Figure 1: On to Mars 2 – 2016 Rover Sample Retrieval Challenge Tool Examples

Variety of hand-held sample collection tools

Innovative robotic sample collection tool

Team uses telescoping tool for soil collection

Off-vehicle team uses unique tool at Station Stop No. 4

Figure 2: On to Mars 3 – 2017 Rover Sample Retrieval Challenge Course at USSRC

Main Course

FW – Fold/Weigh

CU – Carry/Unfold

RS – Race Start

RF – Race Finish

Rover Sample Retrieval

SRS – Sample Retrieval Start

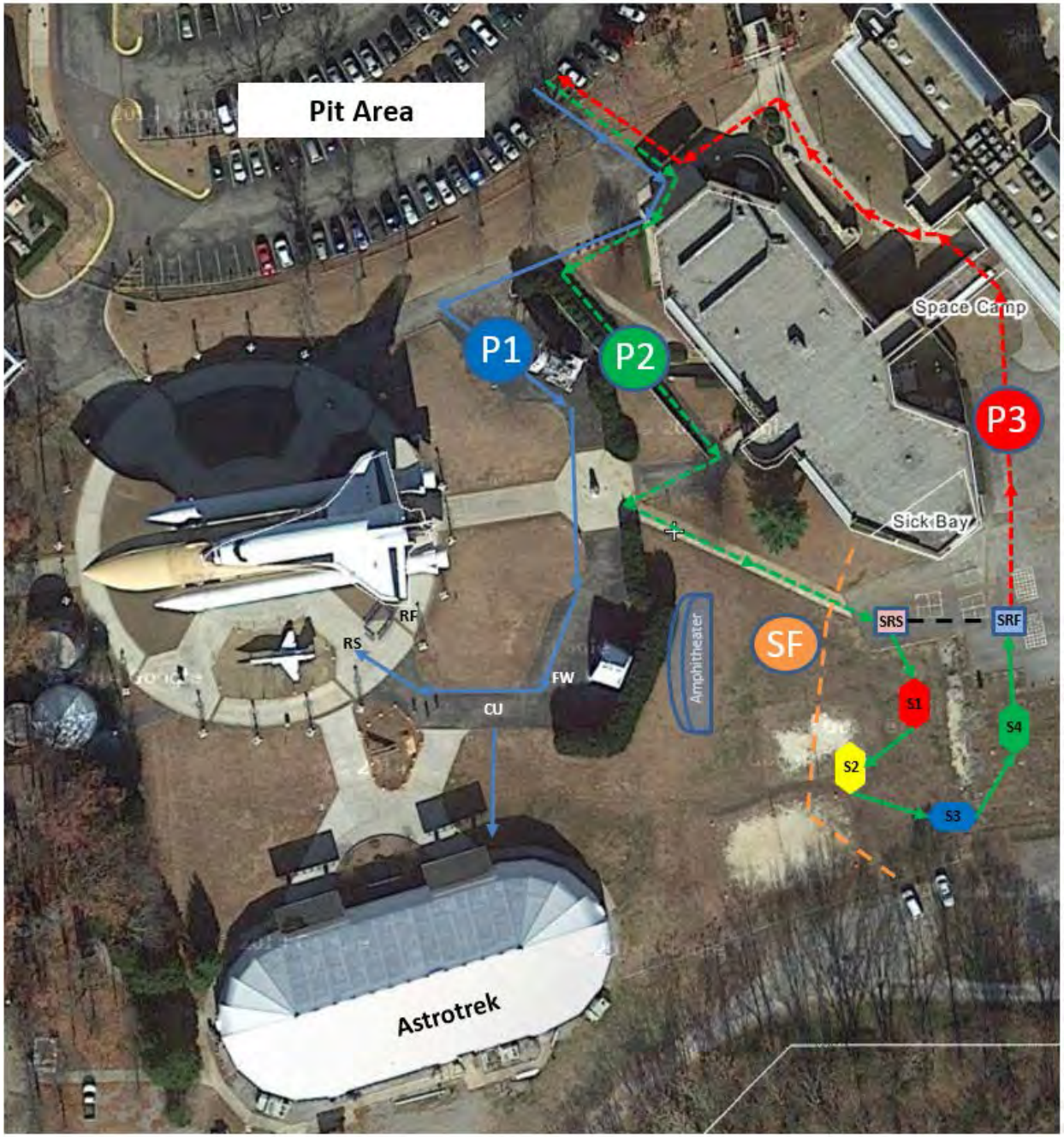
S1 – Sample 1 (Soil Riding)

