



Copy That, CAPCOM

Objectives

Students will:

- Practice effective communication skills
- Use teamwork to engineer a physical object
- Utilize time management skills

Suggested Grade Level

3rd – 12th

Subject Areas

Science, Engineering

Timeline

45-60 minutes

Standards

- **3-5-ETS1-3** Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.
- **MS-ETS1-1** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

21st Century Essential Skills

- Collaboration and teamwork
- Communication
- Social skills
- Leadership
- Initiative
- Obtaining/evaluating/communicating ideas
- Creativity and imagination

Background

Mission Control Center (MCC) is the location that oversees crucial aspects of every U.S. human space flight. "Shuttle MCC workers only spend about 10 percent of their time controlling missions. Seventy-five percent of their time is spent planning and organizing, and 15 percent is devoted to their own training and education. For Space Station missions, the amount of real time spent on missions is considerably larger since the project runs 24 hours a day, seven days a week, 365 days a year.

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'Besides managers, Mission Control is divided into flight-control and ground-team workers,' said William Foster, an MCC ground controller. The ground team gathers data from the spacecraft and launch facilities and the flight control team then analyzes that data to make decisions on how best to proceed. 'As a team, we generate procedures, which are rules and conditions for response. We have generic procedures that are in place for every launch and mission-specific procedures that are tailored for a very specific situation. Every flight brings new situations, and sometimes we find we need to modify procedures that are already in place. It's always changing.'"

"In order to be prepared to help astronauts in any situation that could arise, MCC workers go through simulations with the astronauts and the training team. During the simulations, where workers practice responses, an unexpected event might be thrown into surprise everyone. This anomaly, called a simfault, requires fast thinking and logical responses. "A simfault could be a malfunctioning piece of equipment or it could be a major disaster situation," said Foster. "The way the workers respond shows us how we need to prepare in case the real thing should ever happen.

"If you ever see a scene from the Shuttle Mission Control Center you may notice that each console is identified with an acronym that doesn't make much sense unless you know what it stands for. Each person represented there plays a crucial role in the success of a space mission."

(Dunbar, 2009)

From the Mars Rover to the Saturn V to the Space Shuttle Discovery, space exploration requires a dedicated team on the ground to make sure the mission goes smoothly. At NASA's Mission Control, if everyone was talking to the crew members on orbit simultaneously, it would be a noisy, confusing babble. Right from the beginning of the U.S. space program, astronauts realized they needed one voice—someone they could trust—to be their relay on Earth. That person is called the Capsule Communicator, or CAPCOM. (MasterClass, 2019)

Materials

- Science Fair boards (sturdy, tri-fold boards)
- Various objects, examples include:
 - Large cups (Styrofoam or plastic)
 - Small cups (Dixie)
 - Straws
 - Popsicle sticks
 - Pipe cleaners
 - Paper plates

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Classroom Setup

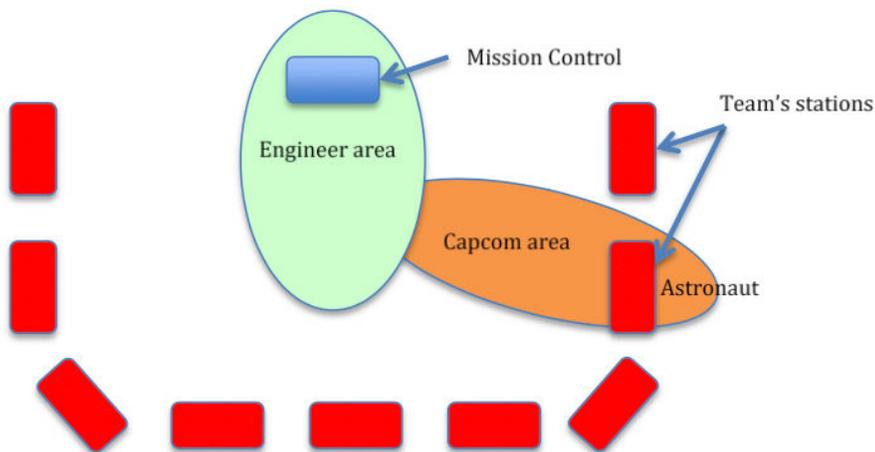
Students will be grouped in teams of three to simulate how a NASA team uses communication, attention to detail and teamwork to complete a mission. Each team member will have a specific role during the mission.

