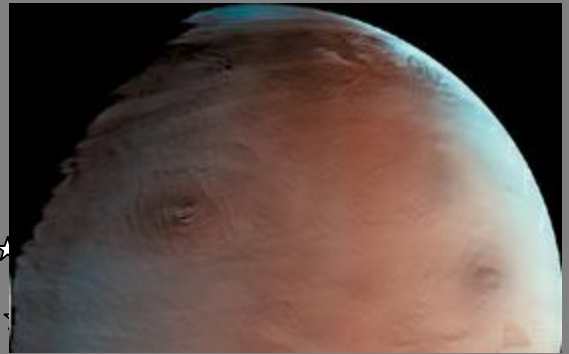


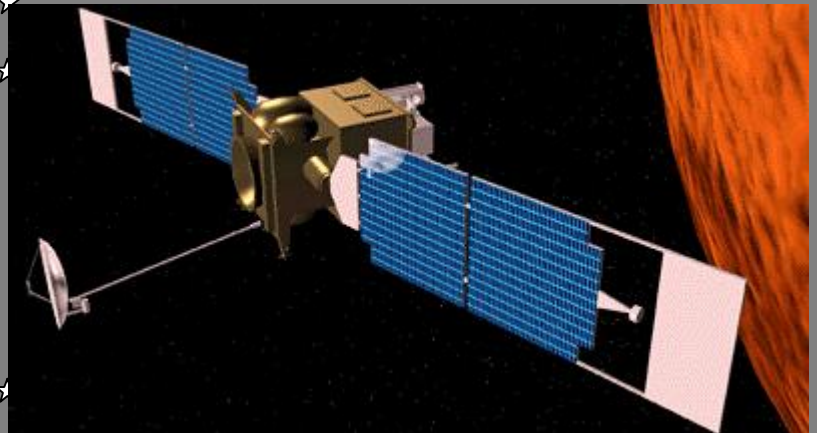
Mars and Beyond!



Mars taken by Mars Orbital Camera



Family Portrait of Jupiter's Great Red Spot and the Galilean Satellites



Mars Global Surveyor

By Nancy Wilkinson

Mars and Beyond
Lesson 12
Design Your Own Space Shuttle Crew Compartment

Objective:

Students will use measurement and proportion to design their own space shuttle living area.

Materials Needed:

Graph paper (page 65)

You might want to copy off pages 61 – 63 for student reference.

Opening Activity:

Ask the students what items they think an astronaut might want to have on the space shuttle.

Activity:

- 1) Show the picture on the page 64 of the space shuttle.
- 2) Explain that the crew compartment's volume on the space shuttle is 2,325 cubic feet. If there is 6.5 feet of height, what might the base area be? (For simplicity, the crew compartment is in the shape of a rectangular prism) ($\approx 357.69 \text{ ft}^2$)
- 3) Read the excerpt on the next page about the crew compartment on the space shuttle.
- 4) Tell the students that they are going to be able to design their own space shuttle crew compartment. It should be for seven people to go into space. They will want to make sure their design includes the following:
 - a) Food system and dining
 - b) Shuttle orbiter medical system
 - c) Radiation equipment
 - d) Crew apparel
 - e) Sleeping provisions
 - f) Personal hygiene provisions and area
 - g) Housekeeping supplies (vacuum, cleaner)
 - h) Photography equipment
 - i) Crew equipment stowage
 - j) Exercise equipment
 - k) Flight seats
 - l) Scientific study area



