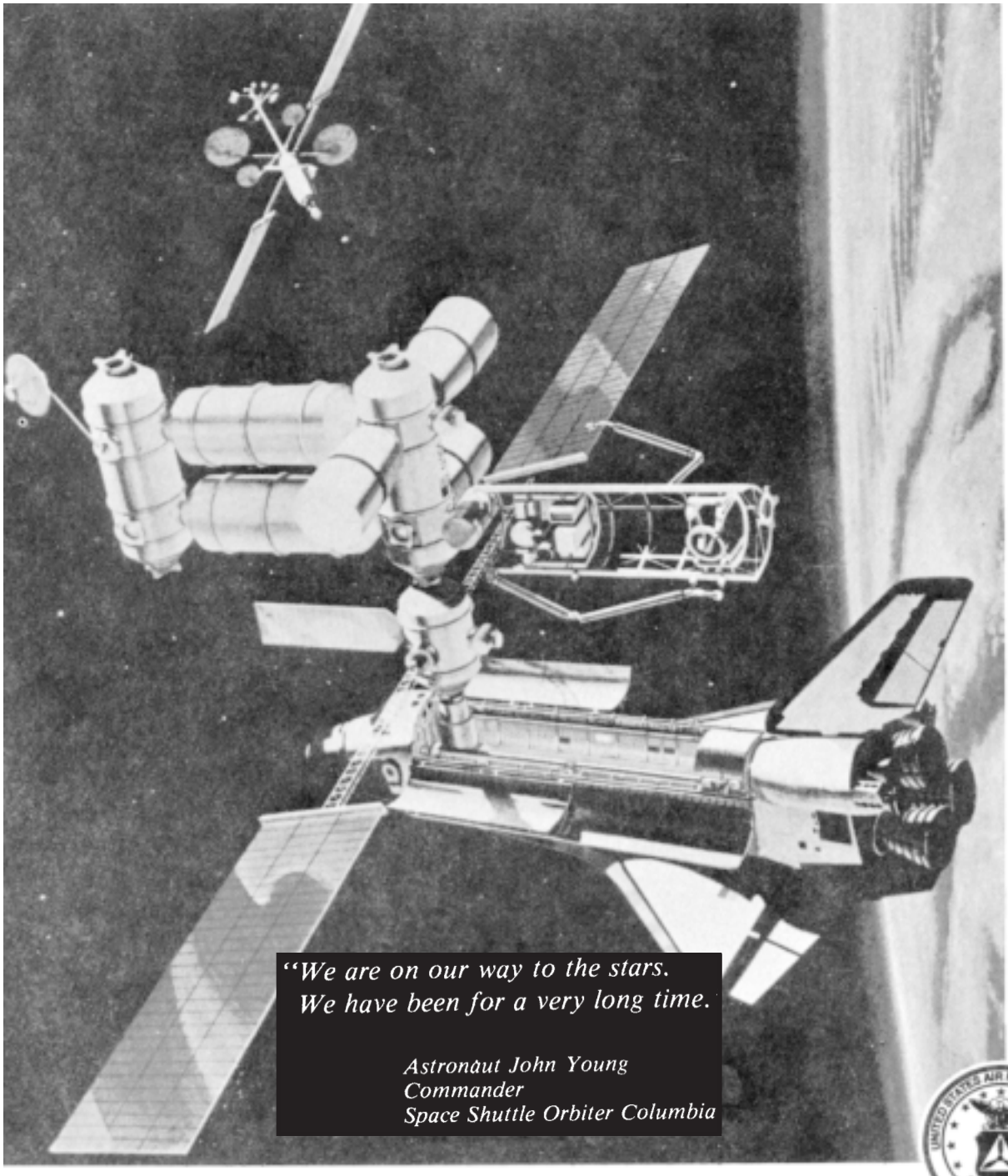
SPACE SHUTTLE

A SPACE TRANSPORTATION SYSTEM



SPACE SHUTTLE

LEARNING PACKET

REPRINT
1997

Published by

NATIONAL HEADQUARTERS
CIVIL AIR PATROL
MAXWELL AFB, ALABAMA

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INTRODUCTION

The space program of the United States began with the passage of the National Aeronautics and Space Act on October 1, 1958. The military had been doing work on rockets and satellites prior to 1958.

The National Aeronautics and Space Act of 1958 established the National Aeronautics and Space Administration (NASA). NASA is the civilian agency administering our nation's space exploration program and is responsible for the civilian space program. The Department of Defense (DOD) is responsible for the space activities necessary for our national defense.

Our space program has led us to manned moon landings and the unmanned exploration of the planets. It has gathered new scientific knowledge, developed vast new technology, and has applied this new knowledge and technology to the improvement of the quality of life for all mankind.

Our space program entered a new era with the development of the Space Shuttle and its ability to transport a variety of payloads into orbit about the Earth. The Space Shuttle is launched from Earth like a rocket and delivers a manned spacecraft into orbit. After the crew performs their mission, the manned spacecraft then glides back to Earth and lands on a runway. This rocket-orbiter-glider can be reused at least 100 times.

The Space Shuttle is designed to reduce costs and, by its versatility and reusability, open the door to the economic and routine use of space. It is providing space travel with the workhorse capabilities of carriers such as trucks, ships, and airplanes and will be as important to our future in space as the earthbound carriers of today are to the economic life of our country. Experience has shown that mankind is the most flexible and reliable system to go into space. The Space Shuttle is designed to take advantage of this flexibility and use the best characteristics of machines to provide an efficient system for routine space operations.

This aerospace education learning packet contains information about the Space Shuttle and accomplishes the broad learning objectives by using a series of visual displays and learning activities. It provides for an understanding of the Space Shuttle as an important space effort during the last quarter of the twentieth century. Additionally, it explains the unique capabilities of the Space Shuttle. Finally, it discusses some of the proposed uses of the Space Shuttle including international programs. This learning packet provides information in narrative form on the Space Shuttle vehicle, crew, and mission. The students' knowledge will be reinforced as the various task cards are completed and the accompanying visual displays are studied.

The learning packet includes a text to assist you, plus posters and task cards for the students. When the posters are displayed, they will help to motivate the students as well as provide information as each task card is completed. The 20 task cards are study- and activity-oriented. Each card provides information and instructions for completing a related activity. Subjects covered include mathematics, science, reading, geography, health, language, speech, spelling, social studies, music, art, values clarification, and careers. These nonsequential enrichment activities free you from additional research.

Also included are a recommended teaching method; a short text that covers the Space Shuttle vehicle, crew, and mission; a materials list; suggestions for evaluating student activities; a test with a test key; an aerospace education achievement award; a student record sheet; and sheets of poster art.

The recommended teaching method is a list of steps you can take to guide your students along the path toward successful completion of the entire learning packet. This is only one route. You may diverge from the path as you see fit and use your academic discretion to achieve the desired learning outcome. The materials list tells you what is required to complete each of the tasks. This list will allow you to gather all the materials necessary for the activities. A list of suggestions is provided which you may find useful in evaluating the work done by your students as they progress through the tasks.

If you wish, you may use the test and test key as a pretest before your students begin work on their first task. After all tasks have been finished, it may be used again as a posttest to identify gained knowledge. If you use the test, a block is provided on the student record sheet for the scores and dates administered.

The blank aerospace education achievement award may be copied on the school's duplicating machine and used at your discretion. The students' record sheets give you and your students a record of their progress through the learning process. Students will enter start and finish dates for each of the tasks and will, in return, expect your initialed acceptance of that work in the block provided for your initials plus any comments necessary.

TEACHING METHOD

PREPARATION:

- Cut each task card along the dashed line and glue to a piece of card stock.

  — A student may accomplish this job.
  — The cards will last longer if they are laminated in plastic.

- Provide materials and supplies in a designated place.

  — Materials list is included.

- Display the enclosed posters (artwork) on a bulletin board where they will be visible and can serve as a source of information.

- Make two tagboard packets and label them SELECT and FINISHED.

  — With this organization, there is less chance of loss. Also, you can quickly see if the cards are being used.

- Write or type the following directions on a 3 X 5 card and tack in between the two tagboard packets.

> **DIRECTIONS**
>
> 1. Take a task card from the SELECT packet.
> 2. Enter the date on your record sheet when you start the task.
>
> **AFTER YOU HAVE FINISHED EACH TASK**
>
> 1. Enter the date on your record sheet.
> 2. Place your finished work in your folder.
> 3. Place the task card in the FINISHED packet.

- Prepare a personalized folder for each student.

- Provide a copy of the student record sheet for each student.

PRESENTATION:

- Introduce the bulletin board materials.

  — Explain the information that is provided as part of the display.

- Instruct the students on:

  — The text.
  — How to use the task cards.
  — Where the materials are located.

- Instruct the students to select the task cards in the order of their choice. (Or, at your discretion, assign task cards.)

- Hand out personalized folders and copies of students' record sheets.

  — Explain how to fill out the record sheets.
  — Assign a location for the folders.

- Administer the pretest before the students begin their activities.

  — The test key is included.
  — Record the scores on the students' record sheets.

- Tell students when you will meet again.

NOTE: If small groups will be doing the tasks, it is beneficial to have heterogeneous groups with a stronger reader assigned to a weaker reader.

EVALUATION

- Have students bring in their folders during individualized instruction or reading time, conference time, or at some other acceptable time.

- Go over assignments, and initial students' record sheets.

  — Unacceptable work should be returned for reaccomplishment, completion, or proofreading. Make appropriate comments on the students' record sheets.

- Meet with small groups to evaluate and schedule future plans (skits, etc.). Initial acceptance when appropriate.

  — Students may monitor and accept assignments but only with your permission.

- Administer the posttest and record the scores on the students' record sheets.

- Award certificates of achievement to students who have satisfactorily completed the activities given on the task cards and who have shown a gain in knowledge of the Space Shuttle.

SPACE SHUTTLE - A SPACE TRANSPORTATION SYSTEM

SPACE SHUTTLE VEHICLE

The Space Shuttle is a three-part vehicle which has an Orbiter, a liquid propellant external fuel tank, and two solid fuel rocket boosters. The Orbiter, which resembles an airliner, carries the crew and payload to and from orbit. The rest of the system is required to launch the Orbiter into space. The Space Shuttle differs from earlier space vehicles in that the Orbiter and the solid fuel rocket boosters are reusable. Only the external fuel tank is expended on each launch. The assembled Space Shuttle weighs about 4,500,000 pounds at liftoff.

ORBITER

The Space Shuttle fleet is made up of four Orbiters. Selected from sea vessels used in world exploration, the names of the first orbiting Space Shuttle craft are Columbia, Challenger, Discovery, and Atlantis. The Orbiter is a winged spacecraft 122 feet long, 57 feet high, 78-foot wingspan, and has an empty weight of 168,000 to 175,000 pounds. It is about the size and general shape of a DC-9 commercial airliner.

The crew is carried in a two-level cabin in the front section of the Orbiter. The upper level, or flight deck, provides seating for the crew plus all the controls and displays to be used by the crew during the flight. The lower level of the cabin contains passenger seats, the dining area, toilet facilities, sleeping quarters, an air lock, and equipment storage compartments.

The middle section of the Orbiter is a large payload bay equipped to carry and handle a variety of payloads. The payload bay is 15 feet wide and 60 feet long and can carry up to 65,000 pounds into orbit and return 32,000 pounds from orbit. It is flexible enough to provide accommodations for unmanned spacecraft in a variety of shapes and sizes and for fully equipped scientific laboratories, such as the spacelab and modules for space stations.

The rear of the Orbiter consists of various liquid fuel rocket engines. Among these are the three main propulsion engines which are used during launch to carry the Orbiter into space. Each main engine can produce 383,900 pounds of thrust at sea level and 470,000 pounds in the vacuum of space. One unique feature of the Space Shuttle is that the propellants for the main propulsion engines are not carried in the Orbiter but in the external fuel tank underneath the Orbiter. The Orbiter also has orbital maneuvering engines which are used to place it into a precise orbit, maneuver it while in orbit, and function as retrorockets to slow the Orbiter down for reentry and return to Earth from orbit. The propellants for the maneuvering engines are carried in the Orbiter. The complex Orbiter is designed to last for at least 100 flights.

SOLID FUEL ROCKET BOOSTERS

For launch there are two large solid fuel rockets attached to the external fuel tank. These two rockets are ignited at launch and continue to burn for about two minutes. At an altitude of about 27 miles the solid fuel rocket boosters are jettisoned and parachuted into the ocean. They are recovered and reused.

