

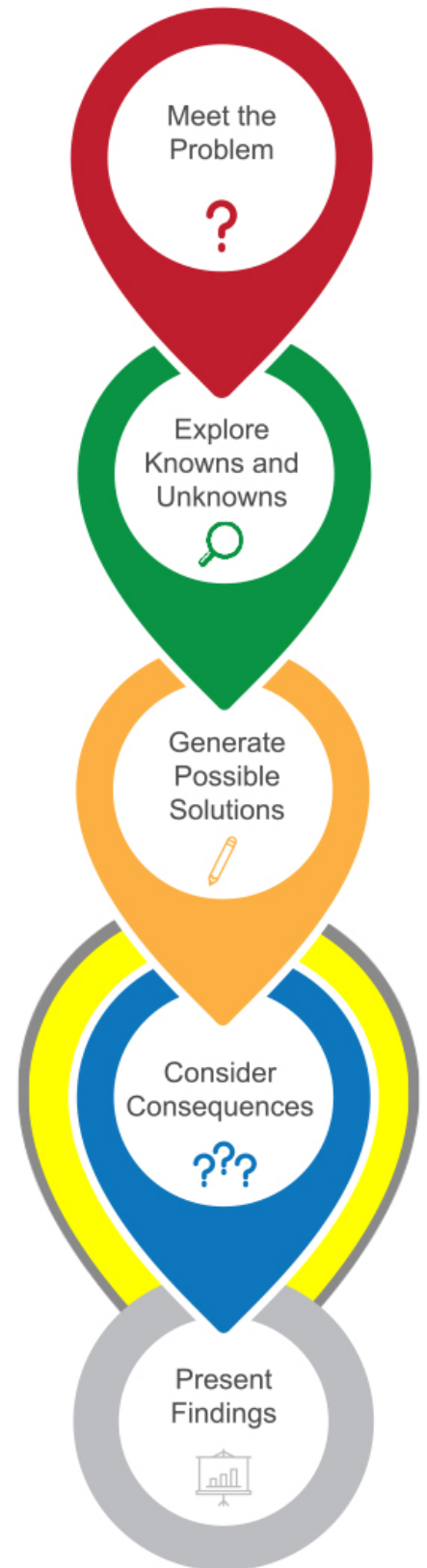
PHASE III

Part 1: Consider the Consequences/Evaluate Tool Redesigns



Close-up view of a set of tongs, an Apollo Lunar Hand Tool, being used by Astronaut Charles Conrad Jr., to pick up lunar samples during the Apollo XII mission, November 19, 1969. Credits: NASA

In Part 1 of Phase III, you and your teammates will conduct testing on the redesigns you built in Phase II. Be sure to review the testing procedure from Phase II and the Tool Feedback Form (TFF) carefully prior to conducting your testing. You will use this testing data to Consider the Consequences. In other words, you will reflect on your tool component redesign and evaluate the pros and cons of the redesign performance. This will help you decide how you will be moving forward. These findings will then be discussed with Mission Directors and other teams when you Present Findings later in Phase III.



Tool Testing Procedure for Redesigns

Follow the instructions you carried out in Phase II in the first round of testing.

STEP 1: Go with your team to your assigned testing site. Take all four redesigned tool components and four new copies of the Phase III TFF with you. (A Mission Director may have already brought over your TFFs. Ask questions if needed for clarification.)



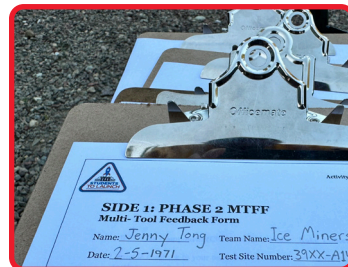
STEP 2: Determine who will be timing your tests with the stopwatch. If it is students and not a Mission Director, each student will take a turn timing another student. Use this time to learn how to use the stopwatch. If needed, ask a Mission Director for help.



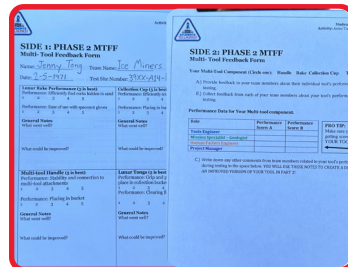
STEP 3: Place all your team's tool components in the marked tool component stage area of the test site. Check with a Mission Director to make sure your test site has been prepared and cleared for testing.



STEP 4: Place your TFF in the provided clipboard if this was not done by a Mission Director. Fill out the test evaluator section in pencil (NAME, TEAM NAME, DATE, TEST SITE NUMBER).



