Activity Summary

This is a simulation activity in which 6 student astronauts spend the period from 0800 hrs Tuesday February 18, 2020 to 1500 hrs Saturday February 22, 2020 within the confines of a mock-up spacecraft and planetary surface within room W027 at the Albert Street Education Centre (440 Albert St., Ottawa). There also is a complement of 3 to 4 student simulators and, in the evening, a complement of 1 ro 2 student mission control staff. All activities take place within the one room. During the day (0800 to 2100 hrs) there also is a complement of 2 to 4 mission controllers who communicate with the student astronauts by voice, text, and video over a VPN from the spacesim office (room 414) at Lisgar Collegiate Institute (29 Lisgar St.). After 1600 hours, this team is supervised by an adult volunteer.

The mock-up spacecraft is a 6 m by 6 m enclosure with exterior and interior walls constructed on a steel stud frame covered by drywall and a steel joist ceiling also sheeted in drywall. The construction was carried out by a private contractor and the mains electrical system was installed by a licenced electrician employed by the school board. The planetary surface mock-up is made on a steel stud frame covered with wire mesh and Aluminum foil covered in setting drywall compound. All student activities take place on the floor of the classroom space. No part of the planetary surface mock-up intrudes into the 1 m wide egress paths around the exterior of the spacecraft mockup.

Astronaut students sleep on a shift system in which at least two astronauts are awake and carrying out duties within the spacecraft mock-up at all times. Astronauts sleep on bunks in one of the rooms within the spacecraft mockup. There are two egress routes from this room out of the spacecraft mock-up (see figure 1). There is one egress route out of room W027. A second exit from the room leads to a storage room with access to the outside through a roll-up steel door. As such, this does not qualify as a fire exit route. For this reason, the overnight use of the room is limited to 15 persons. Egress routes out of the room and the building are clearly marked.

There are no electrical outlets in the bunks. Food preparation and clean-up takes place in a separate room and makes use of a microwave oven to heat mostly pre-prepared meals. The simulation incorporates a procedure by which refuse can be removed from the mock-up regularly.

Simulator and mission control students are awake and carrying out duties during their shifts. Thus, there are at most 4 students asleep at any given time.

All activities are overseen by an adult supervisor. The supervisors work in shifts and are awake and monitoring activities at all times throughout the day and night. They do so by direct observation and over a closed network visible-light/infrared video system. All activities are pre-approved by the teacher supervisor for the simulation program and are described on a daily list for the supervisors.

The building is maintained as a continuing education centre by the Ottawa Carleton District School Board and operates with all of the normal safety systems and procedures that are part of a regular day school. There are two egress routes from the room to the exterior; both have fire extinguishers and fire alarm pull boxes along the route. Basic first aid material is present.

The room and its contents are assessed for health and safety on a regular basis by the teacher advisor and the site's chief custodian.

A more detailed description of this educational activity can be found at the end of this document and on the spacesim website: www2.spacesim.org.

Extract from OFM-TG-01-2002 Section 4: Safety Procedures (Ottawa Fire Department)

4.1 Custodians

One of the custodians is on duty at all times during the mission event. They are familiar with the school and its emergency equipment and systems.

Their regular daily duties include:

- check fire alarm system for operation
- check egress routes and exits to ensure that they are available for use and not obstructed
- check that exit lights are illuminated while the building is occupied
- check that smoke alarms and carbon monoxide alarms are in place and functional
- check that fire access routes are kept clear
- collect and remove refuse from the building

Emergency duties in event of fire or alarm

- activate the fire alarm
- call fire department
- provide access to public address system if necessary
- meet emergency responders and supervisory staff at principal entrance

4.2 Adult Supervisors

The supervisory staff will be readily identifiable to all the participants. In the event of an emergency, they have a reflective vest to identify them to emergency responders.