Each solid fuel rocket booster is 12.2 feet in diameter and 149.1 feet high. They each weigh 1,300,000 pounds and produce 2,658,000 pounds of thrust. The propellant is a mixture of aluminum powder, aluminum perchlorate powder, and iron oxide catalyst, held together with a polymer binder.

EXTERNAL FUEL TANK

The external fuel tank is 28.6 feet in diameter, 154 feet long, and weighs a total of 1,667,677 pounds at liftoff. It contains 140,000 gallons of liquid hydrogen fuel and 380,000 gallons of liquid oxygen which are burned in the Orbiter's three main propulsion engines.

The main propulsion engines burn for about 8 minutes, consuming the usable propellants in the external fuel tank. The external fuel tank is jettisoned at an altitude of about 70 miles while traveling over 17,500 miles per hour. It will fall into an uninhabited stretch of the ocean and is the only part of the Space Shuttle system which is not recovered for reuse.

The two solid fuel rocket boosters and the three main engines on the Orbiter provide a total liftoff thrust of almost 6,500,000 pounds.

The Space Shuttle is launched like a rocket, and in orbit it operates like a spacecraft. When returning to Earth and upon entry into the atmosphere, it sails back like a glider and lands at a designated ground location.

The high cargo capability and major component reusability of the Space Shuttle make it a very economical space vehicle.

SPACE SHUTTLE CREW

The usual Space Shuttle crew consists of two astronauts who operate the Orbiter and carry out the flight plan, the commander and pilot, one or more mission specialist astronauts, up to four payload specialists, and one or more space flight participants (such as the teacher/journalist in space program). A total of eight persons may fly on any one mission.

COMMANDER

The commander commands the flight and is responsible for the Orbiter operations, all personnel, and crew safety. The commander is skilled in all phases of vehicle flight and is knowledgeable of payload and payload systems.

PILOT

The pilot is second in command and equivalent to the commander in skill. The pilot is the second crew member for Extravehicular Activity (EVA). EVA is any activity taking place outside the Space Shuttle.

MISSION SPECIALIST

The mission specialist astronauts operate the Orbiter systems and support payload operations. Skilled in payload and equipment operations and with a knowledge of the orbiter and payload systems, this astronaut is the prime crew member for EVA operations.

PAYLOAD SPECIALIST

The payload specialist is skilled in payload and experiment operations and has detailed knowledge of payload instruments, objectives, and supporting equipment. Payload specialists are not career astronauts. They are scientists or technicians who go into orbit on a particular mission to operate their own experiments and those of their colleagues. Payload specialists may be selected to fly on more than one mission, but there are no plans to create a permanent corps of payload specialists. There are certain missions on which payload specialists may not be carried.

SPACE FLIGHT PARTICIPANTS

The space flight participants represent citizens in space, such as teachers, writers, musicians, and poets who will be able to communicate their feelings of space travel to the millions who have not had a similar experience.

SPACE SHUTTLE MISSION

The Space Shuttle is not designed to accomplish a single mission as were our previous manned spacecraft. The Space Shuttle has many missions. It can carry a number of different payloads (military and civilian) of various shapes, sizes, and complexities. The Space Shuttle functions as a space truck to haul payloads into space, repair satellites in space, or return payloads from space to Earth. The Space Shuttle's versatility makes it easy to discuss its mission.

In the Space Shuttle program, the National Aeronautics and Space Administration (NASA) becomes a vendor offering a carrier service to organizations interested in using space for some purpose. NASA will establish rates depending on the size, weight, and complexity of the payload and will guarantee delivery into space. The customer will have to adhere to strict requirements for power, payload dimension, and safety. Once arrangements are made, the customer will be given space on a particular flight and must deliver the payload and any required special support equipment to the launch site at a specific time. All Space Shuttle missions have the common elements of launch, orbit, reentry, landing, and turnaround.

LAUNCH

Space Shuttle missions are launched from the Kennedy Space Center (KSC) in Florida and from Vandenberg Air Force Base (VAFB) in California. There are two launch sites because some of the Space Shuttle missions will place the Orbiter into a polar orbit where it will travel north and south over the poles. The VAFB site allows a southward launch without the Space Shuttle traveling over any land masses. The KSC site is used to launch those Space Shuttle flights that will place the Orbiter into an equatorial orbit.

The Space Shuttle rockets from the launch pad to an altitude of about 27 miles with both the solid fuel rocket boosters and the main propulsion engines firing. The solid fuel rocket boosters are then jettisoned and parachuted into the ocean for recovery. The main propulsion engines continue to burn, carrying the Orbiter to an altitude of about 70 miles. When the propellants in the external fuel tank are expended, the tank is released and the Orbiter maneuvering engines ignite and carry the Orbiter into orbit. Once in orbit, the Orbiter's flight altitude is maintained by the firing of small rockets. These rockets are part of the craft's reaction control system.

ORBIT

In Earth orbit, the Space Shuttle delivers a payload, services satellites already in orbit, or retrieves a payload from orbit. Delivering a payload into Earth orbit is the Space Shuttle's primary mission. The payload may be a satellite, spacelab, or module for a space station.

The science and engineering experiments flown aboard early Space Shuttles suggest the great potential of the Orbiter as a platform for scientific and applications research and the benefits of routine access to Earth orbit. The payloads have been NASA sponsored, getaway special canisters, and cooperative international projects. They span the scientific disciplines, and they include experiments from the private sector, commercial concerns, students, and foreign governments.

NASA's Office of Space and Terrestrial Applications sponsored the first scientific and applications payload, which flew on the second Space Shuttle mission, Space Transportation System (STS-2), in November 1981. The payload was a set of instruments that involved remote sensing of land resources, atmospheric phenomena, and ocean conditions.

The first Office of Space Science package of experiments flew on STS-3 in March 1982. The package of eight experiments was mounted on a pallet in the Orbiter's cargo bay. Six studied the interaction of the Orbiter with its environment, trapped meteoroids, and monitored the buildup of contaminants in the cargo bay. Two were solar experiments. A ninth in the crew cabin was a miniature terrarium called plant growth unit which studied the effects of weightlessness on plants.

The Shuttle Student Involvement Project is a competition to give secondary school students opportunities to develop payload experiments suitable for flight aboard the Shuttle. Each winning student has a NASA scientist and corporate sponsor who give advice and instructions on readying experiments for flight.

Payload assignments are given to Shuttle flights as the experiments are ready and payload space is available. The first student project to fly, *Insects in Flight Motion Study,* was on STS-3. Many more have flown since, and many more will fly in the future.

Getaway specials, small self-contained payloads, are low-cost experiments flown in canisters. Scheduled for flight on a space-available basis, they are available to educational organizations, industry, individuals, and governments. There are no stringent requirements, but the canister must meet safety criteria and the experiment must have a scientific or technological objective. A test canister was flown on STS-3. The first operational getaway special flew on STS-4 during June and July 1982. The canister held nine experiments designed by Utah State University students. Later an ant colony experiment developed by Camden, New Jersey, high school students was flown. A number of other similar experiments have flown and many more will fly in the future.

The first operational flight of the Space Transportation System (STS-5) was in November 1982. It deployed two communications satellites from the cargo bay into low-Earth orbit. Numerous satellites have been deployed by subsequent Space Shuttle flights.

Servicing in-orbit satellites was demonstrated during mission 51-I when Astronauts Fisher and vanHoften repaired the $85 million Leasat Communication Satellite as the Orbiter Discovery circled the Earth at an altitude of 200 miles.

During mission 51-A, in addition to the Canadian Anik D2 and the U.S. Navy Syncom 4-1 communication satellite being deployed, Mission Specialist Astronauts Allen and Gardner retrieved the two satellites Palapa and Westar from orbit. With the two satellites clamped down in the cargo bay, Discovery brought the first two salvaged satellites back to Earth for repair.

REENTRY

Following its orbital mission, the Orbiter maneuvering engines are fired as retrorockets to slow the Orbiter down. As the Orbiter reenters the Earth's atmosphere, the crew flies it like a glider with the nose high so that the tremendous heat of reentry occurs all along the bottom surface. The bottom surface, the leading edges of the wings and tail, and the nose of the Orbiter are all covered with materials to protect it from temperatures between 650 and 2600 degrees. The Orbiter is slowing down while it is plunging through the atmosphere.

LANDING

Preparations are begun for the approach and landing at an altitude of about 130,000 feet and while traveling over 5,000 miles per hour. Various electronic navigational aids are used to ensure a safe landing. A long runway like those found at large airports has been prepared at Kennedy Space Center and Edwards Air Force Base. The Orbiter glides down at almost 200 miles per hour, lowers the landing gear, and lands like an airplane.

TURNAROUND

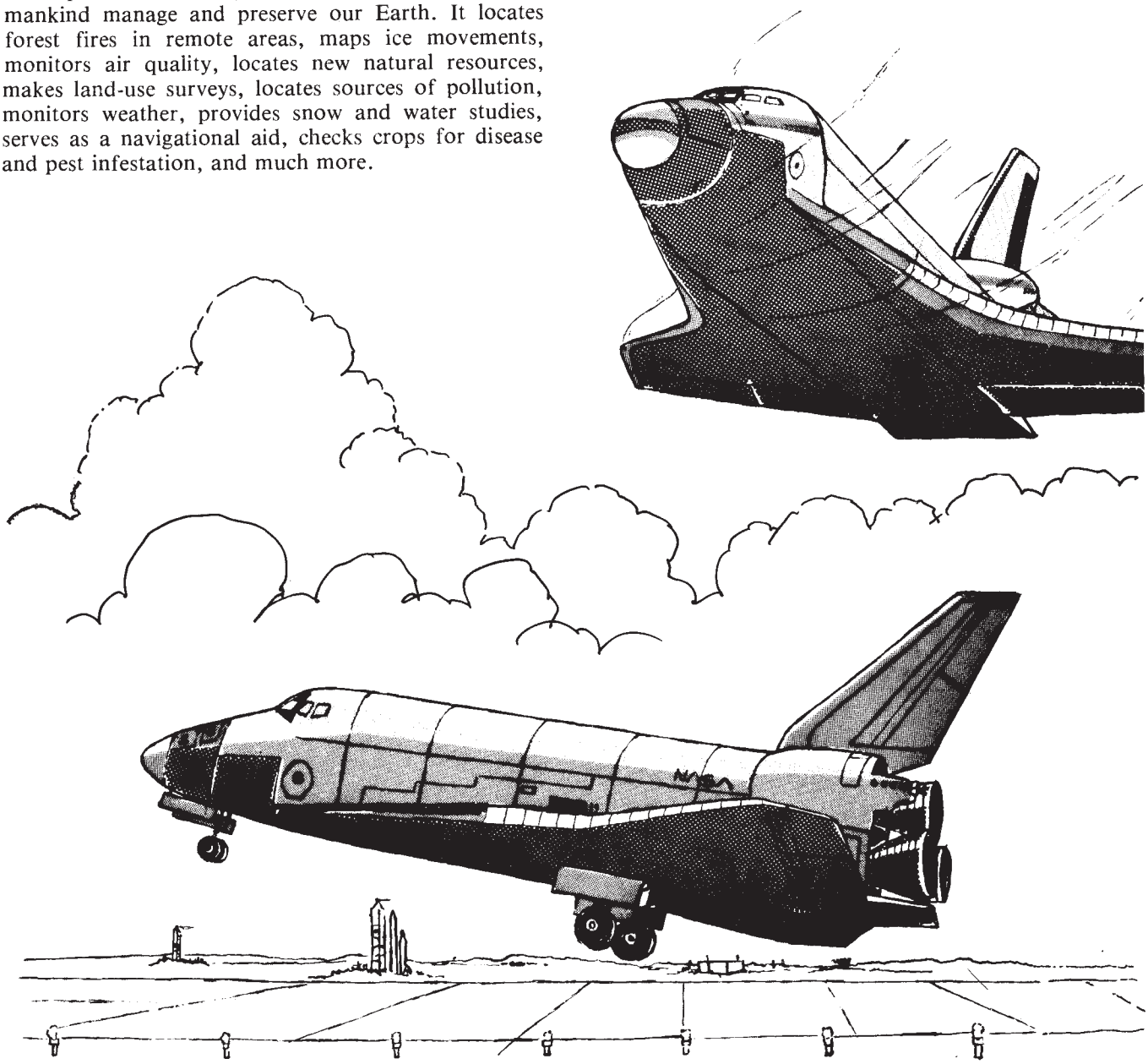
The Space Shuttle is designed to permit the Orbiter to be reconditioned and ready for another mission in 14 days. After the Orbiter lands, the crew is removed, a safety in-

spection is made, and it is towed into a "hangar" where refurbishing takes place. If a satellite is returned from orbit, it is removed. The heat shields are refurbished and all systems are checked and repaired as necessary. A new payload is installed in the cargo bay, the landing gear is retracted, and the Orbiter is rotated to a vertical position. The Orbiter is then lifted onto the launch platform and connected to the external fuel tank and the solid fuel rocket boosters. The launch platform is then carried from the assembly building to the launch pad for final checkout. Two hours prior to launch the external fuel tank is filled with propellants and the crew enters the Orbiter for the next mission.

