuss and create a blank data table for data collection.

Step 3: BACKGROUND RESEARCH Approximate Time Frame: 2-3 class periods

Main Objective(s)	Helpful Hints
Gather basic background research and information.	Review the importance of building on existing knowledge and keeping track of sources. It is recommended to divide students into 6-7 groups to log information from the 6-7 topics listed. You may choose to only focus on topics 1-6 as topic 7 deals with planetary comparisons. You may want to have students complete an investigation focusing on Earth first before they delve into a planetary comparison. As students collect and log information, they should keep track of all sources used.
Log bibliographical and summary information from each source.	
Continue to collect and log data.	Once students finish logging information on their assigned topic, they should collect and log data.

By the end of this step, students should report out their information to the rest of the class. This will ensure all team members learn consistent and complete information regarding their investigation.

Step 4: EXPERIMENT DESIGN <i>Approximate Time Frame: 1 class period</i>	
Main Objective(s)	Helpful Hints
Finalize the team research question	Have students discuss the current research question and decide if the question can be refined.
Reformulate and finalize hypothesis	Once students have decided on a refined and final research question, they should reformulate and finalize their hypothesis. This refined hypothesis should be aligned with the final research question. Students should include observations and other knowledge that support this hypothesis.
STUDENTS SHOULD NOT MAKE MAJOR CHANGES TO THEIR QUESTION OR HYPOTHESIS FROM THIS POINT ON. ADDITIONAL DATA COLLECTED AND ANALYZED WILL ALLOW STUDENTS TO INDICATE IF THEIR HYPOTHESIS WAS SUPPORTED OR REFUTED.	
Finalize the plan on what data to collect and where students will gather that data.	Discuss each of the seven items listed as part of the experiment design. All students should be in agreement and have an understanding as to how they will address each of the methods listed.
Make sure everyone logs data consistently.	Have student use the model data table as a guide to create their own. Column headings should reflect the individual pieces of data students will collect/log.
Step 5: COLLECT & COMPILE DATA <i>Approximate Time Frame: 1-2 class periods</i>	
Main Objective(s)	Helpful Hints
Compile all collected data into a Master Data Table(s)	It will be important to compile data collected from different team members into one Master Data Table. If students had multiple data tables (were collecting multiple types of data) they may have more than one Master Data Table. If student have hand-written data tables, it will be useful to transfer all the information into a spreadsheet. Make sure every data table includes a complete set of logged data.
Fill out and submit Data Request Form (optional)	If students would like to have new data acquired by an astronaut on the International Space Station, they can fill out a Data Request Form. Only one request permitted per class.
Step 6: DISPLAY DATA <i>Approximate Time Frame: 2-3 class periods</i>	
Main Objective(s)	Helpful Hints
Decide on the different ways to display collected data.	Discuss the four different types of data displays discussed in the guidebook. Have students brainstorm the types of data displays they think should be created.
Create data displays.	Once students have decided on the types of data displayed to be created, have different groups of students be responsible to create those displays. Displays should be available for all students to view and make observations.
List observations of data displays	Students should make observations of each data display. Use the Observation Table provided to help students organize their observations.
Discuss observations of each data display as a class. Encourage students to circle or highlight observations that seem especially relevant to the research question and hypothesis.	
Step 7: ANALYZE AND INTERPRET DATA <i>Approximate Time Frame: 3 class periods</i>	
Main Objective(s)	Helpful Hints
Examine observations from each data display.	Have students focus on the observations they highlighted or circled as being especially important. These observations will be included in the first column of the Analysis and Interpretation of Data table.

Make interpretations of those observations (how observations relate to and help students answer their question).	Students should discuss how each individual observations listed can be interpreted to help them make a connection or inference related to their question and/or hypothesis. Students should write their interpretation of each observation in the 2 nd column of the data.
Provide specific evidence from the data displays or background knowledge that support each interpretation.	Students should list additional evidence that supports the interpretation of their observation. This can be evidence from other data displays or from background knowledge they gained during their research.
Make additional copies of the Analysis and Interpretation of Data table as necessary.	
Consider potential erros, inaccuracies, misinterpretations or limitations of data.	Students should reflect on their research and list potential errors, inaccuracies, misinterpretations or limitations of data. Stating these challenges or aspects of their research will help them as they consider and draw conclusions about their research question and consider whether their hypothesis was supported or refuted.
Step 8: DRAW CONCLUSIONS <i>Approximate Time Frame: 1-2 class periods</i>	
Main Objective(s)	Helpful Hints
Restate the research question and answer it.	As students state and answer their question, they should summarize pertinent evidence that supports their answer.
Restate the hypothesis and indicate whether it was supported or refuted.	As students state whether their hypothesis was supported or refuted, they should summarize pertinent evident that supports their answer.
Emphasize to students that it is not good enough to simply answer their question or state whether their hypothesis was supported or refuted. Students MUST be able to summarize specific and supporting evidence that support their answers.	
Consider what new research could be conducted based on the investigation.	Discuss with students how knowledge gained generally sparks new questions. Science is about continuing to explore and gain new knowledge. Curiosity never ends, and never does science.
Acknowledge those that helped you with your investigation.	Let students know that professional scientists always acknowledge those that have helped them with their investigation. This is considered a professional courtesy.
Reflect on your investigation and think about how it could have been improved.	Students should discuss how the investigation could be improved if it were to be done again. This will help students attack new problems and investigations even better in the future.
Step 9: SHARE RESEARCH <i>Approximate Time Frame: As Time Permits</i>	
Main Objective(s)	Helpful Hints
Share research with others.	Science really is not considered complete until it is shared with others. Options for sharing students' research could be a school presentation, publishing their research on their own Expedition Earth and Beyond Team Wiki, writing a research paper, or presenting their research to professional scientists.
Discuss with students the numerous skills they have experienced and improved throughout their investigation. This includes the knowledge they have gained, their communication skills, their discussion and debate skills, and their understanding of skills and practices used by actual STEM professionals.	