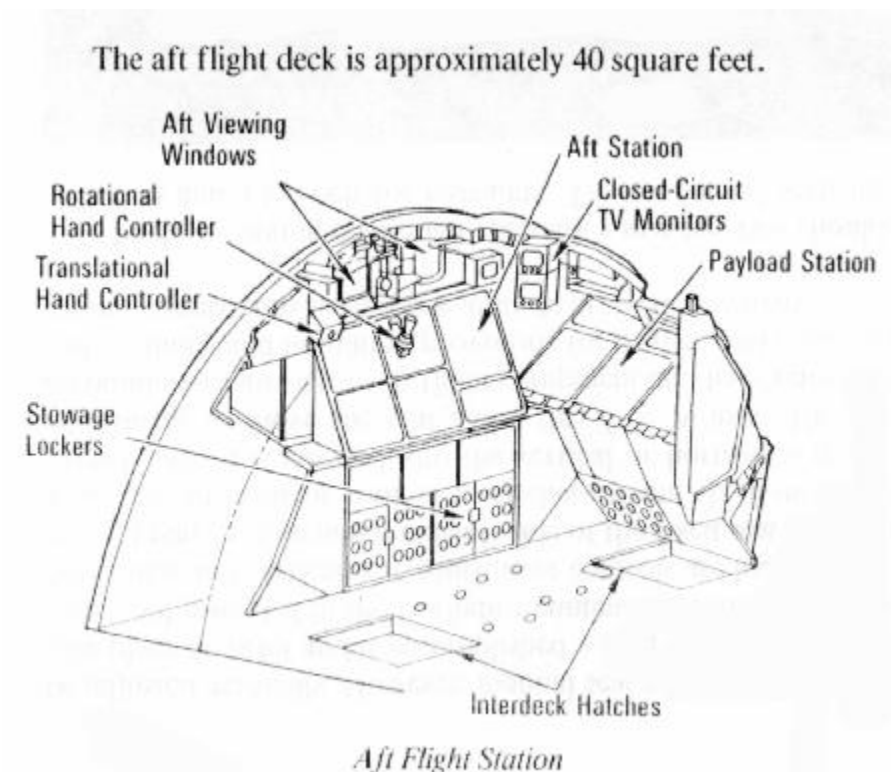
The Cassini Orbiter's mission consists of delivering a probe (called Huygens, provided by ESA) to Titan, and then remaining in orbit around Saturn for detailed studies of the planet and its rings and satellites. It was launched October 15, 1997.

Closure:

Students may share their crew compartments with the class.

About the Space Shuttle (Information taken from NASA)

The space shuttle crew compartment is in three levels and consists of 2,325 cubic feet. In the front is the where the flight seats are located. There are seven seats in all. The specialists' seats are removed and stowed in the middeck on orbit. No tools are required since the legs of each seat have quick-disconnect fittings. Each seat is 25.5 inches long, 15.5 inches wide and 11 inches high when folded for stowage.



The aft flight deck is the back part of the crew compartment. It is approximately 40 square feet.

The third section is the midsection. This is where most of the activity takes place.

There is no refrigerator or freezer for food available on board the Space Shuttle. Health and safety regulations require that all food items are precooked or otherwise processed. NASA categorizes all consumed food items into five different categories:

- 1) Rehydratable food: One way to reduce weight and preserve food longer is through dehydration. Before consumption, the removed water has to be re-added to the food item, which is otherwise hard "like a rock." Thus, each pack of dehydrated foods has a label with the exact amount of water and soaking time needed for re-hydration. For example, the label of a sausage pattie instructs to add 1 ounce of hot water and wait 3 to 5 minutes. Water is supplied by the Shuttle's fuel cells, which produce water as a byproduct of electrical power generation. Foods packaged in rehydratable containers include soups, casseroles like macaroni and cheese, appetizers such as shrimp cocktail and breakfast items like scrambled eggs.
- 2) Thermostabilized food: Thermostabilized foods are heat processed to destroy microorganisms and enzymes. Individual servings of thermostabilized foods are prepackaged for one serving and can be easily cut open after preheating. This food category includes products such as grilled chicken and ham, tomatoes and eggplants, or puddings.

- 3) Intermediate moisture foods: This term describes food items which are preserved by restricting the water available for microbial growth while retaining sufficient water to give the food a soft texture and allow it to be eaten without further preparation. Food items representing this category are dried peaches, pears and apricots, and dried beef.
- 4) Natural form foods: Food items such as nuts, granola bars and cookies are classified as natural form foods. They are ready to eat, packaged in flexible pouches and require no further processing before consumption in flight.
- 5) Irradiated meat: Beefsteak and smoked turkey are irradiated products. The meat is cooked, packaged in pouches and sterilized by exposure to ionizing radiation so that they are stable at ambient temperature.