The Space Shuttle is providing information to help mankind manage and preserve our Earth. It locates forest fires in remote areas, maps ice movements, monitors air quality, locates new natural resources, makes land-use surveys, locates sources of pollution, monitors weather, provides snow and water studies, serves as a navigational aid, checks crops for disease and pest infestation, and much more.

The Space Shuttle provides foreign countries with the ability to explore without the tremendous expense of building their own rockets and launch facilities. Foreign satellites and foreign personnel are flown on the Space Shuttle. Ten European countries developed and paid for the spacelab, a reusable manned laboratory that is carried in the Orbiter's payload bay. Scientists from many countries will be able to continue conducting their experiments in orbit using the spacelab.

The Space Shuttle is serving many users (foreign, domestic, private, and public) and will accomplish many purposes. It is benefiting all mankind and will continue to for many years.



MATERIALS LIST

TASK	MATERIALS NEEDED
1. LANGUAGE	Pencil and paper.
2. LANGUAGE	Literature about Space Shuttle, photos, newspapers, pencil, and paper.
3. LANGUAGE	Pencil and paper.
4. SPELLING/LANGUAGE	Dictionary, pencil, and paper.
5. SPELLING	Dictionary, pencil, and paper.
6. READING	Dictionary, pencil, and paper.
7. READING	Library books, informational materials from NASA, pencil, and paper.
8. SOCIAL STUDIES	Pencil and paper.
9. SOCIAL STUDIES	Science books, encyclopedias, informational materials from NASA, pencil, and paper.
10. SCIENCE	Science books, encyclopedias, library books, magazines, NASA literature, pencil, and paper.
11. GEOGRAPHY	World Atlas, geography books, pencil, and paper.
12. GEOGRAPHY	World Atlas, geography books, pencil, and paper.
13. ART	Drawing paper, crayons, and colored marking pens.
14. HEALTH	Dictionary, health book, pencil, and paper.
15. HEALTH	Pencil and paper.
16. CAREERS	Encyclopedia, book on careers, pencil, and paper.
17. MUSIC	Cassette or tape player, tape, pencil, and paper.
18. MATHEMATICS	Pencil and paper.
19. MATHEMATICS	Pencil and paper.
20. VALUES CLARIFICATION	Pencil and paper.

TEST

1. The three main parts of the Space Shuttle are the
   a. Orbiter, booster, payload, and a fuel tank.
   b. Orbiter, crew, booster, and a fuel tank.
   c. Orbiter, crew, payload, and a fuel tank.
   d. Orbiter, two boosters, and a fuel tank.

2. An example of a space flight participant is the
   a. teacher in space.
   b. Shuttle commander.
   c. payload specialist.
   d. pilot of the Shuttle.

3. The first successful launch of the Space Shuttle into orbit was in
   a. 1980.
   b. 1981.
   c. 1982.
   d. 1983.

4. A Space Shuttle soaring majestically south into the Pacific sky to reach a polar orbit has been launched from
   a. Houston Space Center, Texas.
   b. Kennedy Space Center, Florida.
   c. Vandenberg Air Force Base, California.
   d. Space & Rocket Center, Tranquility Base, Alabama.

5. Spacelab was developed by 10
   a. European nations.
   b. German engineers.
   c. American companies.
   d. Asian organizations.

6. The Space Shuttle crew is carried in a
   a. two-level cabin in the front of the Orbiter.
   b. cockpit-like module located in the rear of the Orbiter.
   c. specially designed capsule in the payload bay of the Orbiter.
   d. single cabin located in the front of the payload bay of the Orbiter.

7. The Space Shuttle carries its payload in the Orbiter's
   a. cabin.
   b. first stage.
   c. payload bay.
   d. external tank.

8. Unlike all other spacecraft, the Space Shuttle Orbiter lands
   a. on a runway.
   b. in the ocean.
   c. on any water surface.
   d. only on a salt lake bed.

9. The Space Shuttle will place large solar arrays into orbit to beam to receivers on Earth energy in the form of
   a. electricity.
   b. microwaves.
   c. sunlight.
   d. fusion.

10. The Space Shuttle Orbiter is about the same size as a
    a. 747.
    b. C-5A.
    c. C-47.
    d. DC-9.

TEST KEY

1. d.
2. a.
3. b.
4. c.
5. a.
6. a.
7. c.
8. a.
9. b.
10. d.

STUDENT RECORD SHEET

SPACE SHUTTLE
A SPACE TRANSPORTATION SYSTEM

BY

STUDENT'S NAME_____

	Started	Finished	Comments	Initials
Task 1—LANGUAGE				
Task 2—LANGUAGE				
Task 3—LANGUAGE				
Task 4—SPELLING/LANGUAGE				
Task 5—SPELLING				
Task 6—READING				
Task 7—READING				
Task 8—SOCIAL STUDIES				
Task 9—SOCIAL STUDIES				
Task 10—SCIENCE				
Task 11—GEOGRAPHY				
Task 12—GEOGRAPHY				
Task 13—ART				
Task 14—HEALTH				
Task 15—HEALTH				
Task 16—CAREERS				
Task 17—MUSIC				
Task 18—MATHEMATICS				
Task 19—MATHEMATICS				
Task 20—VALUES CLARIFICATION				

Pretest Score: Date:	Posttest Score: Date:

TASK 1—LANGUAGE

The Space Shuttle is made up of three parts—the Orbiter, the two solid fuel rocket boosters, and the external fuel tank. The Orbiter carries the crew, passengers, and payload to and from orbit. The crew is carried in a two-level cabin in the front section of the Orbiter. The upper level provides seating for the crew plus all the controls and displays. The lower level contains passenger seats, the dining area, toilet facilities, sleeping quarters, an air lock, and equipment storage compartments. The payload bay is the middle section of the Orbiter.

The Space Shuttle rockets from the launch pad and orbits the Earth like a spacecraft. Following its mission, the Orbiter reenters Earth's atmosphere where the crew flies it like a glider down to almost 200 miles per hour, lowers the landing gear, and lands on a runway like an airliner.

The Space Shuttle crew usually consists of two astronauts who operate the Orbiter and carry out the flight plan, the commander and pilot, one or more mission specialist astronauts, up to four payload specialists, and one or more space flight participants.

Choose one of the following to do:

1. Pretend you are an astronaut back from a recent mission and write about your experience.

2. Pretend you are an astronaut back from a recent mission and describe your experience to your class.

PLACE YOUR WORK IN YOUR FOLDER. DATE YOUR RECORD SHEET.

TASK 2—LANGUAGE

It is April 1981; the Space Shuttle has been launched successfully and is now in orbit. In addition to the crew, there are marine scientists aboard. They will be mapping the surface temperatures of oceans and observing current patterns. The Orbiter will be conducting a combined satellite and emplacement mission. In its payload bay is a High Energy Astronomy Observatory which will be placed into orbit after servicing of the Earth Observations Satellite is completed.

Form a news team with three or four of your classmates. Write a front page story for the newspaper describing the successful mission of the Space Shuttle. Include the general public's reaction to this scientific achievement. Use photos or sketches, captions, and a headline that captures the reader's attention. Research the subject and carefully plan your article.

PLACE YOUR WORK IN YOUR FOLDER. DATE YOUR RECORD SHEET. ALSO, EACH MEMBER OF "NEWS TEAM" DATE YOUR RECORD SHEET.

TASK 3—LANGUAGE

Today, you watched the first launch of the Space Shuttle from Vandenberg Air Force Base, California. You were impressed as you watched this engineering marvel perform perfectly and the Space Shuttle soar majestically south into the Pacific sky to reach a polar orbit. You thought of the many people who had worked as a team to develop the Space Shuttle and to make this historical launch a success.

Write a letter to a friend and describe the launch. Tell him/her how you felt as you watched the Space Shuttle rise from the launch pad. Express your excitement. State how you wish you were a member of the Space Shuttle crew. Describe the sounds, the weather conditions, and the people in the crowd watching history being made. Convey your feelings to your friend.

PLACE YOUR WORK IN YOUR FOLDER. DATE YOUR RECORD SHEET.

TASK 4—SPELLING/LANGUAGE

Our *intellect* and *ingenuity* created the space program and with it we will continue to explore the *frontiers* of space. The Space Shuttle has opened the window to the *solar system.* We have learned that the *planets* are different even though they were all created out of one *nebula* at roughly the same time.

Evidence today suggests that possibly one-third of all stars in the *galaxy* have planets. The Space Shuttle makes it possible to carry into orbit *telescopes* able to *detect* planets around nearby stars and to *unravel* the *mysteries* of the *universe. Phenomena* unknown before the Space Shuttle can now be examined.

Arrange the italicized words into a list alphabetically. Look at each word. Look it up in a dictionary if you do not know its meaning. When you know the definition and the correct spelling, have a friend test you.

PLACE YOUR WORK IN YOUR FOLDER. DATE YOUR RECORD SHEET.

TASK 5—SPELLING

The words in the list below are associated with the Space Shuttle, its mission, and its crew. Examine each word. Look it up in a dictionary if you don't know its meaning. When you know the correct spelling and definition of each word, have a friend test you.

air lock	reentry	payload
rocket	altitude	astronaut
satellite	jettison	retrorocket
booster	communicate	propellant
extravehicular	orbit	launch
mission	thrust	atmosphere
economical	instrument	specialist
fuel	reusable	exploration
module	maneuver	ignite

PLACE YOUR WORK IN YOUR FOLDER. DATE YOUR RECORD SHEET.

TASK 6—READING

The Space Shuttle is a space *transportation* system. It is designed to reduce the cost and increase the effectiveness of using space. Because of its *versatility* and payload-carrying *capacity,* the Space Shuttle can combine missions. The *spacious* payload bay can also *accommodate* a fully equipped laboratory. The spacelab is used for many types of observations and *experiments. Astronauts* and scientists have demonstrated their ability to perform useful work in space. The Space Shuttle is designed to take advantage of the most efficient *characteristics* of both human and *complex* machines.

1. Use a dictionary and look up the italicized words. Write the meaning beside each word.

2. Write a short sentence about the Space Shuttle using each of the italicized words.

PLACE YOUR WORK IN YOUR FOLDER. DATE YOUR RECORD SHEET.

TASK 7—READING

The Space Shuttle provides, and will continue to provide, important information to help us manage and preserve our Earth.

Use your school library, your local library, or write to the National Aeronautics and Space Administration, Washington, DC 20546 for information about the Space Shuttle and the services it is performing.

1. Pretend you are an ecologist. Write a report about how the Space Shuttle is helping you do your job more efficiently.

2. Pretend you are a geologist for a major oil company with the responsibility of locating new petroleum resources. Write a report about how the Space Shuttle is helping you accomplish your job more efficiently.

PLACE YOUR WORK IN YOUR FOLDER. DATE YOUR RECORD SHEET.

TASK 8—SOCIAL STUDIES

Many countries have joined hands in the exploring of space and in sharing the scientific knowledge gained from this adventure. We cooperated with Italy, Great Britain, Spain, West Germany, and the Netherlands in the launching of scientific satellites. Investigators from 17 countries analyzed data gathered by skylab.

Ten European nations developed spacelab, a scientific laboratory which is manned by a team of international scientists aboard the orbiting Space Shuttle.

Write a report of at least two paragraphs telling why you think people from many nations, working together, can benefit all mankind.

PLACE YOUR WORK IN YOUR FOLDER. DATE YOUR RECORD SHEET.

TASK 9—SOCIAL STUDIES

The Space Shuttle performs many jobs and serves many users. It places satellites into orbit that (1) speeds communications between continents; (2) performs environmental studies and monitors pollution; (3) supports exploration for oil, gas, and mineral deposits; (4) aids forest conservation by early fire detection; (5) assists oceanographers in the study of ocean current patterns; (6) takes completely equipped scientific laboratories into Earth orbit; and (7) helps solve the world's food problems by identifying plant diseases and insect infestation.

1. Select the Space Shuttle task you feel is most important. Read about it in science books, encyclopedias, or in literature about the Space Shuttle. Make a list of ten facts you think are most important about the task.

2. State why you feel it is the Space Shuttle's most important task.

PLACE YOUR WORK IN YOUR FOLDER. DATE YOUR RECORD SHEET.

