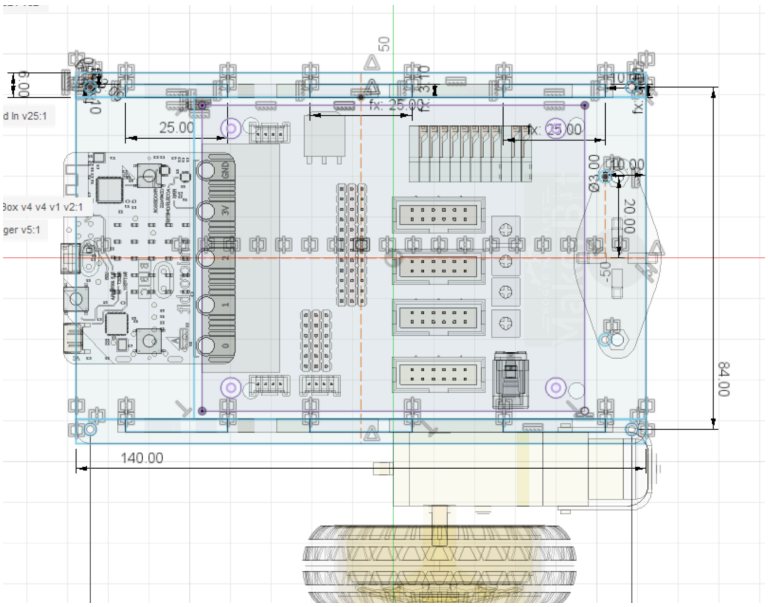
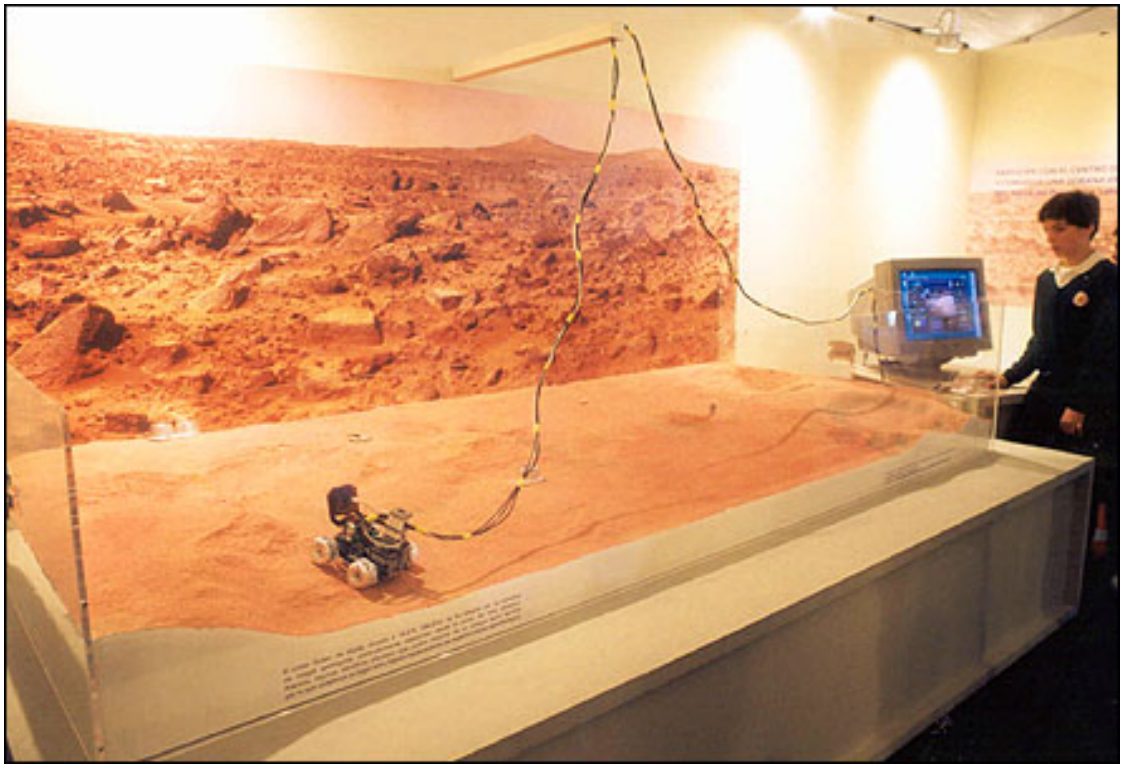
MakerBit Remotely-Operated Mars Rover