Because many astronauts find that food tastes a little bland in space, NASA uses different condiments to spice up the food, such as catsup, mustard, mayonnaise, taco sauce and hot pepper sauce, as well as liquid salt and pepper. Most condiments come in little packages, just as offered in cafeterias. Salt and pepper are dissolved in fluids (pepper in oil, salt in water) to avoid hazards from floating pepper or salt corns.

Instead of bread, flour tortillas are used to avoid crumbs. The tortillas are stabilized by packing them in a pouch with a modified atmosphere. The tortillas are packed in an airtight container together with oxygen scavengers. The oxygen scavengers remove the oxygen from the internal atmosphere and prevent mold growth.

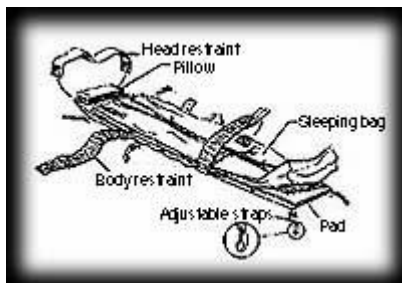
All beverages and drinks are contained in drink bags with straws. The drink bag is prefilled with powdered coffee, tea, milk or flavored instant drinks, similar to Tang! After mixing water with the powder, the beverage can be consumed by sticking a straw inside the bag. The straw has a closure in the middle, to close up the bag between sips to avoid spilling fluid drops.

On board the Space Shuttle, meals are stowed in locker trays with food packages arranged in the order they will be used. A label on the front of the locker tray lists the tray contents. A five section net restraint keeps food packages from floating out of the tray. In addition to the personal food lockers, NASA flies two pantry food lockers and a fresh food locker. The pantry food lockers contains additional food items, available to everybody on board. The crewmembers can use those items if they don't want to eat their pre-selected menu. The fresh food locker contains fresh bread, fruits and vegetables such as bananas, carrots, oranges and celery sticks. Items in the fresh food locker have to be consumed early in flight to avoid offgasing.

Once the astronauts have selected their food items for the next meal, the food is prepared in the galley located on the orbiter's middeck. The galley is a modular unit that contains a water dispenser and an oven. A hot and cold water dispenser is used to rehydrate foods, thus the dispensed water quantities can be selected in one-half ounce increments up to eight ounces. The galley oven is a forced air convection oven and used for warming foods to the proper serving temperature. The temperature of the oven is maintained at 160 to 170 degrees Fahrenheit.

Some astronauts use a meal tray to hold the food containers. The tray can be attached to an astronaut's lap by a strap or can be attached to a wall. The meal tray becomes the astronaut's dinner plate and allows them to choose from several food items at once. Conventional eating utensils are used in space. Each astronaut owns a personal set of silverware, consisting of a knife, fork, two spoons (large and small) and a pair of scissors to open up the pouches and packages. Following the meal, the empty containers are discarded in the trash compartment below the middeck floor. Eating utensils and food trays are cleaned at the hygiene station with premoistened towelettes.