TASK 10—SCIENCE

The Space Shuttle's payload bay accommodates a fully equipped laboratory. The spacelab is used for many types of observations and experiments. One of its uses is to develop new manufacturing techniques and processes in the absence of Earth's gravity.

The Space Shuttle will place large solar arrays into orbit to beam solar energy in the form of microwaves to receivers on Earth. As uranium and fossil fuels are depleted, we will have solar energy as a source for our long-range needs.

1. Select two people to work with you. Choose one of the Space Shuttle's benefits to research. Use the school library, encyclopedias, science books, and magazine articles to aid your research.

2. When you have completed your research, find a team who has researched a different benefit. Discuss the two. Determine if one is more important than the other. Conclude why.

3. Have a group brainstorming session and determine other beneficial tasks the Space Shuttle can perform. Make a list.

PLACE YOUR WORK IN YOUR FOLDER. DATE YOUR RECORD SHEET.

TASK 11—GEOGRAPHY

The following countries cooperated in the development of the spacelab:

Austria	France	Switzerland
Belgium	Italy	West Germany
Denmark	Netherlands	United Kingdom
	Spain	

1. Using a geography book or World Atlas, turn to the appropriate map and locate each of these countries.

2. Write the name of each country on a piece of paper. Using an encyclopedia, look up each of the capital cities and find its population. Write your findings beside the name of each city.

PLACE YOUR WORK IN YOUR FOLDER. DATE YOUR RECORD SHEET.

TASK 12—GEOGRAPHY

Many U.S. companies developed parts for the Space Shuttle. Some of these companies are listed below, followed by the city and state where they have offices and factories.

Rockwell	Downey, California
Bendix	Arlington, Virginia
Brunswick	Skokie, Illinois
Harris	Melbourne, Florida
McDonnell-Douglas	St. Louis, Missouri
Thiokol	Brigham City, Utah
Martin-Marietta	Michoud, Louisiana
IBM-NASA	Huntsville, Alabama
Grumman	Bethpage, New York
Rockwell	Palmdale, California

1. Using an Atlas, draw a map of the United States with the state boundary lines.

2. Locate each of the above cities and place a star in the correct position for each company.

PLACE YOUR WORK IN YOUR FOLDER. DATE YOUR RECORD SHEET.

TASK 13—ART

Study the Space Shuttle on the art panels.

1. Draw the Space Shuttle.

2. Using crayons or colored marking pens, color the color-coded areas of your drawing. Include the markings.

Color Code

- Grey-green—nose tip.
- Black-grey—bottom ½ of body and wings.
- Off-white (grey-ivory)—top ½ of body and wings.
- Very light blue—windows.
- Grey (metal)—engines and nozzles.

Markings

- U.S.A.—top of right wing.
- United States—sides of body over midwing.
- U.S.A. Flag—top of left wing and preceding United States.

PLACE YOUR WORK IN YOUR FOLDER. DATE YOUR RECORD SHEET.

TASK 14—HEALTH

Many advances in health care are the result of devices developed to monitor Space Shuttle astronauts in orbit and send data back to Earth. Two examples are the lightweight, battery-powered mobile unit used by *paramedics* to link their units directly to a *physician* and a blood pressure cuff that measures pressure automatically and displays a numerical reading.

Paramedic units are equipped to perform *electrocardiograms, respiratory resuscitation,* and *fluid aspiration.* They also administer *oxygen* and *drugs* and measure *blood pressure.*

High blood pressure is a common medical problem. It can lead to a *stroke* or a *heart attack;* therefore, early detection is important to save lives.

1. Using a dictionary or health book, look up the italicized terms.

2. Write a least one paragraph about each term.

PLACE YOUR WORK IN YOUR FOLDER. DATE YOUR RECORD SHEET.

TASK 15—HEALTH

The precautions taken with food for the Space Shuttle astronauts have led to new and improved methods of processing, sterilizing, and preserving food. Food additives and nutritional quality are areas of concern for the food industries of the world. The food supply for the Space Shuttle crew must meet rigid requirements. It must be free from bacterial contamination, high in nutritional value, stable without refrigeration for long periods of time, and it must be capable of fast, reliable, foolproof preparation.

Using these precautionary methods, certain foods can be stored for emergency or disaster situations. Some adaptations of these foods have appeared on the shelves in our grocery stores.

1. Name several foods that are used by the Space Shuttle astronauts.
2. Pretending you are stocking a survival shelter, make a list of at least eight foods you will include in your supplies.

PLACE YOUR WORK IN YOUR FOLDER. DATE YOUR RECORD SHEET.

TASK 16—CAREERS

The Space Shuttle is locating mineral resources; detecting plant diseases, insect infestation, and other agricultural problems; performing environmental studies; and performing oceanographical surveys. Skilled personnel perform jobs related to each of these fields of activity.

1. Choose one of the above fields and name two occupations associated with it.
2. Using an encyclopedia or book on careers, read about these occupations.
3. Write a paragraph about each of these occupations.

PLACE YOUR WORK IN YOUR FOLDER. DATE YOUR RECORD SHEET.

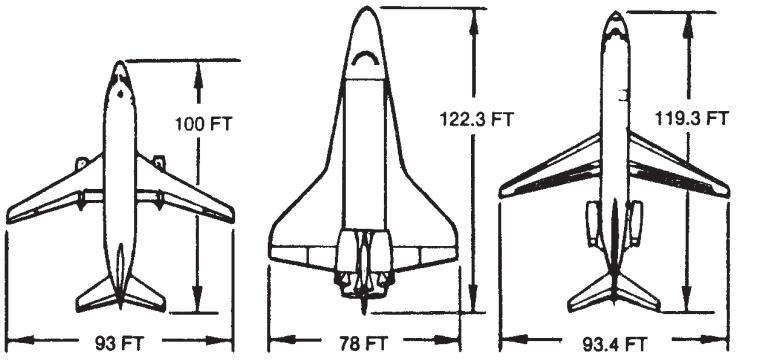
TASK 17—MUSIC

The synthesizer produces music electronically and is sometimes called the music instrument of the "Space Age."

1. Using a tape or cassette player, listen to music played on the synthesizer.
2. Make a list of other musical instruments that produce music electronically.

PLACE YOUR WORK IN YOUR FOLDER. DATE YOUR RECORD SHEET.

TASK 18—MATHEMATICS



1. Is the Orbiter's wingspan greater or less than the DC-9's? How many feet?
2. Comparing the overall length of the Orbiter with that of the Boeing 737, how many inches longer is the Orbiter?
3. Pretending you have a hangar with the dimensions 172' X 123', which two of the above vehicles, parked wingtip to wingtip, would come closest to fitting your hangar?

PLACE YOUR WORK IN YOUR FOLDER. DATE YOUR RECORD SHEET.

TASK 19—MATHEMATICS

In 1903, the Wright brothers made the first flight in a powered aircraft. The flight lasted 12 seconds and covered a distance of 120 feet. Sixty-six years later, Neil Armstrong stepped onto the surface of the moon. In 1981, about 23 years after the first American venture into space, the Space Shuttle was launched on its first mission.

1. How many years are there between the Wright brothers' flight and the launch of the Space Shuttle?

2. How many years are there between the first American venture into space and Neil Armstrong's "giant step for mankind" on the moon?

3. If it took the Wright brothers 12 seconds to cover 120 feet, at the same rate of speed, how many seconds would it have taken them to cover 1½ miles? How many minutes?

PLACE YOUR WORK IN YOUR FOLDER. DATE YOUR RECORD SHEET.

TASK 20—VALUES CLARIFICATION

With each advance in civilization and each stride toward a higher standard of living, we have used more and more irreplaceable resources. We have scarred the Earth's surface with strip mines, burned and cut the forests, and polluted the air and water. We have littered the face of the Earth with empty cans, broken bottles, garbage dumps, and desolate battlefields.

Only recently have we realized that we must stop waste. We must recycle and reuse many materials, and we must conserve our dwindling natural resources.

The Space Shuttle is an important tool in the management and preservation of the Earth's resources.

1. In your opinion, did our greed, thoughtlessness, and ignorance contribute to the depletion of natural resources? Explain your opinion.

2. In your opinion, should laws be enacted to punish litterers? Explain your opinion.

3. List five things we can do to improve our environment.

PLACE YOUR WORK IN YOUR FOLDER. DATE YOUR RECORD SHEET.

SUGGESTIONS FOR EVALUATING STUDENT ACTIVITIES

TASK 1—LANGUAGE

The written report should contain facts about the Space Shuttle, the crew, and the orbit, as well as the writer's impressions of the experience. The speech should make the same points.

TASK 2—LANGUAGE

The newspaper article should have a headline, facts about the crew and the mission, quotes from observers or public opinions of nonobservers, and illustrations showing the Space Shuttle.

TASK 3—LANGUAGE

The letter should be more than a restatement of facts; it should be a statement of excitement. Use academic discretion.

TASK 4—SPELLING/LANGUAGE

Definitions for:

Detect To discover or determine the existence, presence, or fact of.

Frontiers The farthermost limits of knowledge or achievement with respect to a particular subject.

Galaxy One of billions of systems each including stars, nebulae, star clusters, and interstellar matter that make up the universe.

Ingenuity Cleverness or aptness of design or contrivance.

Intellect The power of knowing or the capacity for knowledge.

Mysteries Something not understood.

Nebula Any of many immense bodies of highly rarefied gas or dust in interstellar space.

Phenomena An observable fact or event.

Planets Any of the seven celestial bodies sun, moon, Venus, Jupiter, Mars, Mercury, and Saturn that in ancient belief have motions of their own among the fixed stars.

Solar System The sun with the group of celestial bodies that are held by its attraction and revolve around it.

Telescope A usually tubular optical instrument for viewing distant objects by means of the refraction of light rays through a lens or the reflection of light rays by a concave mirror.

Universe The entire celestial cosmos.

Unravel To resolve the intricacy, complexity, or obscurity of.

TASK 5—SPELLING

Air lock An intermediate chamber between the outer and inner area.

Rocket To convey by means of a rocket.

Satellite A celestial body orbiting another of larger size.

Booster An auxiliary device for increasing force, power, or pressure.

Extravehicular Taking place outside a vehicle (as a spacecraft).

Mission A specific task with which a person or a group is charged.

Economical Marked by careful, efficient, and prudent use of resources.

Fuel A material used to produce heat or power by burning.

Module An independent unit that is a part of the total structure of a space vehicle.

Reentry The action of reentering the Earth's atmosphere after travel in space.

Altitude The vertical elevation of an object above sea level.

Jettison To drop from an airplane or spacecraft in flight.

Communicate To cause to pass from one to another.

Orbit A path described by one body in its revolution about another.

Thrust A strong continued pressure.

Instrument A measuring device for determining the present value of a quantity under observation.

Reusable Capable of being used again or repeatedly.

Maneuver To make a series of changes in direction and position for a specific purpose.

Payload The load that is carried by a spacecraft and that consists of things that relate directly to the purpose of the flight as opposed to things that are necessary for operation.

Astronaut A person who travels beyond the Earth's atmosphere.

Retrorocket A rocket that produces thrust in a direction opposite to or at an oblique angle to the motion of the object for deceleration.

Propellant Something that propels. Fuel plus oxidizer used by a rocket engine.

Launch To release, catapult, or send off.

Atmosphere The whole mass of air surrounding the Earth.

Specialist One who devotes oneself to a special occupation or branch of learning.

Exploration The act or an instance of exploring. Explore = To travel over new territory for adventure or discovery.

Ignite To subject to fire or intense heat. Ignition = The process or means (as an electrical spark) of igniting a fuel mixture.

TASK 6—READING

Transportation Means of conveyance or travel from one place to another.

Versatility The quality or state of being versatile. Versatile = Changing or fluctuating readily.

Capacity The ability to hold, receive, store, or accommodate.

Spacious Vast or ample in extent.

Accommodate To make room for.

Experiments Operations carried out under controlled conditions in order to discover an unknown.

Astronaut A person who travels beyond the Earth's atmosphere.

Characteristics Distinguishing traits, qualities, or properties.

Complex Having confusingly interrelated parts. Hard to separate, analyze, or solve.

TASK 7—READING

Each report should contain at least one Space Shuttle function that helps ecologists and geologists perform their jobs.

TASK 8—SOCIAL STUDIES

Report should be at least two paragraphs in length. Use academic discretion in judging students' opinions.

TASK 9—SOCIAL STUDIES

List should contain at least 10 separate facts. Use academic discretion in judging students' opinions of why the task is most important.

TASK 10—SCIENCE

List of beneficial tasks should show evidence of research and brainstorming.