S2 – Sample 2 (Off-Veh. Lg. Rock)

S3 – Sample 3 (Liquid Riding)

S4 – Sample 4 (Off-Veh. Sm. Rock)

SRF – Sample Retrieval Finish



Paths

P1 = From Pit Area to/from Race Start/Finish

P2 = Escort Teams from Pit Area to SRC Start

P3 = Escort Teams from SRC Finish to Pit Area

SF = Security Fence to Separate Observers from SRC Activities (Cones and Ropes, as in Main Race)

Figure 3: Historical Human Exploration Sampling Examples

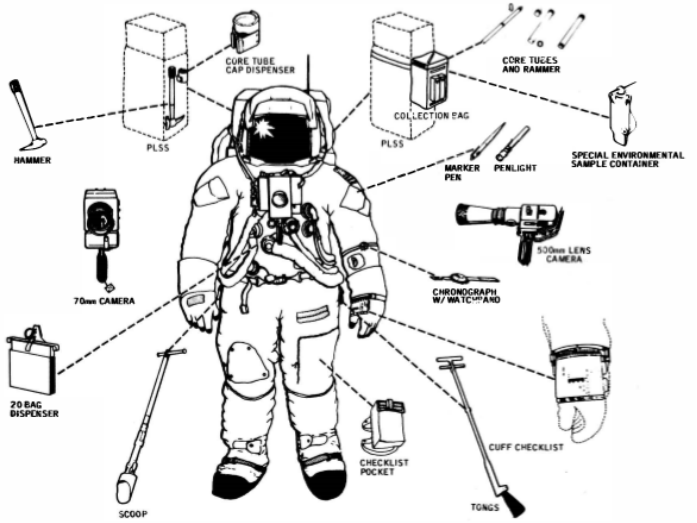
FIGURE 45A.—Scoop with extension handle. Its use in Apollo 12 is shown in figure 45B.

FIGURE 46.—Tongs shown in use on Apollo 12 to collect a small rock. NASA PHOTO S-71-31075.

FIGURE 45B.—Note the small rock in the scoop. NASA PHOTO AS12-49-7212.

FIGURE 47.—LRV Sampler. This tool will be used by the astronauts to collect samples of the Moon while seated on the Rover. The tool contains several nested bags. As each bag is used, it is removed and stowed. NASA PHOTO S-72-52308.

Apollo Sample Collecting Tools



Apollo Exploration Equipment and Rover

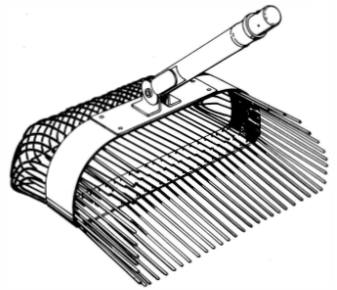
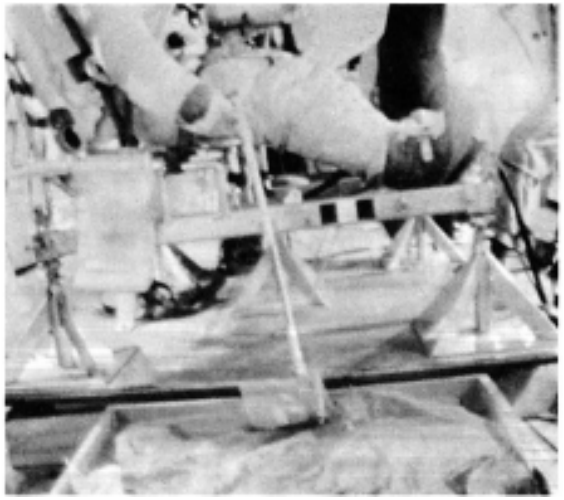


FIGURE 59.—Rake. This tool was used on Apollo 15 and 16 to collect marble-sized rocks. It

Apollo Rake and Collection Bags

FIGURE 51.—Lunar sample bag. The bag resembles the familiar kitchen item "Baggies." It is made of Teflon. A strip of aluminum is used to close the bag. Each bag has a number printed on the aluminum strip for identification.



