Challenge #1: Getting into Space
- To escape the Earth’s gravity, rockets must be used to reach high speeds 11.2km/s or 40,320km/h
- Acceleration speeds must be carefully calculated based on weight so that there is not too much vibration or gravitational pull on the shuttle and astronauts
- Then they must reach the perfect speed (at an altitude of 242 km above Earth, orbital velocity is about 27,400km/h) to stay in orbit

Fuel
- There is a reaction between the fuel and oxygen
- Almost all of the fuel is used to overcome the pull of gravity during the launch
- Once in orbit, fuel is only used for short spurts to alter course
- Nuclear energy can also be used
  - Advantages: a small amount produces enormous amounts of energy
    - Less fuel means more cargo, faster traveling and lower cost
    - Can cut the time it takes to get to Mars in half (From 8 months to 4 months)
  - Disadvantages: If an explosion occurred at a launch site, everything around it would be covered with nuclear material

Challenge #2: Living in Anti-gravity
- Things in space are in continuous free fall (like on a rollercoaster) and so things inside them have a feeling of weightlessness, even though the pull of gravity inside the ISS is only slightly less than at Earth’s surface
- Microgravity environment: an environment in which objects behave as though there is little gravity affecting them
- Everything must be secured
Health Effects

- Things in our bodies require gravity to assist in their function
- About 50% of astronauts experience dizziness, disorientation, and nausea during the first few days of exposure to microgravity
- Blood pools in the upper body - can cause dehydration (puffy face)
- Muscle atrophy - bird legs
  - They must exercise at least 2 hours a day to prevent muscle atrophy
- Bone loss - lose up to 2% per month
  - This makes space the perfect place to study osteoporosis (causes a loss of bone mass - ¼ women and 1/8 men over age 50 suffer
  - Studies can be conducted more quickly and less expensively than on Earth
- Radiation from the Sun - space vehicles must have special protective shields
  - There is no atmosphere to protect them

Challenge #3: Water and Food

Water:
- Every drop of water is recycled (from water vapour to urine) through a water-purifying system
- Astronauts use special soap and shampoo that do not require the use of water

Food:
- Currently, astronauts enter their mission with all the food they'll require for the duration of the trip

Humans on Mars

- Human-occupied spacecraft have landed on the Moon
- The next step is to safely land humans on the Moon to set up a permanent lunar base and then land on a nearby planet (e.g. Mars)
- The cooperation of many governments, businesses, scientists, engineers, and health care professionals will be required
- The long trip to Mars will be one of the biggest challenges
  - The spacecraft needs enough fuel for the ship plus food and water for the crew during the journey
  - A second robotic craft with supplies would have to safely land on Mars before the astronauts arrive
Space Junk

- Because so many countries have launched satellites, space probes, and telescopes into orbit since the 1950s, some of this technology becomes waste that stays in space
- **Space junk** is debris from artificial objects that orbits Earth
  - Can also be tools or other materials that astronauts have accidentally misplaced
- Space junk travels at speeds of 40,000km/h and can damage satellites or the ISS orbiting Earth
- When space shuttles launch, they have to avoid hitting the floating junk

Homework: Read Pg. 419-425
Pg. 425 #1,3,5,6,8,10