TASK 11—GEOGRAPHY

COUNTRY	POPULATION*	CAPITAL	POPULATION
Austria	8,000,000	Vienna	1,700,000
Belgium	10,000,000	Brussels	165,000
Denmark	5,000,000	Copenhagen	644,000
France	52,000,000	Paris	2,600,000
Italy	55,000,000	Rome	2,800,000
Netherlands	14,000,000	Amsterdam	840,000
Spain	35,000,000	Madrid	3,000,000
Switzerland	7,000,000	Bern	167,000
West Germany	60,000,000	Bonn	300,000
United Kingdom	56,000,000	London	3,000,000

*Populations are approximations and are provided to give you a benchmark to compare with students' researched data. Also, population may be of countries or capital cities depending on students' interpretation of directions.

TASK 12—GEOGRAPHY

Work should consist of a map of the United States with state boundary lines and stars at ten locations.

TASK 13—ART

Work should consist of a drawing of the Space Shuttle colored following color code and marked appropriately.

TASK 14—HEALTH

Work should consist of 11 paragraphs defining and describing each of the medical terms.

TASK 15—HEALTH

Work should consist of a list of foods that have been used by astronauts (i.e., Tang, energy sticks, etc.) and of at least eight foods for stocking a survival shelter.

TASK 16—CAREERS

Work should consist of at least two paragraphs describing students' choice of occupations.

TASK 17—MUSIC

Work should consist of a list of electronic musical instruments.

TASK 18—MATHEMATICS

1. a. Less.

DC-9	=	94 feet
Orbiter	=	78 feet
		16 feet

b. 16 feet.

2. 264 inches.

Orbiter	=	122 feet
Boeing 737	=	100 feet
		22 feet X 12 = 264 inches

3. Boeing 737 and Orbiter.

Boeing 737	=	93 feet
Orbiter	=	78 feet
		171 feet

Any other combinations will be 172 feet or greater.

TASK 19—MATHEMATICS

NOTE:

Wright brothers first powered flight.	1903
First American venture into space.	1958
Neil Armstrong stepped onto the moon.	1969
Space Shuttle launched on first flight.	1981

1. 78 years.

Space Shuttle	=	1981
Wright brothers	=	1903
		78 years.

2. 11 years.

Giant step	=	1969
First venture	=	1958
		11 years.

3. 792 seconds. 13.2 minutes.

or

912 seconds. 15.2 minutes.

Both answers are correct and depend on whether student solved for nautical miles at 6080 feet or statute miles at 5280 feet.

If nautical miles:

6080 X 1.5 = 9120/10* = 912/60 = 15.2.

If statute miles:

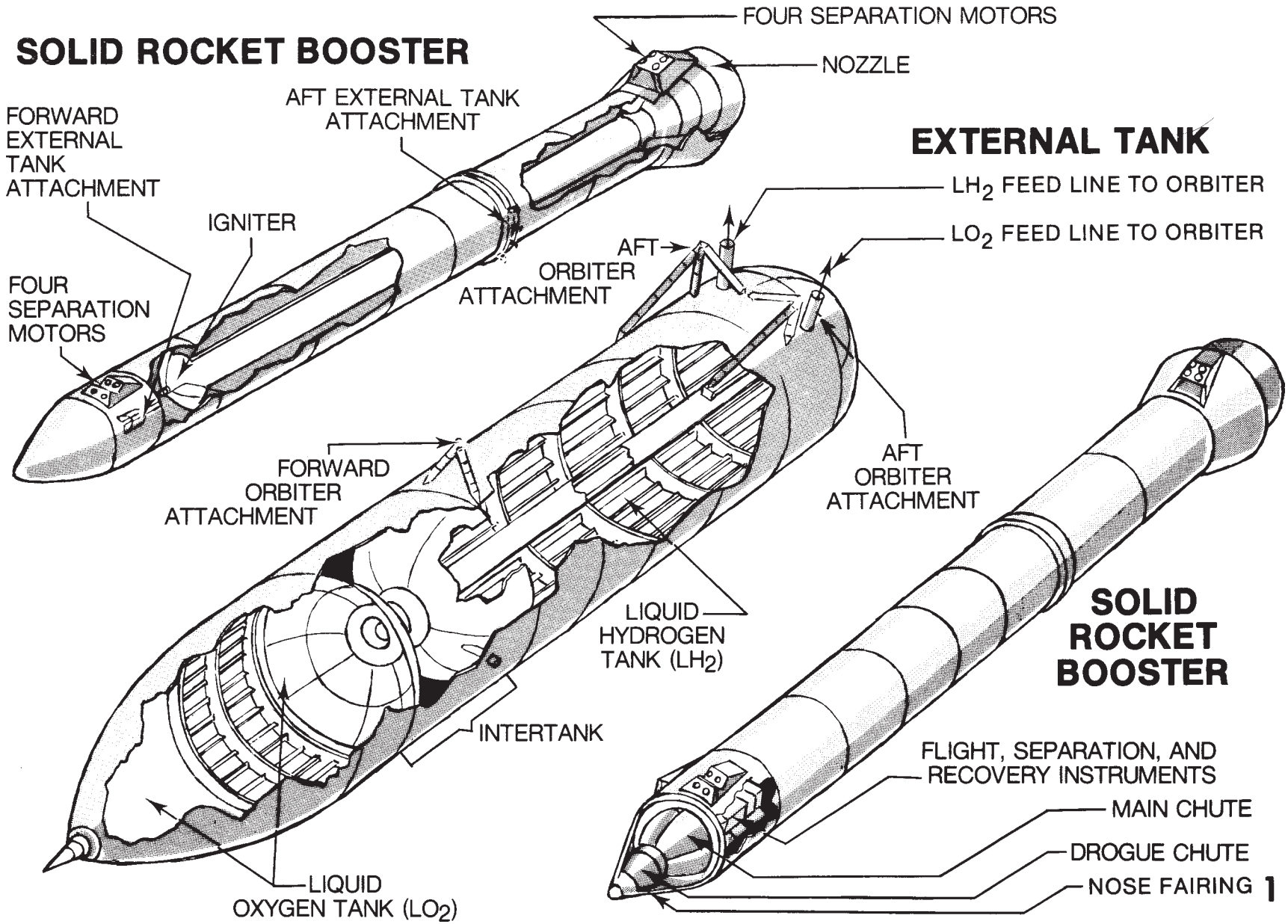
5280 X 1.5 = 7920/10 = 792/60 = 13.2.

*distance/time = feet per second
120/12 = 10

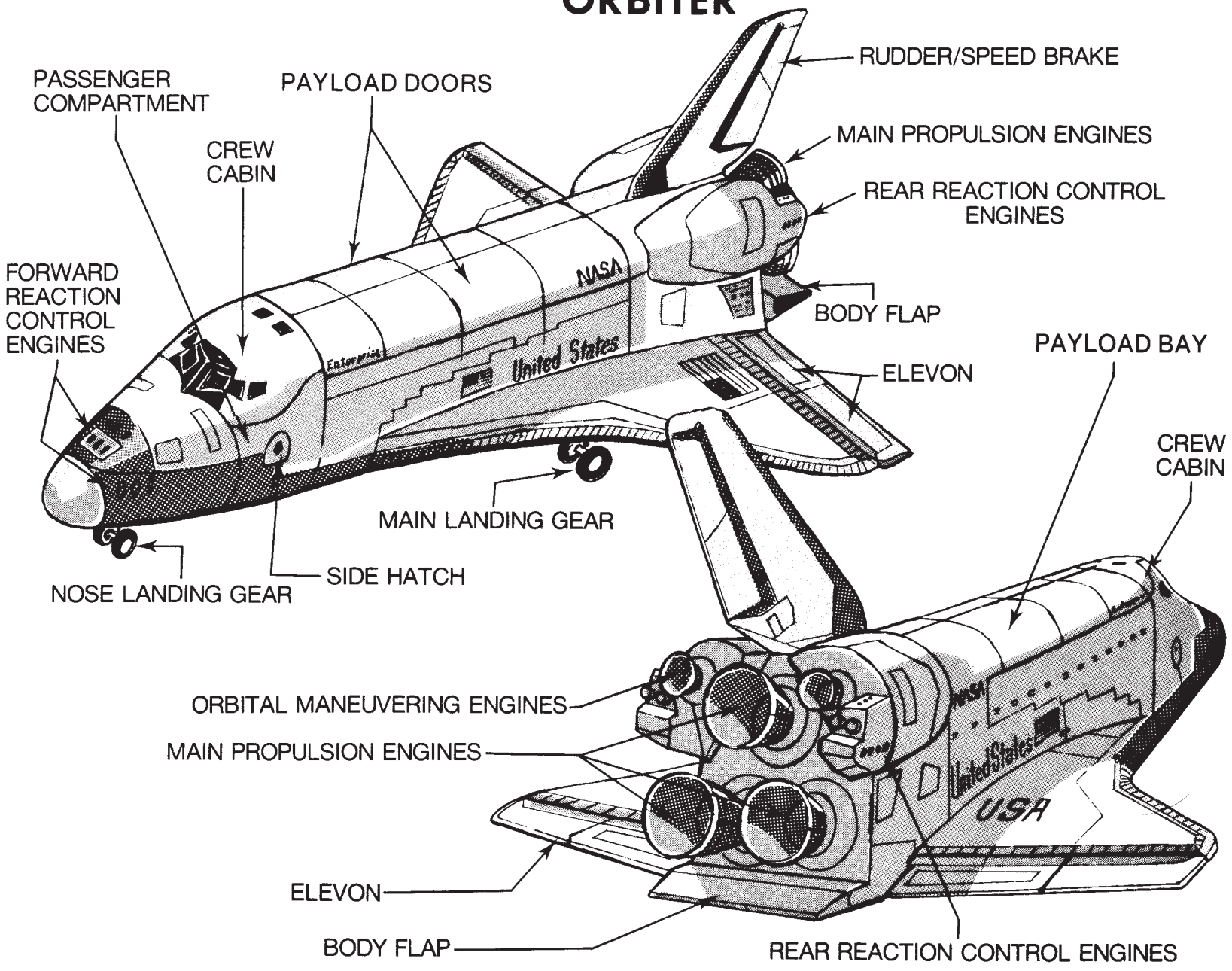
TASK 20—VALUES CLARIFICATION

Work should consist of students' opinions and explanations and a list of five things we can do to improve our environment. Use academic discretion in grading this task.