https://bit.ly/35NQ30Y

Designed by Roger Wagner, 1010 Technologies LLC



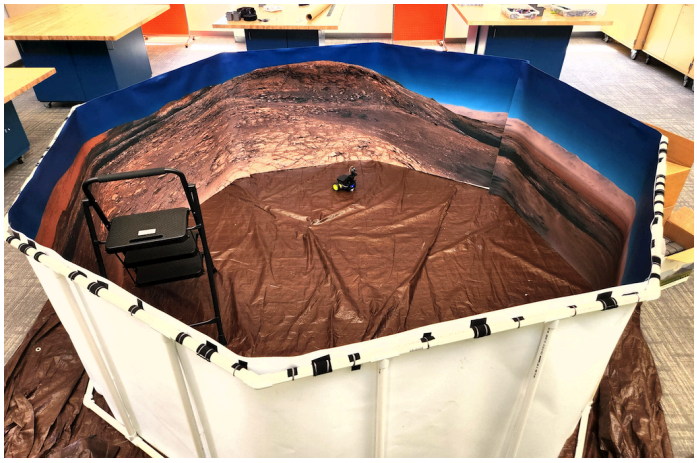


In 2001, a team of students traveled to Malin Space Science Systems to operate the camera aboard the Mars Global Surveyor mission, at that time in orbit around Mars. A year later, a different group of students worked at the Jet Propulsion Laboratory learning to operate the FIDO rover, a prototype rover designed to support upcoming NASA Mars missions. And, in early 2004, a team of Red Rover Goes to Mars Student Astronauts worked inside mission operations at the Jet Propulsion Laboratory while the Mars Exploration Rovers explored the Red Planet.

Over the next 20 years, strangely no real progress was made in this form of simulated driving of a rover on Mars.

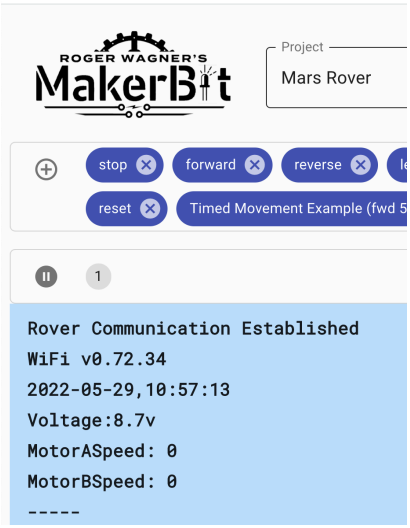
However, now, in 2023, the MakerBit Remotely-Operated Mars Rover is the first remotely-operated robotics vehicle designed to be used by students in a simulated Martian landscape. These vehicles can be used locally, or sent to another location for them to simulate a remotely-operated planetary exploration.

Among many other alternatives, and as just one example, other students anywhere in the world can control the vehicles built by the local team.



This is what the Zoom session looks like. Each student can control and receive data about an individual aspect of the vehicle and mission.

The phone provides the zoom session connection with the camera view of whatever is in front of the vehicle. The vehicle itself is connected to a local or remote controller using a WiFi connection. What's "in front of" the rover is a simulated Martian or alternate landscape seen in the photos above.



Students work in pairs, with one computer for the camera image from the rover, and the other for the data telemetry seen in the MakerBit Console window.

[Google Slides Introduction]

Preparing for the Mission

Constructing the Mars arena (in-progress draft document)

Assembling the Rover

- Construct the rover, and optionally a “twin” to use in parallel with the rover on Mars during the mission.

Pre-Flight Planning

- Start your journal. Scientists, engineers, explorers, and writers in general often keep a journal in which to make notes about their observations, data gathered, and their conclusions and reflections.

- Use the operating handbook to view the data reported in the console, making a point to understand the significance of the different types of data that are reported.

- Test out the assembled rover, and determine some good motor speeds for straight movement in the forward and reverse directions.

- Determine some good motor speeds for left and right turns. Compare moving in an arc, to a turn-in-place.

Mission: Mars Exploration

When you are satisfied with the performance of the rover, you will move it to the Mars arena, where you will complete as many of the following challenges as possible in a given amount of time.