Regular duties

- verify that the fire wardens are on duty
- conduct a fire safety assessment in the room and corridor outside the room once per hour to include:
    - check egress routes and exits to ensure that they are available and unobstructed
    - check to ensure that there is no smoking
    - check to ensure that there are no open flames in use (candles)
- meet with the simulator fire warden at the start of the warden's shift.
- meet with the custodian to inquire about any unforeseen issues with the building

Emergency duties in event of fire or alarm

- activate the fire alarm
- ensure that evacuation has started and perform final walk-through (figure 1, §5)
- meet custodian and emergency responders at the designated assembly point after checking each student off the attendance log
- report to emergency responders of any persons that may still be in building

4.3 Student Fire Wardens

Regular daily duties

- assign a helper to any person who may need assistance to evacuate
- ensure means of egress from sleeping area is kept clear
- be aware of fire evacuation procedures
- report any fire hazards to the adult supervisor
- ensure that there is no smoking or open flames present
- communicate with the supervisor at the start of their shift

Emergency duties

- assist in evacuation of assigned sleeping area to outside collection area
- help the supervisor check off the attendance log

Extract from OFM-TG-01-2002 Section 5: Floor Plans (Ottawa Fire Department)

Figure 1) Path for final walk-through during an emergency evacuation.

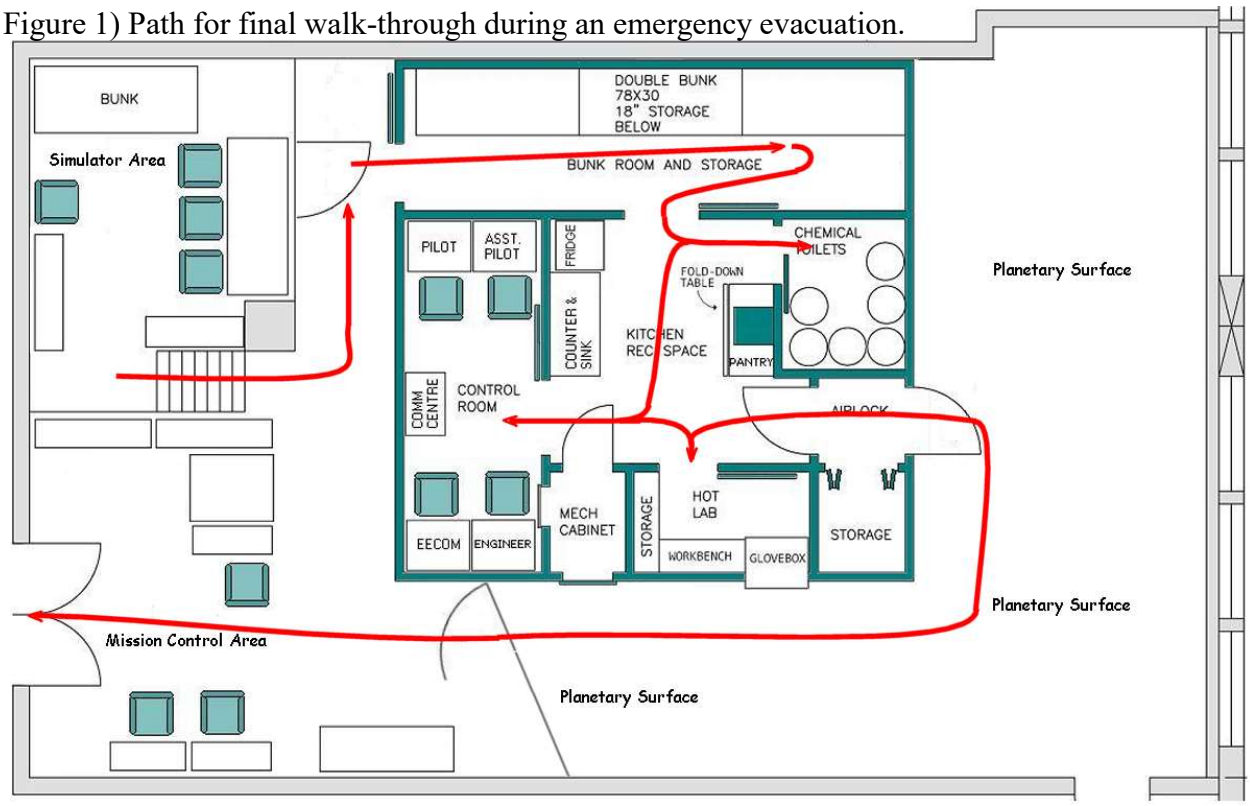
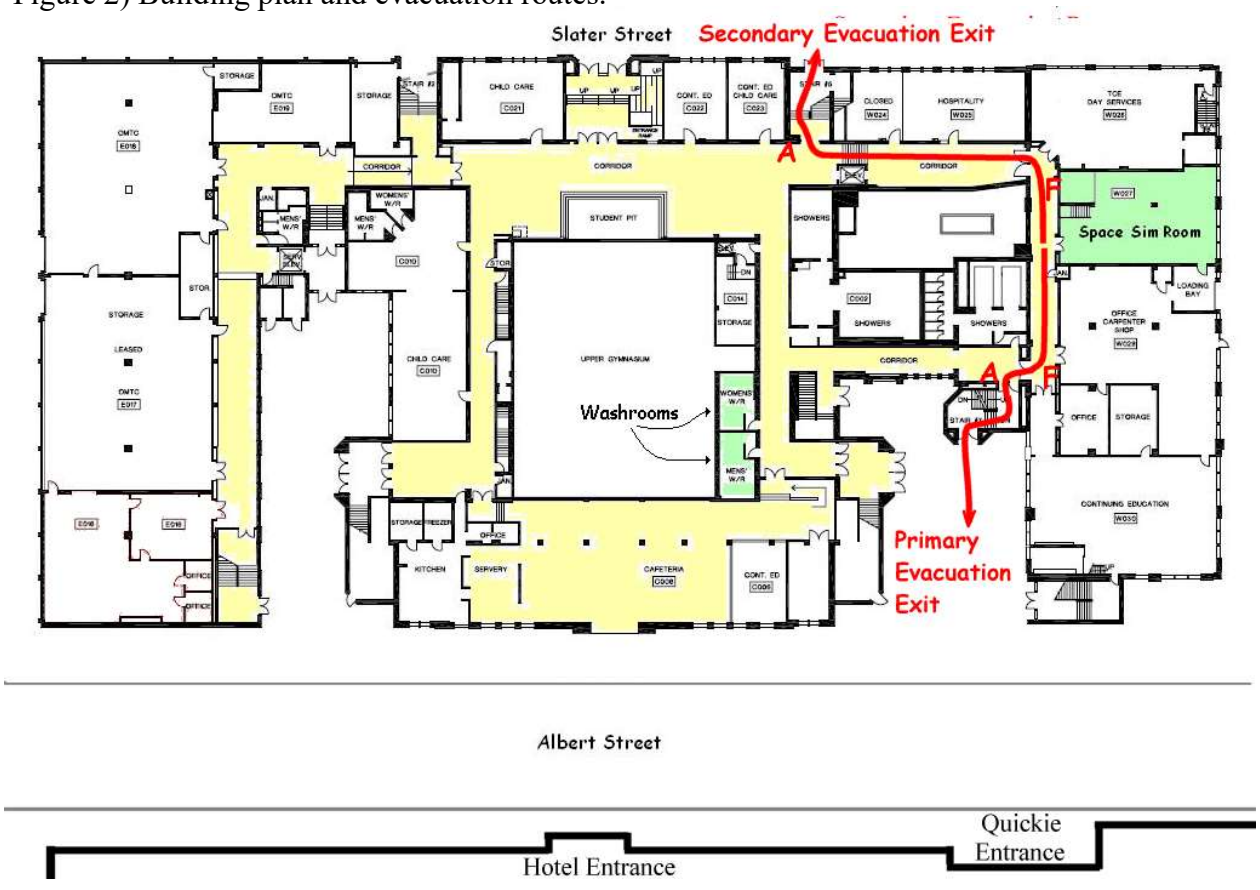