SOLID ROCKET BOOSTERS AND EXTERNAL TANK



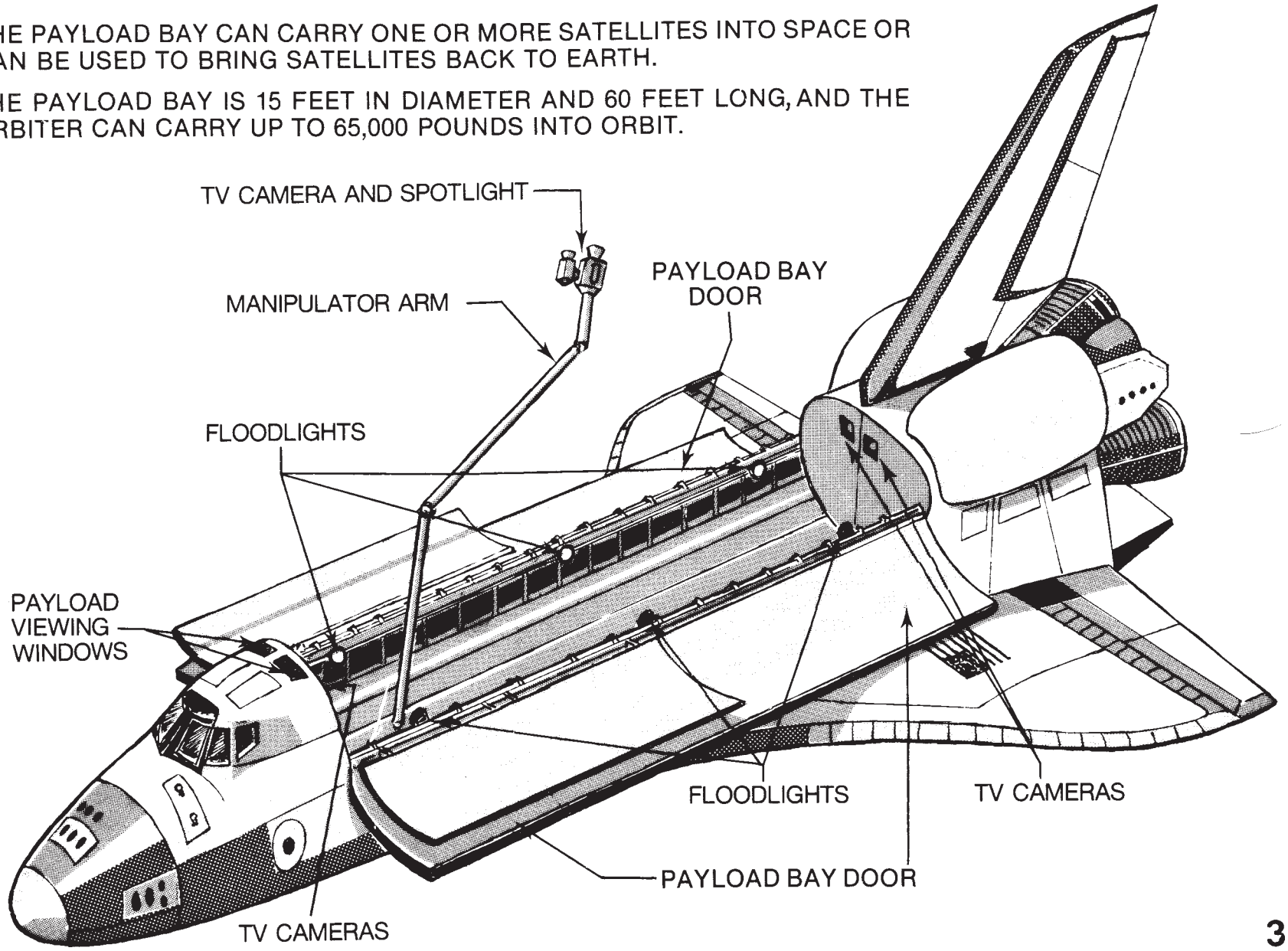
ORBITER


PASSENGER COMPARTMENT
CREW CABIN
PAYLOAD DOORS
RUDDER/SPEED BRAKE
MAIN PROPULSION ENGINES
REAR REACTION CONTROL ENGINES
FORWARD REACTION CONTROL ENGINES
BODY FLAP
PAYLOAD BAY
ELEVON
CREW CABIN
MAIN LANDING GEAR
SIDE HATCH
NOSE LANDING GEAR
ORBITAL MANEUVERING ENGINES
MAIN PROPULSION ENGINES
ELEVON
BODY FLAP
REAR REACTION CONTROL ENGINES
NASA
United States
Enterprise
USA

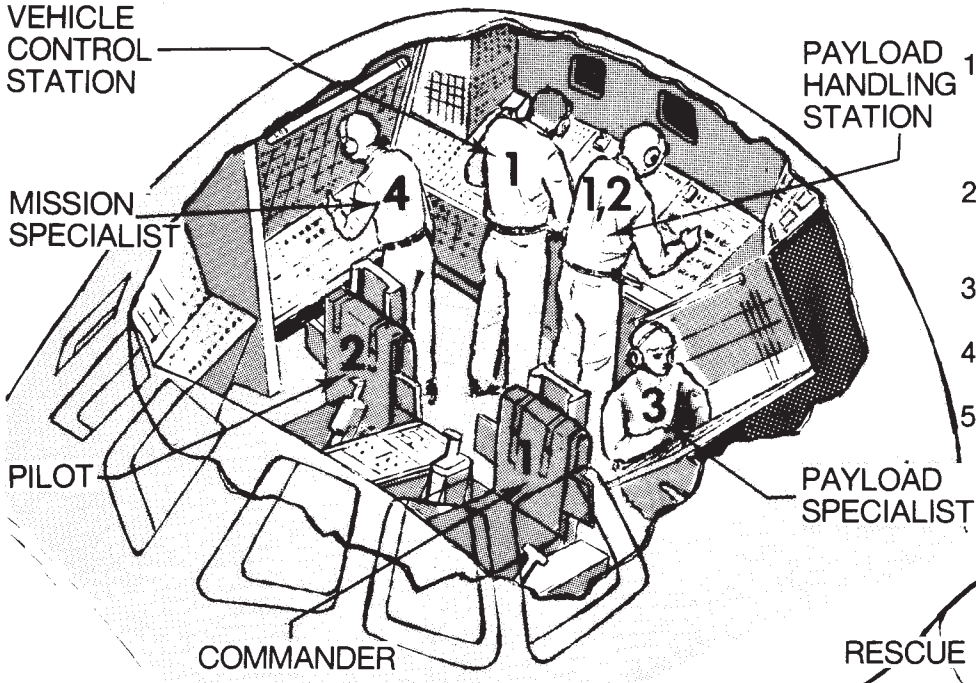
PAYLOAD BAY

THE PAYLOAD BAY CAN CARRY ONE OR MORE SATELLITES INTO SPACE OR CAN BE USED TO BRING SATELLITES BACK TO EARTH.

THE PAYLOAD BAY IS 15 FEET IN DIAMETER AND 60 FEET LONG, AND THE ORBITER CAN CARRY UP TO 65,000 POUNDS INTO ORBIT.

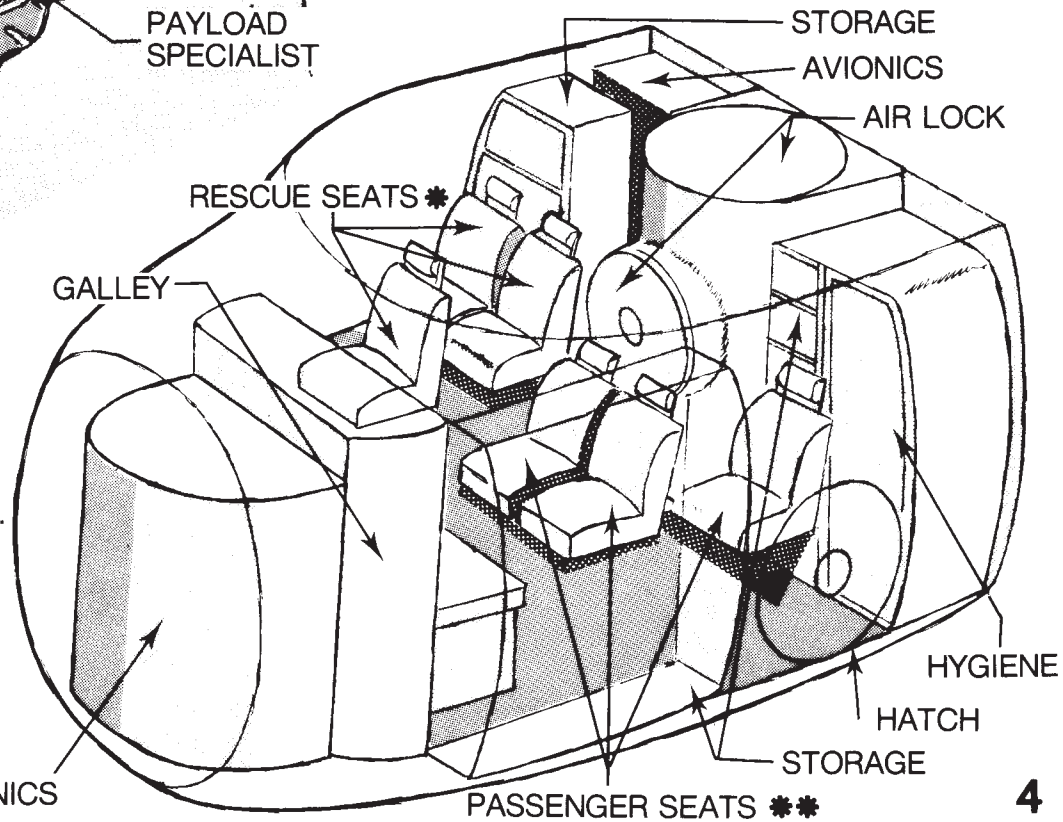


CREW AND PASSENGER COMPARTMENTS



CREW

1. SHUTTLE COMMANDER: ALSO OPERATES THE VEHICLE CONTROL STATION OR THE PAYLOAD HANDLING STATION IN ORBIT.
2. PILOT: ALSO OPERATES THE PAYLOAD HANDLING STATION IN ORBIT.
3. PAYLOAD SPECIALIST
4. MISSION SPECIALIST
5. SPACE FLIGHT PARTICIPANT



*** PASSENGER COMPARTMENT AND CREW LIVING QUARTERS.**

BUNKS REPLACE RESCUE SEATS ON FLIGHTS NOT INVOLVING RESCUE.

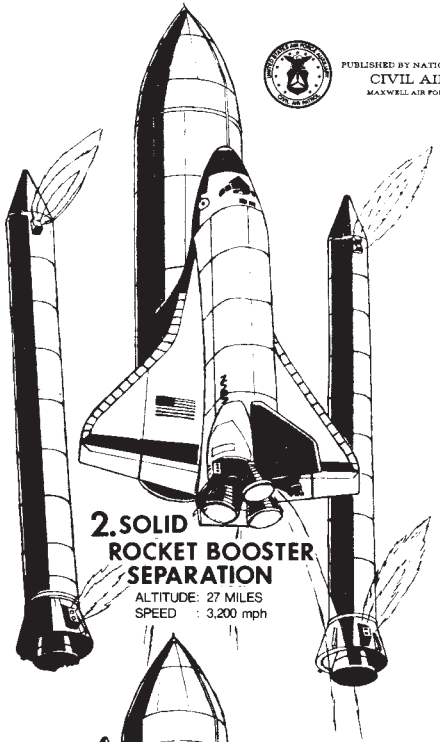
** PASSENGER SEATS NOT CARRIED ON FLIGHTS NOT INVOLVING PASSENGERS.

SHOWER AND LAVATORY ARE IN THE HYGIENE AREA.

AIR LOCK PROVIDES ENTRY INTO THE PAYLOAD BAY.

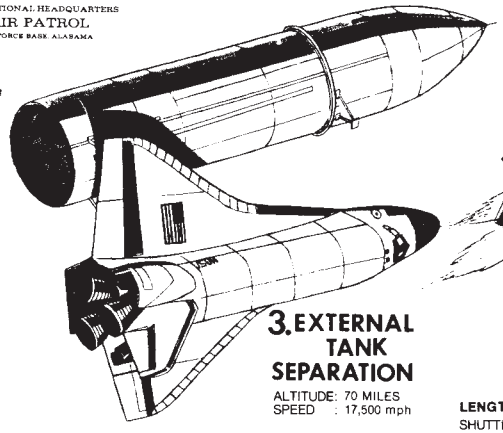
A TYPICAL SHUTTLE MISSION

PUBLISHED BY NATIONAL HEADQUARTERS
CIVIL AIR PATROL
MAXWELL AIR FORCE BASE, ALABAMA



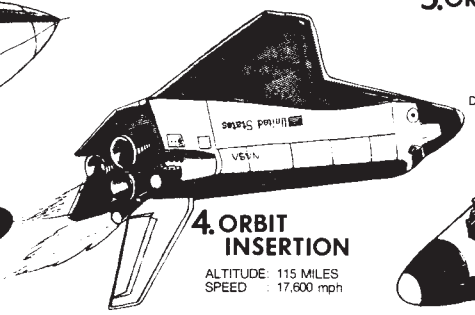
2. SOLID ROCKET BOOSTER SEPARATION

ALTITUDE: 27 MILES
SPEED : 3,200 mph



3. EXTERNAL TANK SEPARATION

ALTITUDE: 70 MILES
SPEED : 17,500 mph



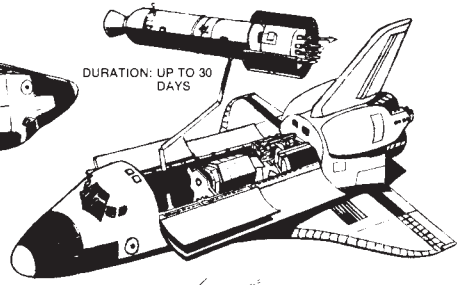
4. ORBIT INSERTION

ALTITUDE: 115 MILES
SPEED : 17,600 mph

5. ORBITAL OPERATIONS

ALTITUDE: 100 - 600 MILES

DURATION: UP TO 30 DAYS



SHUTTLE CHARACTERISTICS

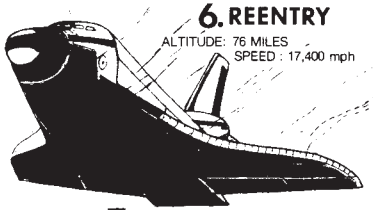
LENGTH:
SHUTTLE - 184 FT.
ORBITER - 122 FT.

HEIGHT:
SHUTTLE - 76 FT.
ORBITER - 57 FT.