STEP 5: Pre-read both sides of your TFF to prepare for what you are expected to report on after your test session. Then discuss with your team any questions you may have.



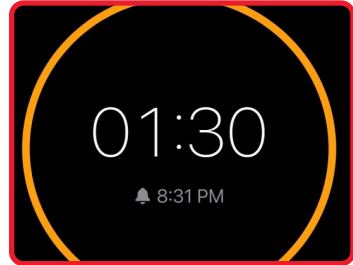
STEP 6: The Tools Engineer will test first. PUT ON THE SPACESUIT GLOVES as explained in Phase II. Each member will have a 1 minute 30 second time frame to collect as many lunar rocks as possible by raking, scooping, and picking with the spacesuit gloves.



STEP 7: Collect as many lunar rock specimens as possible using the Tool attachments and place them in the collection bucket. All the tools in the kit must be used during the testing time. Remember, do not use the gloves to directly pick up the samples.



STEP 8: After 1 minute and 30 seconds the timer should say “Stop!” Stop collecting rocks. Any rocks that have not been placed in the collection bucket should be placed back into the test site.



STEP 9: When the first team member is finished, they should count the number of rocks collected with the Tool and record the number on their TFF.



STEP 10: Repeat the testing process for the remaining three team members. When testing is completed, each student should complete Side 1 only of the Tool Feedback Form (TFF) about their testing trial. Good luck! Happy Testing.



Great job completing retesting of the tool!

Now it is time for your team to share their observations and data in a stand-up presentation.

- A. Group members should stand in a circle.
- B. The maker of the tool component (lunar rake, collection cup handle, or lunar tongs) should refer to the notes on the TFF and speak for 1 minute about its performance to their team members.
- C. Each team member should then share their feedback about the tool component (refer to notes on TFF) with the maker of the component (lunar rake, collection cup, handle, or lunar tongs). The maker should record the feedback on SIDE 2 of their TFF.

Steps A-C should be repeated for the remaining team members until everyone has SIDE 1 and SIDE 2 of their TFFs completed.

NUMBER OF ROCKS COLLECTED:

Student Name: _____ Team Name: _____

Date: _____ Test Site Number: _____

Lunar Rake (5 is best)

A. Performance: Efficiently find rocks hidden in sand.
1 2 3 4 5

B. Performance: Ease of use with spacesuit gloves.
1 2 3 4 5

General Notes
What went well?

What could be improved?

Collection Cup (5 is best)

A. Performance: Efficiently scoop rocks into bucket.
1 2 3 4 5

B. Performance: Placing in bucket.
1 2 3 4 5

General Notes
What went well?

What could be improved?

Tool Handle (5 is best)

A. Performance: Stability and connection to tool attachments.
1 2 3 4 5

B. Performance: Placing in bucket.
1 2 3 4 5

General Notes
What went well?

What could be improved?

Lunar Tongs (5 is best)

A. Performance: Grip and pickup rocks and place in collection bucket.
1 2 3 4 5

B. Performance: Clearing fine debris.
1 2 3 4 5

General Notes
What went well?

What could be improved?

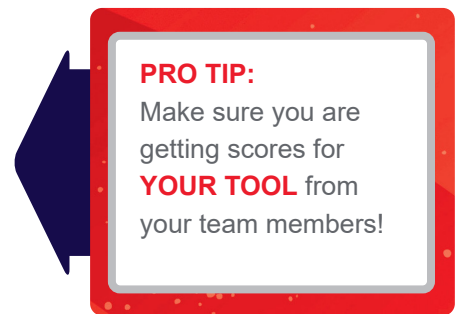
SIDE 2: PHASE III Tool Feedback Form TFF

Your Tool Component (Circle one): Handle Rake Collection Cup Tongs

- A. Provide feedback to your team members about their individual tool's performance during testing.
- B. Collect feedback from each of your team members about your tool's performance during testing.

Performance Data for Your Tool component.

Role	Performance Score: A	Performance Score: B
Tools Engineer		
Mission Specialist - Geologist		
Human Factors Engineer		
Project Manager		



- C. Write down any other comments from team members related to your tool's performance during testing in the space below.

PHASE III

Part 2: Present Findings/Discuss Final Recommendations



Astronauts Reid Wiseman of NASA (left), Jeremy Hansen of the Canadian Space Agency (middle), and Victor Glover of NASA (right) pay close attention to Moon samples as they receive a lesson in the Apollo Lunar Lab at NASA's Johnson Space Center in Houston on May 9, 2023. Credits: NASA

Congratulations on completing your evaluation of your redesigned prototypes. You will now PRESENT YOUR FINDINGS and recommendations to NASA!

Prepare for a Group Presentation & Discussion!