Figure 2) Building plan and evacuation routes.



Extract from OFM-TG-01-2002 Section 8: Fire Protection Equipment (Ottawa Fire Department)

Fire Protection Procedures and Equipment

A) Active monitoring.
There is an adult supervisor as well as student participants awake and monitoring the detectors and environment of the activity room at all times.

B) Smoke detectors.
Each room on the spacecraft has a battery operated smoke detector that is tested and furnished with a new battery prior to the start of the mission. The rest of room W027 outside of the spacecraft structure is integrated into the building alarm system.

C) Carbon monoxide detectors.
As the event room is not in close proximity to any service room with fuel-fired equipment, a carbon monoxide detector has not been installed in the sleeping room of the spacecraft. Should the fire prevention officer deem it advisable to have one present, one will be installed prior to the start of the activity.

D) Fire extinguishers.
Although the emergency response protocols do not involve the use of this equipment, fire extinguishers are available along each of the two emergency egress routes from the building, in close proximity to the door to the event room.

E) Fire alarm pull boxes.
There is a fire alarm pull box near the building exit along each of the two emergency egress routes.

Program and Activity Description

Our main activity each year consists of a simulated mission to another celestial object. This is a 100-hour long procedure in which 6 student astronauts spend the entire time within a mock-up of an interplanetary spacecraft in room W027 at the Albert Street site. The only time that they emerge is to explore and collect samples from a mock-up planetary surface at their destination. Other students carry out mission control duties: communicating with the astronauts through radio, closed circuit video, telemetry software, and computer text communication. They assist the astronauts in their duties, help solve emergencies as they arise, and take part in analysis and planning activities. Mission control usually is situated in the spacesim office at Lisgar Collegiate (usually 3 to 4 students), but runs from the backup MC at Albert Street during the overnight shifts (1 to 2 students). A third group of students is the simulators who build the planetary surface; cause various events, emergencies, and malfunctions; and ensures that the other two groups stay within the bounds of the simulated reality. They also work out of room W027 in the Albert St. site. The usual complement of this group is 3 to 4 students.

The simulation process has two components. The physical component consists of the spacecraft, the planetary surface, and the mission control room. The computer simulation component consists of 10 computers networked together in a private local area network, each running one part of the simulation.

Physical Simulation: spacecraft

The spacecraft structure has 6 compartments totalling 37 square metres. It is a steel stud/drywall construction with an independent plumbing system and mains electrical service. It was constructed by the school board using outside contractors. It contains all of the computer, networking, and communications equipment needed to carry out the mission. It has numerous functional and non-functional spacecraft equipment, most of which can be monitored by the simulator students. Functional equipment is integrated into the computer simulation and affects the performance of the simulation. The spacecraft also contains bunks; kitchen facilities; toilet facilities; an airlock with EVA suits; repair equipment, materials and spare parts; a lab space with equipment to collect, store, and analyse samples (all chemical analyses are simulated using safe materials); and a closed-circuit camera system used both for communications as well as for monitoring by the adult supervisor.

Physical Simulation: planetary surface

The planetary surface is constructed by the simulators through the first half of the school year in secret from the astronauts and most other students. All student members take part in the choosing of the destination based on what might be found there and what goals can be addressed by going there. They then decide what they are likely to find there, what they hope to find in detail, and what experiments they want to carry out. The simulators take all of this research and sets of goal statements and decide what their constructed planetary surface should look like, how they are going to construct it, and what items of interest it should contain.

The basic construction process is much like that which is used on a major movie set. A steel stud frame is constructed and covered with chicken wire folded into an approximation of the landforms to be built. This is covered in strips of aluminum foil coated in fast-setting sheetrock compound. Once this sets up, it is coated with more detailed structures made of sheetrock compound and pigment as well as sand, rock, mud, volcanic debris, etc. as is needed. These are patterned to mimic the geological and biological features that ought to be there. The planetary surface is larger than the interior of the spacecraft and takes an enormous amount of planning and work to pull off in time for the mission.

Example of a Planetary Surface: Mars




The primary safety features related to the planetary surface construction are that it is made of non-combustible materials, it is stable, and that none of the features block the egress paths out of the room. None of the features extend closer than 81 cm to swing path of the swinging door.

Computer-based Simulation

The computer component of the simulation is a set of in-house software applications running on a network computers that manage different aspects of the mission. These include flight software that manages the motion of celestial bodies piloting functions; engineering software that manages the simulated generators, electrical power distribution systems, and all other engineering devices; and environmental software that manages the gas pressures in each compartment as well as other environmental and consumable items. Each component affects the running of the others.

Each of these applications has counterpart applications running in mission control to monitor it. There also are applications running in the simulator section which allow the simulators to monitor the state of the simulation and enact different malfunctions and mission events.

Running the Mission

The safe execution of the mission activity results from careful construction of a mission plan. This includes a time line of events and a detailed outline of how each event is to be carried out. The mission plan is available to the adult supervisors and any specific issues that they need to watch for are communicated to them on a ***daily summary package***. The nature of the simulator events is such that they are unknown to the mission control team and astronauts before they occur. Most will involve responses specified in a set of standard operating procedures so that unforseen actions by the student crew are avoided. Those events that require the crew to improvise a response will (as is usual) involve consultation with the mission control team. This consultation is monitored by the adult supervisor to ensure that no unsafe actions are planned by the crew. The simulator team has developed a list of likely responses to each event which has been evaluated by the teacher advisor prior to the mission. This is included in the ***daily summary*** given to the simulator team and adult supervisor at the start of each day. The team and supervisor monitors the crew's response to each event to make sure that the response is one that they anticipated and to make sure that unforeseen responses are safe.