WEIGHT:
TAKEOFF - 4 ½ MILLION POUNDS
ORBITER LANDING - 187 THOUSAND POUNDS

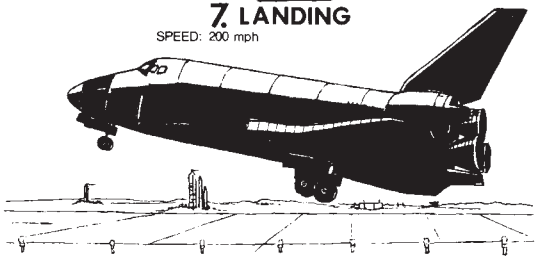
THRUST:
SOLID ROCKET BOOSTERS (2)-2.6 MILLION POUNDS EACH.
ORBITER MAIN ENGINES (3)-470,000 POUNDS EACH.

EACH SHUTTLE ORBITER CAN FLY AT LEAST 100 MISSIONS AND CAN CARRY EIGHT CREW MEMBERS AND PASSENGERS/SPECIALISTS INTO ORBIT.



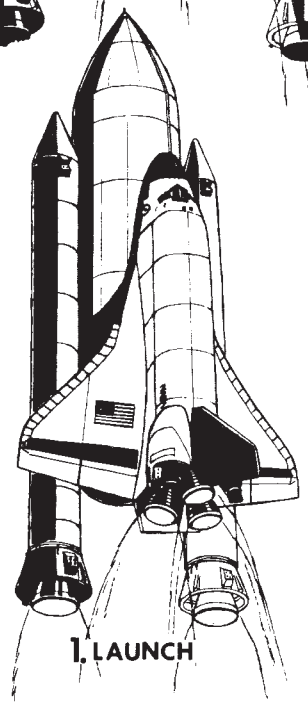
6. REENTRY

ALTITUDE: 76 MILES
SPEED : 17,400 mph

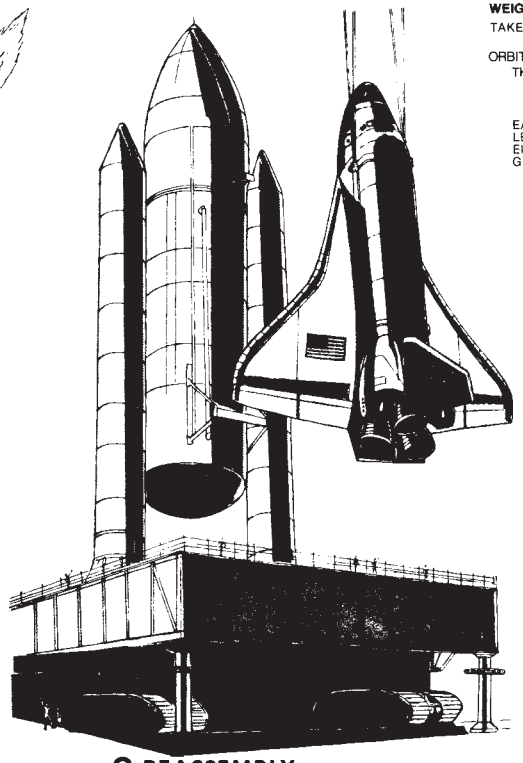


7. LANDING

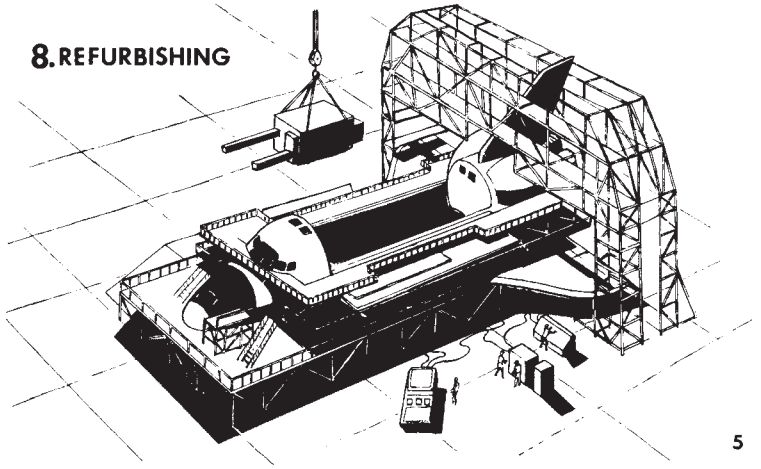
SPEED: 200 mph



1. LAUNCH



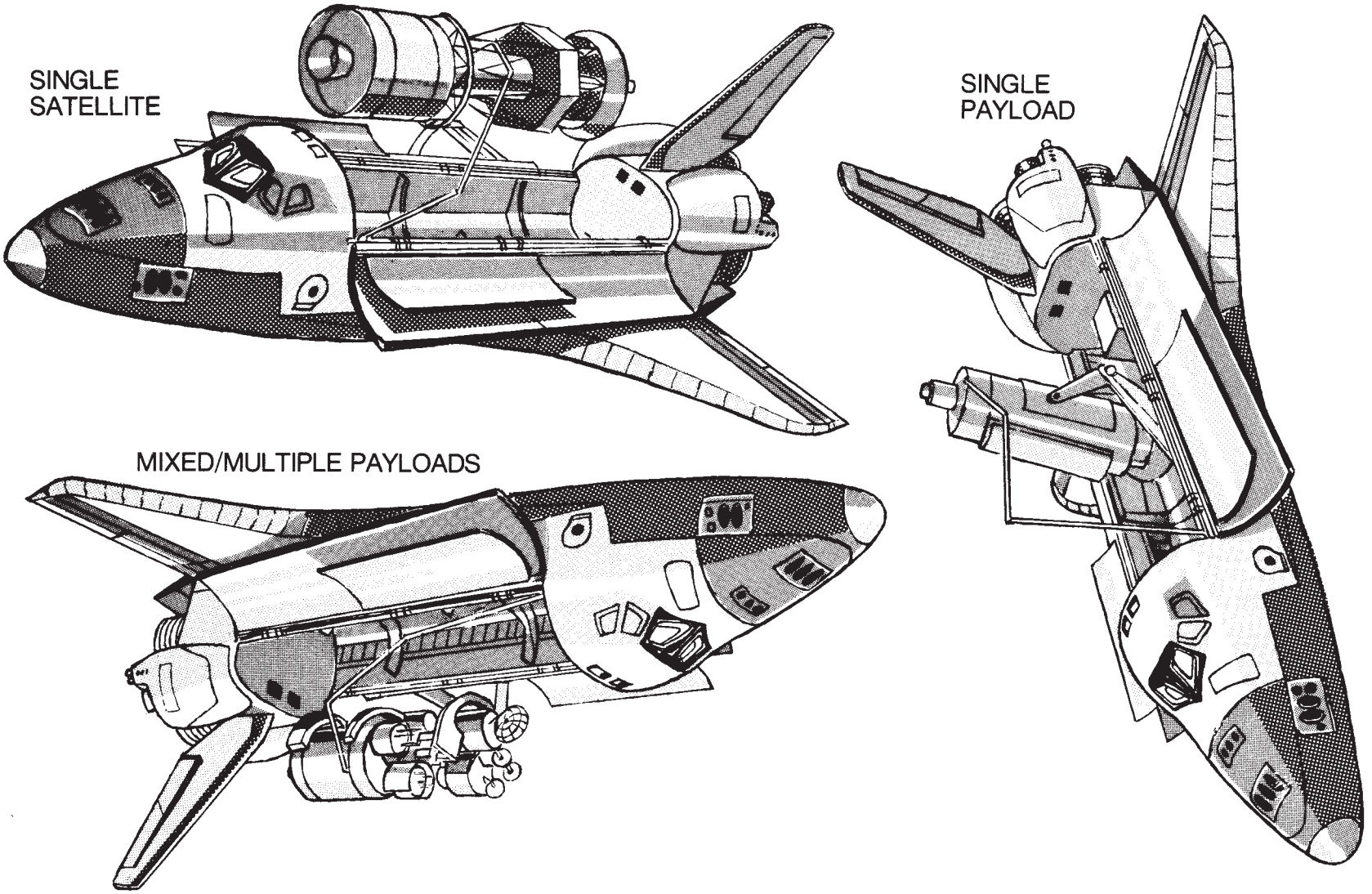
9. REASSEMBLY



8. REFURBISHING

DELIVERING A PAYLOAD INTO EARTH ORBIT

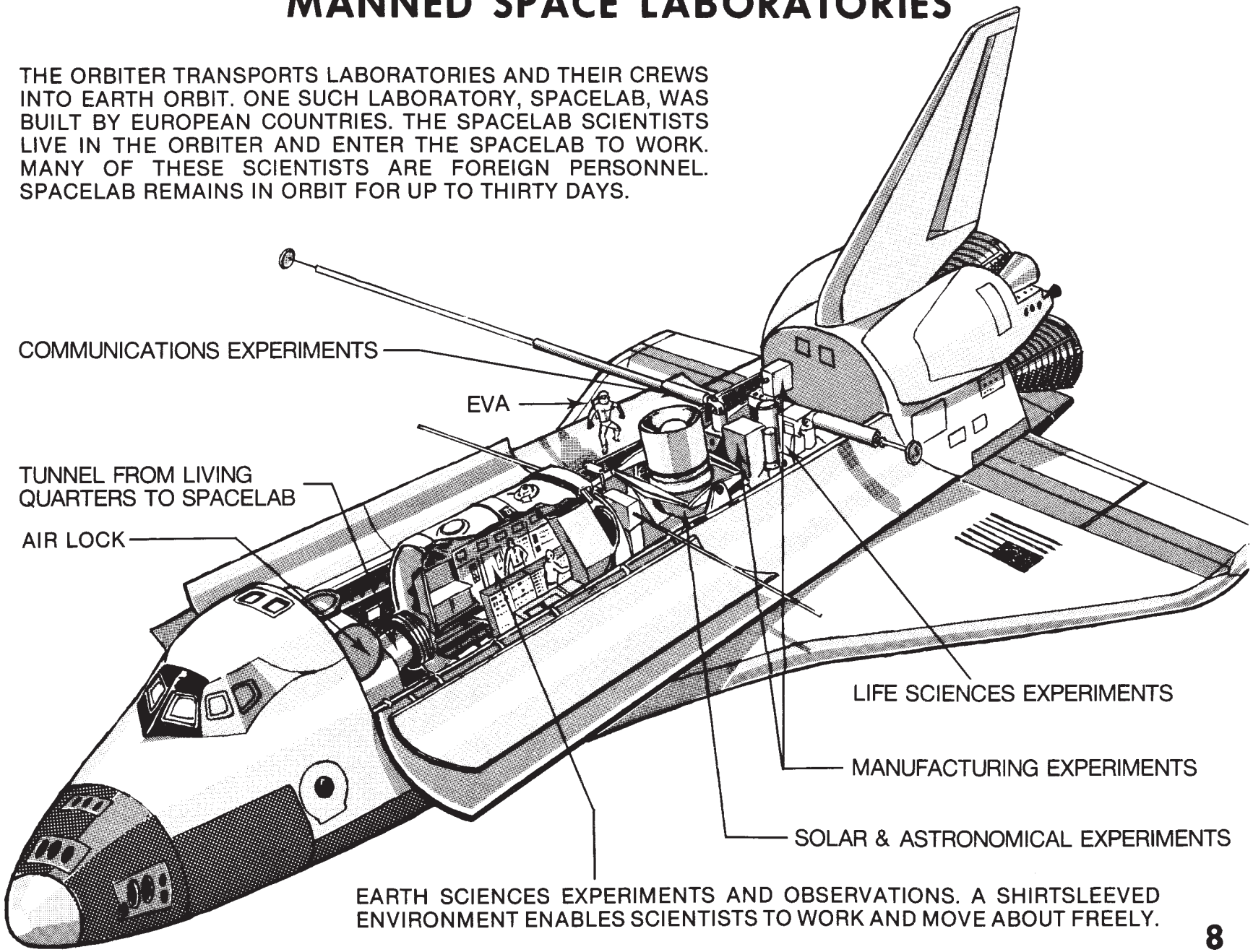
THIS IS THE PRIMARY MISSION FOR THE SPACE SHUTTLE. THE ORBITER CAN DELIVER UP TO 65,000 POUNDS INTO EARTH ORBIT. THIS MAY BE ONE LARGE SATELLITE OR UP TO FIVE SMALLER ONES.