Challenges

1. Find the center of the arena from a random starting point within the arena.
2. Can you use the distance sensor to estimate the diameter and circumference of the arena?
3. Be able to return to the center from any other point within the arena
4. Be able to predict movements of time and power settings (motors A, B) based on spreadsheets and charts created.
5. Make a linear crossing of the arena, turn 180 degrees, and return to the original location using only information available through the Console and zoom images.
    a. Points for how many cm from the starting point. Lowest score “wins”

6. Make a circular navigation of the arena, and return to the original location.
    a. Points for how many cm from the starting point. Lowest score “wins”
7. Use magnetometer to locate a magnetic source underneath the surface
8. Use pitch and roll to locate a “mound” created by a domed structure underneath the plastic surface.

Zoom Session Communication

The camera imaging and transmission is done using a Zoom session on a phone carried by the rover.

Mission Reports

After completing the Mars Mission, teams can use Google docs to write up their reflection on the experience, as well as to summarize both the performance of the rover, and the data and results that their team gathered during the mission.

Rover Disassembly

Disassemble the rover and store parts appropriately in the original containers as were provided at the beginning of the project.

About the Designer - Roger Wagner

Roger Wagner is a California-credentialed educator for physical sciences (chemistry, physics), life science (biology, natural sciences), and mathematics. He has taught in middle school, high school, adult education, and higher education. Wagner is also the author of several programming books, has been awarded a number of patents and trademarks. Perhaps best-known for creating the globally-renowned classroom hypermedia software, HyperStudio. Wagner was recently recognized with the California Computer-Using Educators (CUE) Platinum award, and has received many other awards for his work in education. Wagner has also developed a variety of different curriculum and project designs in physical computing. And his recent work has included the design and creation of microcontroller hardware boards of the HyperDuino for the Arduino, the MakerBit for the BBC micro:bit, and the MakerPort, an animatronics microcontroller for artists and students. Wagner served on the Education Committee of the Tesla Science Center at Wardenclyffe, and in 2024, served as an NSF Panelist Reviewer. Wagner has served as a business and technology advisor to NBD Nanotechnologies, and currently a business advisor to Rufus Labs. He is a private pilot (single engine land & sea, complex & high performance aircraft), licensed in the United States, Canada and Mexico.

Website: rogerwagner.com
Video: CUE Platinum Award
Terry Markwart Award for Corporate Leadership

The MakerBit Mars Rover is developed in a global collaboration with:

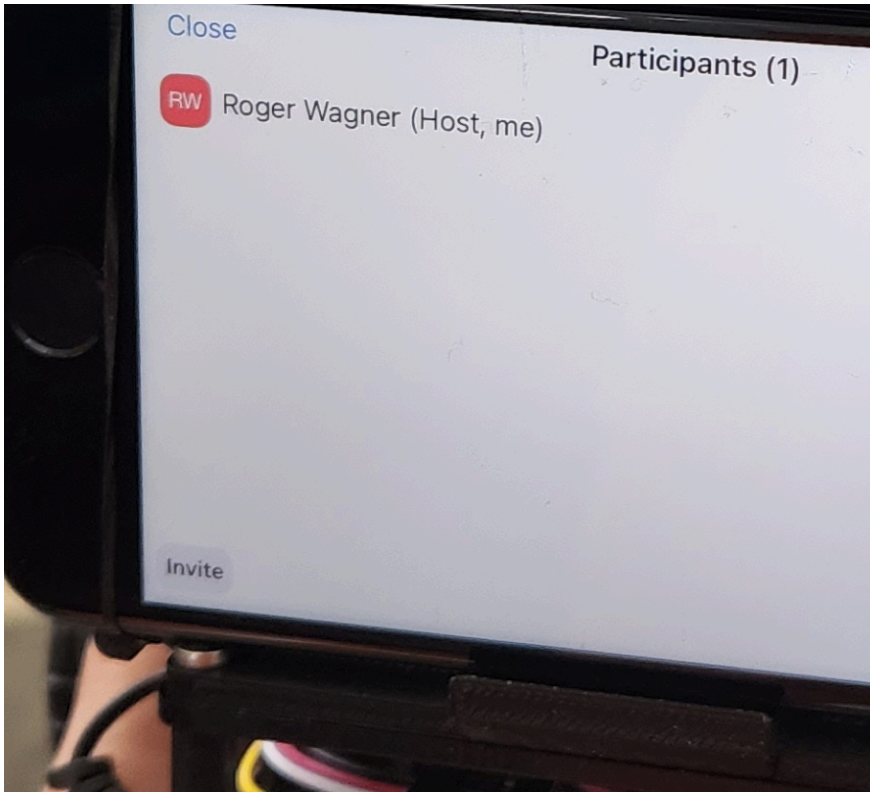
Bob Barboza, Barboza Space Center, “First School on Mars”