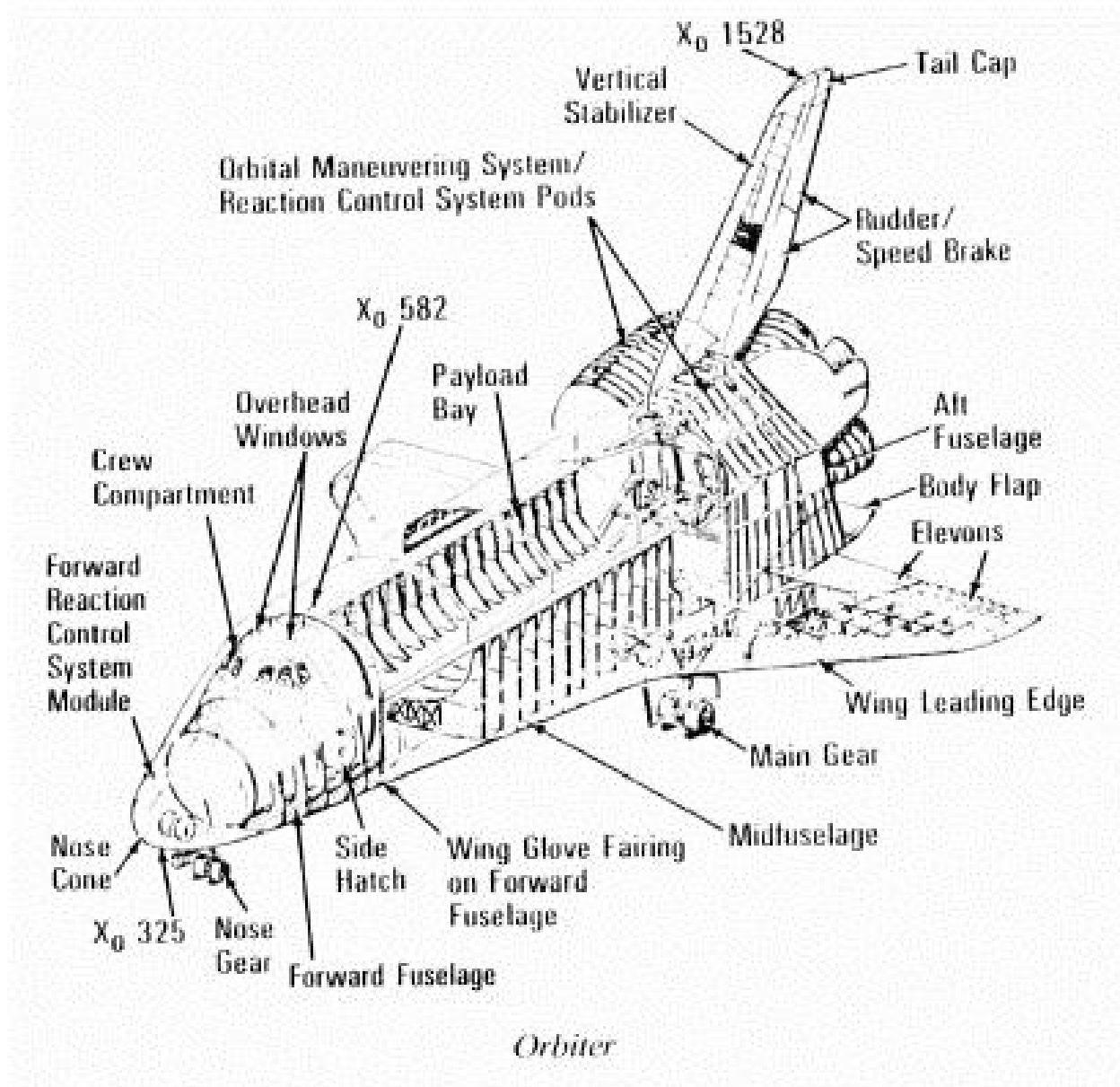
There are no beds on board the Space Shuttle. Astronauts are using sleeping bags to restrain themselves during the sleep period. Restraining is necessary to avoid floating around. Cabin fans circulate the air inside the crew compartment of the Space Shuttle, and if the astronauts were free-floating, they might float along with the air current and bump into other people or accidentally bump critical switches.



There is one sleeping bag for each crewmember. The sleeping bag itself is attached to a flexible support pad by two zippers. Two adjustable elastic straps are used to restrain the body in the bag. The straps pull the astronaut against the support pad and the Shuttle's wall, which applies a pressure to the back similar to sleeping on a mattress. A removable pillow is attached to the upper end of the support pad and a head restraint is available to pull the head into the pillow. This is done to simulate gravity, and many astronauts use the head restraint in the first few days on orbit until they adapt to sleeping in microgravity. A double zipper permits the astronaut to open the bag from the bottom to the top for easy access. Also, the sleeping bag has an armhole on each side to stick the arms out of the bag if desired. Besides the sleeping bag, each crewmember has a personal sleep kit on board, which contains eyeshades and ear plugs to shut out disturbing light and noises generated by the numerous fans, pumps and equipment inside the Shuttle.



Space Shuttle Orbiter Columbia



Each Square represents 1 square foot