Engineer- This person will observe Mission Control's structure, in detail, and then describe that structure to CAPCOM(whispering). The Engineer is the only person that can see Mission Control's structure. Engineer is not allowed to talk to the Astronaut and not allowed outside the Engineer area (light green). Engineer must accurately describe the structure to CAPCOM.

CAPCOM- This person is in direct contact with both the Engineer and the Astronaut. CAPCOM can freely move from the Engineer to the Astronaut and be at the team's station (orange area). CAPCOM is not allowed to touch or manipulate any of the objects at their station. CAPCOM is responsible for relaying accurate information from the Engineer to the Astronaut. (The name CAPCOM originates from the missions where astronauts were in capsules. It is a shortened version of CAPsule COMMunicator.)

Astronaut- This person is the only one that can touch the objects and construct at their station. They are not allowed to leave their team's station and cannot directly communicate with the Engineer. They can only *talk* to CAPCOM. They must use the information from CAPCOM to recreate the mission control's structure.

Below is an example of classroom arrangement. Stations will be constructed around the room with Mission Control Center (teacher's station) position at the front of the class. All stations should be hidden from plain view so that it is only visible to one team.



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Lesson

1. Create a scenario where the class has encountered a problem with their astronauts in space and must save the astronauts by communicating a solution to them.
2. Explain the three roles: Engineer, Astronaut, CapCom
3. Separate the students into groups of 3, assign them to a station.
4. Hand out materials, each group gets one of every item.
5. Arrange groups so that the engineers start in the Engineering Area (green), CAPCOM in front of their station and Astronauts sitting at their station.
6. In a location hidden from direct view of the class (behind a tri-fold board or barrier), the instructor will construct a structure at the Mission Control Center (MCC) using the same materials provided to each group.
7. Instructor should allow an appropriate amount of time for groups to complete their task (for example: 5 minutes).
8. When time starts, students will then follow these steps to complete their mission of rebuilding the structure:
 - a. Engineers must observe the structure at mission control then describe that structure to CAPCOM (whispering). Engineers may go to mission control as many times as needed. Engineers may NOT talk directly to the astronaut.
 - b. CAPCOM will then relay that information to the Astronaut using only verbal communication. CAPCOM may not look at the structure the astronaut is building.
 - c. The Astronaut will then construct the structure as described by CAPCOM.
9. When time limit is reached, students must stop communicating. Have students reveal their structure and compare it to the MCC structure to see if they completed a successful mission. A successful mission is one in which the team has replicated the MCC's hidden solution (this includes the same direction, orientation, etc.)
10. Have students switch roles and repeat with a new MCC solution.
11. Switch roles one last time to ensure all students have done each of the roles.
12. Evaluate your mission. Ask students, "Was your team successful at recreating the model?" Ask, "What improvements in communication can be made?" Answers will vary.

Extensions

- Create more complex designs, add more materials, or shorten the amount of time given for students to complete each mission.
- Allow students to choose their best role and complete a 4th rotation. Discuss why they chose the role they did.

Resources

Dunbar, B. (n.d.). The People Behind the Astronauts. Retrieved from https://www.nasa.gov/audience/foreducators/k-4/features/F_People_Behind_the_Astronauts.html

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MasterClass. (2019, September 3). What Is CAPCOM? Learn How Astronauts Communicate With Mission Control on Earth - 2020. Retrieved from <https://www.masterclass.com/articles/what-is-capcom>

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