Henry Forsyth, design of the 3D printed and laser-cut rover vehicles
Philipp Henkel, MakerBit extensions, WiFi connectivity
Dave Klimas, board design of the MakerBit
BBC micro:bit Foundation
Microsoft, MakeCode development team

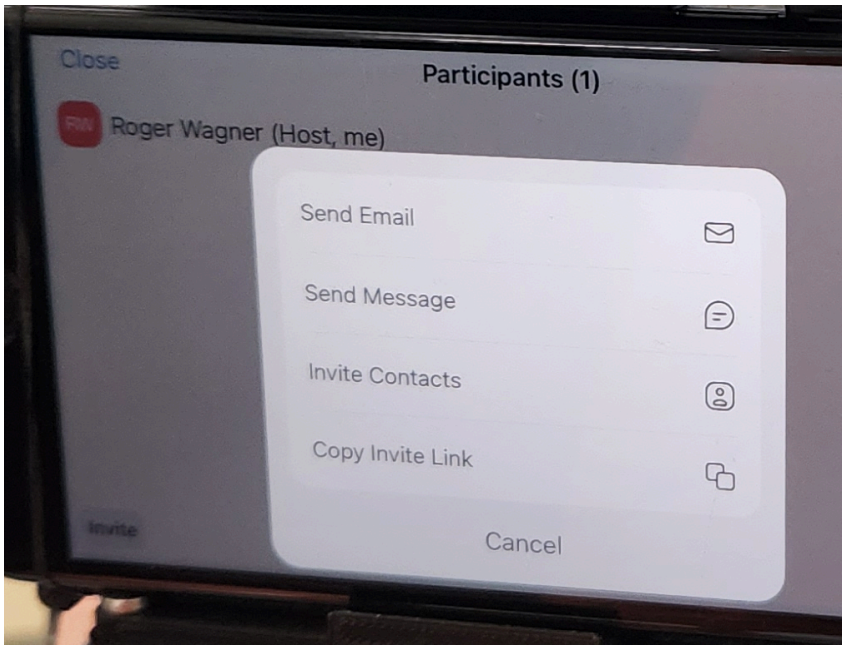
Starting a Zoom Session

Install the zoom app on the phone that will be used on the rover
Attach the phone to the phone holder on the rover using the small rubber bands.
Open the zoom app and start a new meeting
With the meeting window open, choose “Participants”

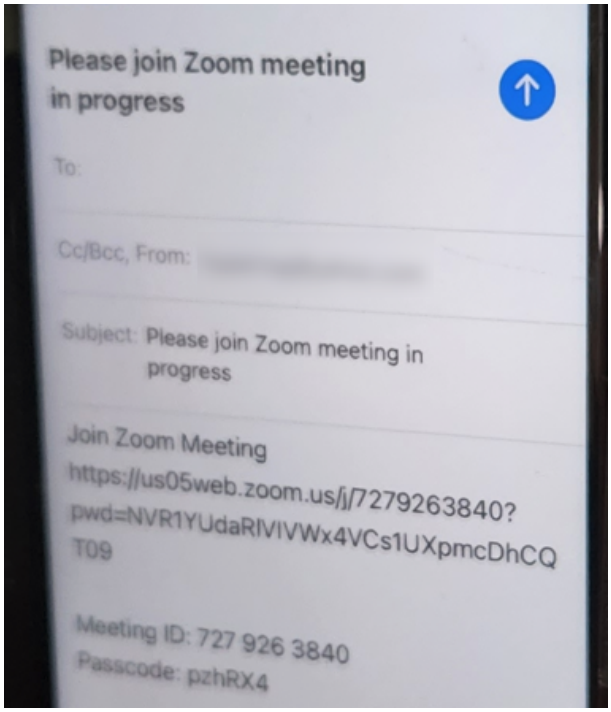
Choose “invite”



Choose “Send email”



Enter the email address of a team member who will be monitoring the camera images. Click the blue arrow to send. When they receive it, they can forward it to other teams.



Note: There is a known problem with Zoom not completing the sending of the email invitation when running on an iPhone. In that case, it will be better to write down the Meeting ID (and Passcode if needed), and use that to inform other team members.