Apollo Astronaut Collecting Test Sample While Seated

	Pre - LRV	Apollo 15	Apollo 16	Apollo 17
EVA Duration (hrs:min)	19:16	18:33	21:00	22:06
Driving Time (hrs:min)	–	3:02	3:26	4:29
Surface Distance Traversed (km)	3.55	27.9	26.9	35.7
Average Speed (km/hr)	0.18	9.20	7.83	7.96
Longest Traverse (km)	–	12.5	11.6	20.3
Maximum Range From LM (km)	–	5.4	4.5	7.6
Regolith Samples Collected (kg)	97.6	77.6	96.7	116.7

291 kg (641 lb) of Soil (Regolith) and Rock Science Samples Returned to Earth

Source: On the Moon with Apollo 17 (NASA EP-101)

Apollo Space Suit Gloves

Figure 4: On to Mars 3 – 2017 Rover Sample Retrieval Challenge Rules

Vehicle and Participants

To be used in the Sample Retrieval Challenge, a vehicle must be taking part in the NASA Human Exploration Rover Challenge race. Described below are the sample collection tools and container that are to be removed from the vehicle for the separate race event.

Riders/collectors can be any two (2) of the six (6) team members -- preferably non-race riders -- with at least one female rider/collector, if available. A single rider or both riders can participate in collecting and storing the samples. Cooperation is encouraged.

Note: Teams that have not completed sample collections within *10 minutes* will be asked to move off the sample retrieval course.

Sample Location

Samples will be located in four (4) individual "Frame Boxes" (5 feet long by 3 feet wide by 6 inches tall) that are sequenced around the shorter optional course near the U.S. Space & Rocket Center Amphitheater area and the Space Camp dormitories.

Samples to Be Collected

1. Soil, while collector sits *on* vehicle -- Collect greater than 1 cubic inch volume. Greater than 0.69 ounce weight.
2. Large Rock, while collector *off* vehicle -- Collect 1. Maximum volume is a cube of 4 inches on each side. Less than 5 pounds weight.
3. Liquid, while collector sits *on* vehicle -- Collect greater than 1 cubic inch volume. Greater than 0.58 oz. weight.
4. Small Rock, while collector *off* vehicle – Collect 1. Marble-sized.

Sample Collection Tool/s

Required to collect samples 1, 3 and 4.

Can be powered or unpowered.

Must be secured on the rover vehicle for travel between sample collection sites.

Sample Collection Bags

Individual, sealable bags or other holders are required for each collected sample (to minimize sample cross-contamination). Bags or holders can be stored in the Sample Container before collections and must be stored on the Rover vehicle in the Sample Container after collections. Seated collection of samples #1 and #3 may be put into the Sample Container upon reaching the next collection site.

Sample Container

The Sample Container must be located on the Rover vehicle and hold all four (4) sample collection bags. The Sample Container need not be a closed container; an open-topped container can be used, as long as samples are not able to bounce out.

Helmets, Seatbelts, Gloves, and Safety Glasses

Fastened seatbelts, helmets, and safety glasses are required for driving, and gloves provided by NASA are required for sample collections. Gloves (without tool) may be used to collect the large rock sample (Sample 2).

Scoring

Winning high school and college teams will be those teams that correctly collect and store the four (4) samples in the quickest total collection time within the allowed *10 minutes*.

If the maximum number of samples collected and correctly stored is less than four (4), then the winner will be the team that collects the greater number of 1, 2 or 3 samples in the quickest time within the *10-minute* time limit.