Be prepared to answer the following questions using insights gathered from your tool experience, your TFFs, and the Recommendation Form found at the end of Phase III.

1. Review the problem situation: what problem were you trying to solve? (Meet the Problem)
2. What areas of needed improvement were revealed when you tested and evaluated the original prototype? (Explore Knowns and Unknowns)
3. How did your redesign address the needed areas of improvement? (Generate Possible Solutions)
4. What are your final recommendations for the tool attachment you were responsible for? (Consider Consequences)

BE SURE TO COMPLETE A RECOMMENDATION FORM, FOUND ON THE NEXT PAGES, FOR YOUR TOOL. YOU WILL USE THESE FORMS ALONG WITH THE TOOLS YOU MADE TO GUIDE YOUR PRESENTATION.



Lunar Rake Recommendation Form

1. What modifications were made during Phase II? Why did you decide to make these modifications?
2. Did the modifications improve performance? (Compare the number of rocks collected and the performance score data in your Phase II TFF with your Phase III TFF.)
3. Make a list of Pros and Cons related to this component.

Pros	Cons

4. Is this component ready to be used on the Moon? If yes, why? If no, why not? Be sure to provide data from the tool experience to support your response.
5. If the answer to question 3 was no, what recommendations do you have to make it Moon ready?

Collection Cup Recommendation Form

1. What modifications were made during Phase II? Why did you decide to make these modifications?
2. Did the modifications improve performance? (Compare the number of rocks collected and the performance score data in your Phase II TFF with your Phase III TFF.)
3. Make a list of Pros and Cons related to this component.

Pros	Cons

4. Is this component ready to be used on the Moon? If yes, why? If no, why not? Be sure to provide data from the tool experience to support your response.
5. If the answer to question 3 was no, what recommendations do you have to make it Moon ready.

Handle Recommendation Form

1. What modifications were made during Phase II? Why did you decide to make these modifications?
2. Did the modifications improve performance? (Compare the number of rocks collected and the performance score data in your Phase II TFF with your Phase III TFF.)
3. Make a list of Pros and Cons related to this component.

Pros	Cons

4. Is this component ready to be used on the Moon? If yes, why? If no, why not? Be sure to provide data from the tool experience to support your response.
5. If the answer to question 3 was no, what recommendations do you have to make it Moon ready.

Lunar Tongs Recommendation Form

1. What modifications were made during Phase II? Why did you decide to make these modifications?
2. Did the modifications improve performance? (Compare the number of rocks collected and the performance score data in your Phase II TFF with your Phase III TFF.)
3. Make a list of Pros and Cons related to this component.

Pros	Cons

4. Is this component ready to be used on the Moon? If yes, why? If no, why not? Be sure to provide data from the tool experience to support your response.
5. If the answer to question 3 was no, what recommendations do you have to make it Moon ready?

Team Presentation & Share

Once your team's recommendation form has been completed and checked off by your team's Project Manager, inform a Mission Director to get your RED sticker and to say that your team is done and ready to present. They may have you present directly to them for verbal feedback or place you in a queue for a whole group presentation. Either way, these are the basic elements you will need for the presentation:

1. Each team member discussing the original tool design. What was good about it and what were its weak points?
2. Each team member discussing what they did to modify the original design, why they did it, and the pros and cons of this modification.
3. Each team member discussing what they would do if the project was to move ahead.
4. How did your team work together to get the project completed?
5. A visual presentation of the two versions of each tool.

You may discuss other items you feel are important, but the total time on the presentation should not exceed 3-4 minutes. Remember to speak clearly and succinctly. Also, hold your prototype tools while you are talking about them.

Congratulations!

NASA is proud of your service and dedication! Your research, testing, and recommendations will go a long way in furthering our knowledge of lunar geology!



**Blue
Sticker**

Phase III Retest: Tools Engineer

- Test your redesigned rake attachment
- Record your data in your Phase III TFF
- Summarize and present your findings to the group



**Blue
Sticker**

Phase III Retest: Mission Specialist - Geologist

- Test your redesigned collection cup
- Record your data in your Phase III TFF
- Summarize and present your findings to the group



**Blue
Sticker**

Phase III Retest: Human Factors Engineer

- Test your redesigned handle attachment
- Record your data in your Phase III TFF
- Summarize and present your findings to the group



**Red
Sticker**

Phase III Retest: Project Manager

- Test your redesigned lunar tongs
- Record your data in your Phase III TFF
- Summarize and present your findings to the group. Check and approve team tasks. Apply blue sticker to this sheet as team members complete their tasks.
- Contact a Mission Director when each phase component is complete to get the red sticker