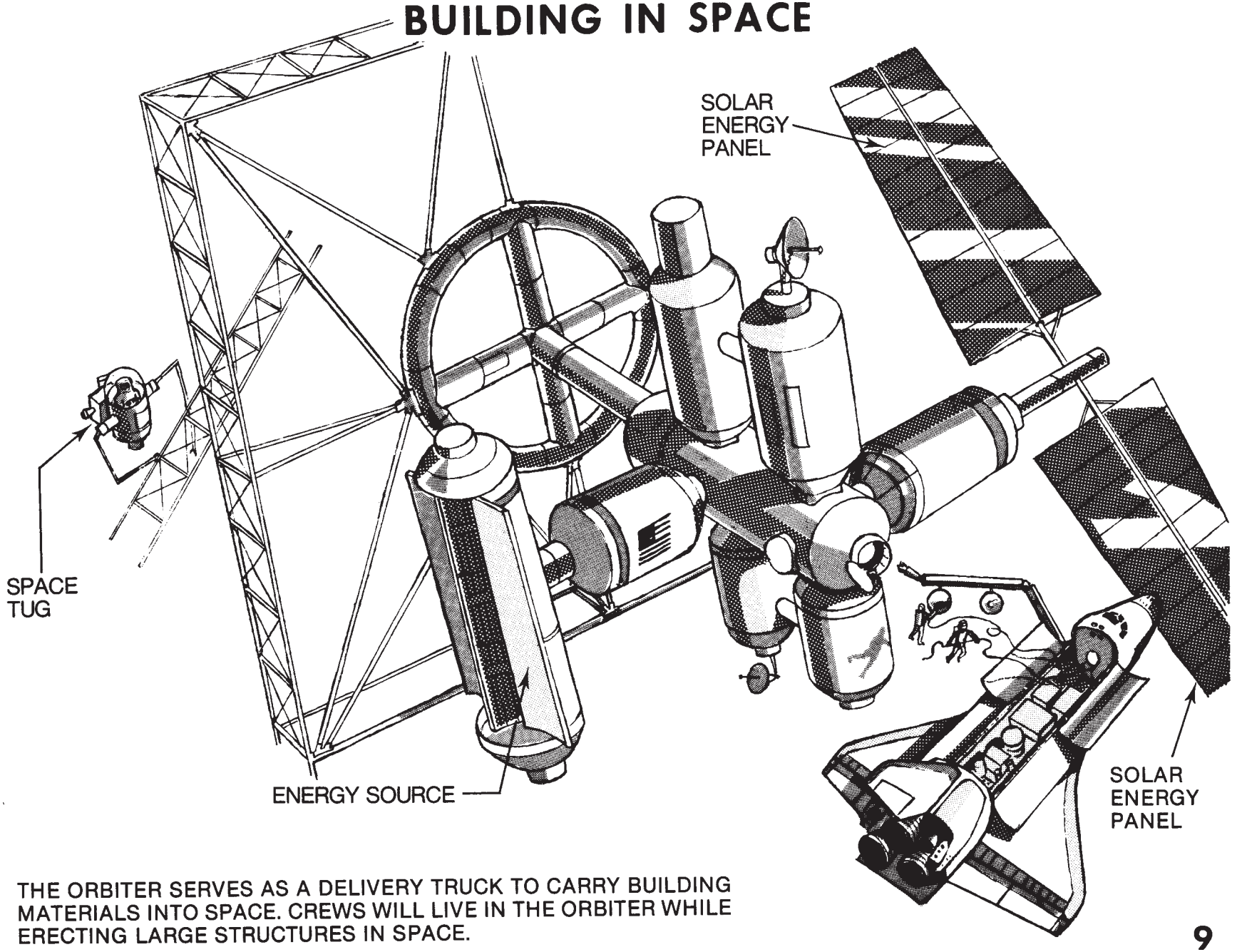
THE ORBITER HAS A THREE-DIMENSIONAL MANEUVERING CAPABILITY. IT CAN ESTABLISH ITSELF IN ANY DESIRED POSITION IN A SPECIFIC ORBIT OR IT CAN CHANGE ORBITS.

MANNED SPACE LABORATORIES

THE ORBITER TRANSPORTS LABORATORIES AND THEIR CREWS INTO EARTH ORBIT. ONE SUCH LABORATORY, SPACELAB, WAS BUILT BY EUROPEAN COUNTRIES. THE SPACELAB SCIENTISTS LIVE IN THE ORBITER AND ENTER THE SPACELAB TO WORK. MANY OF THESE SCIENTISTS ARE FOREIGN PERSONNEL. SPACELAB REMAINS IN ORBIT FOR UP TO THIRTY DAYS.

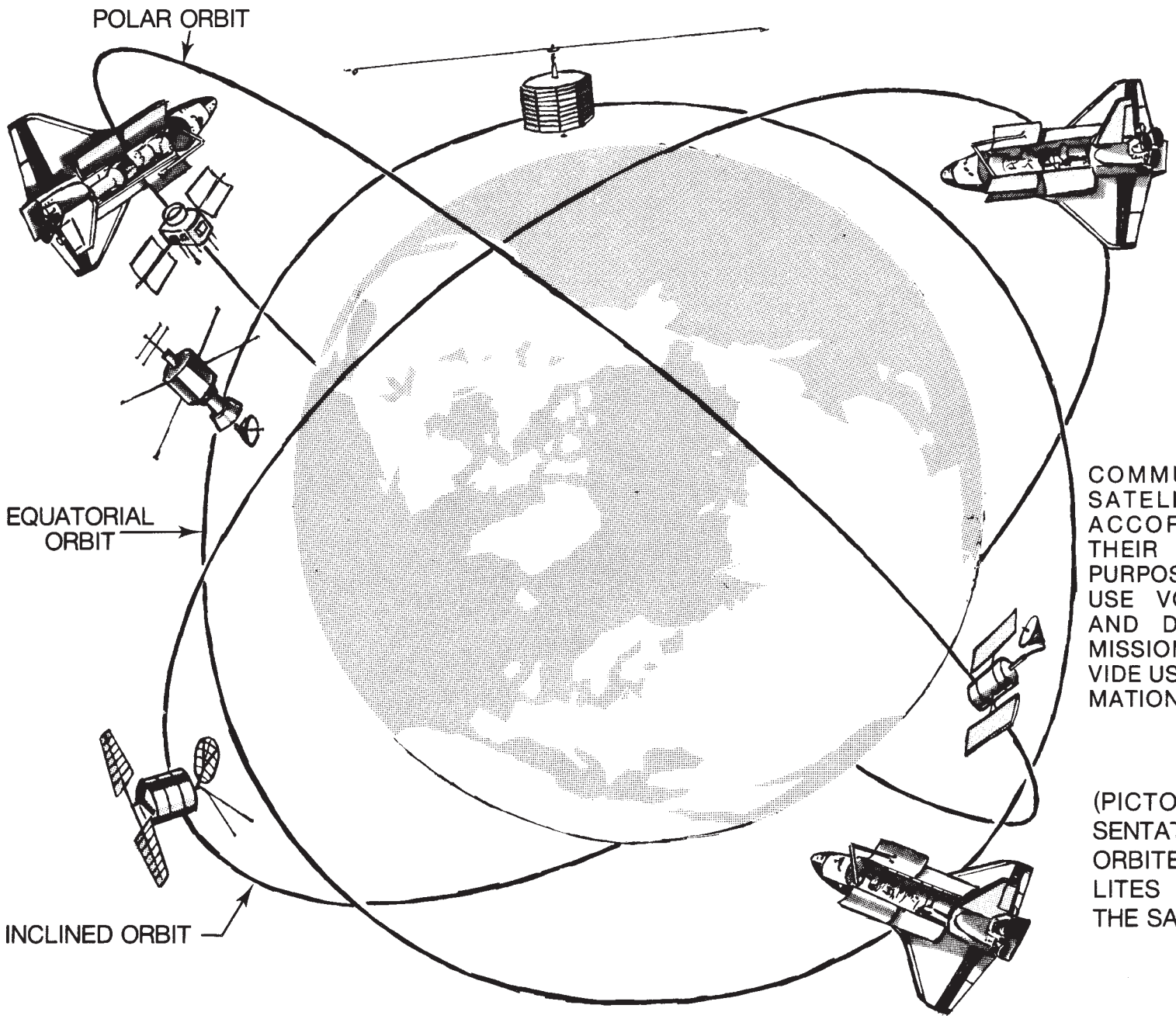


BUILDING IN SPACE



THE ORBITER SERVES AS A DELIVERY TRUCK TO CARRY BUILDING MATERIALS INTO SPACE. CREWS WILL LIVE IN THE ORBITER WHILE ERECTING LARGE STRUCTURES IN SPACE.

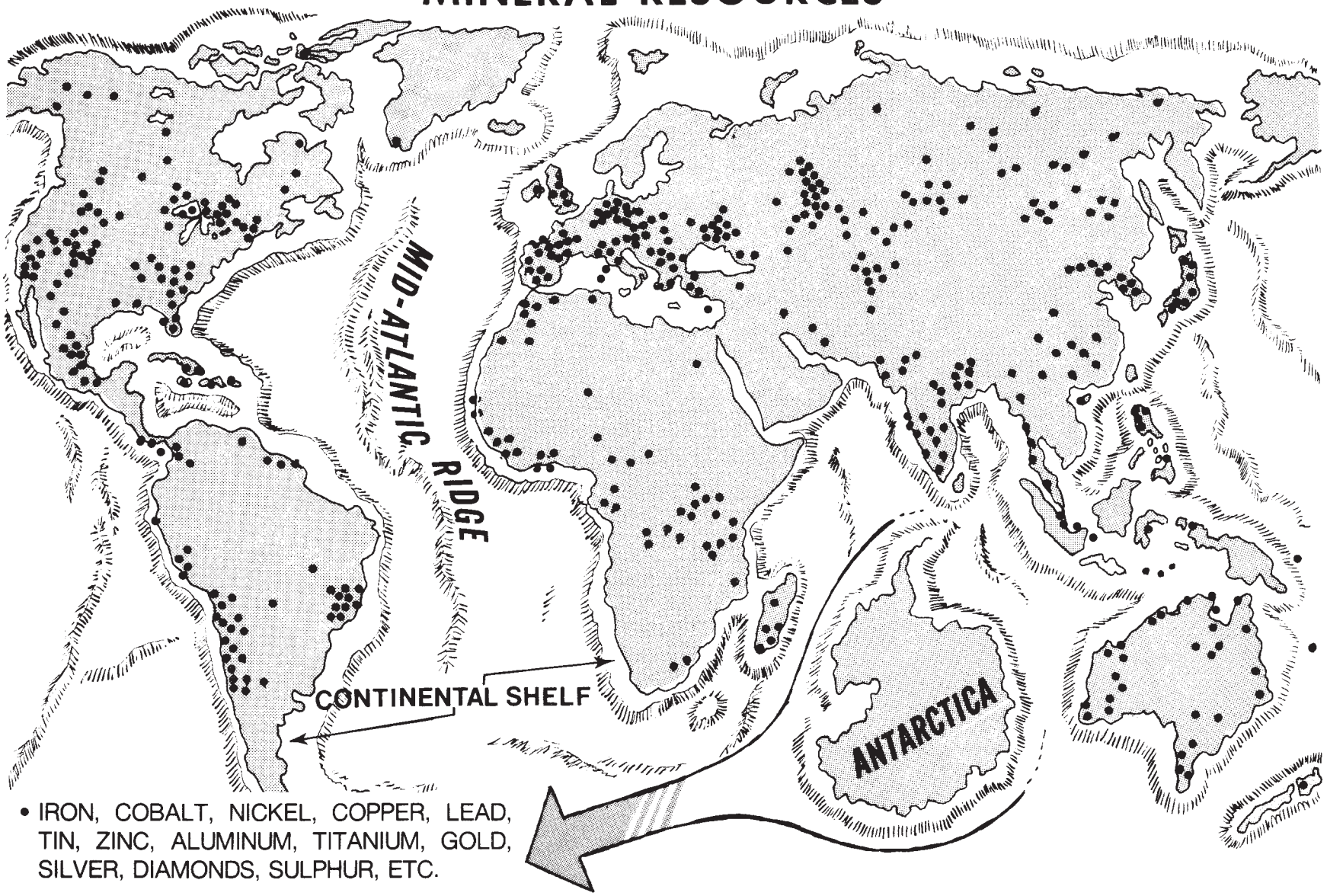
COMMUNICATIONS



COMMUNICATIONS SATELLITES VARY ACCORDING TO THEIR DESIGN AND PURPOSE. THEY MAY USE VOICE, VIDEO, AND DATA TRANSMISSIONS TO PROVIDE US WITH INFORMATION.

(PICTORIAL REPRESENTATION OF THE ORBITER & SATELLITES ARE NOT IN THE SAME SCALE.)

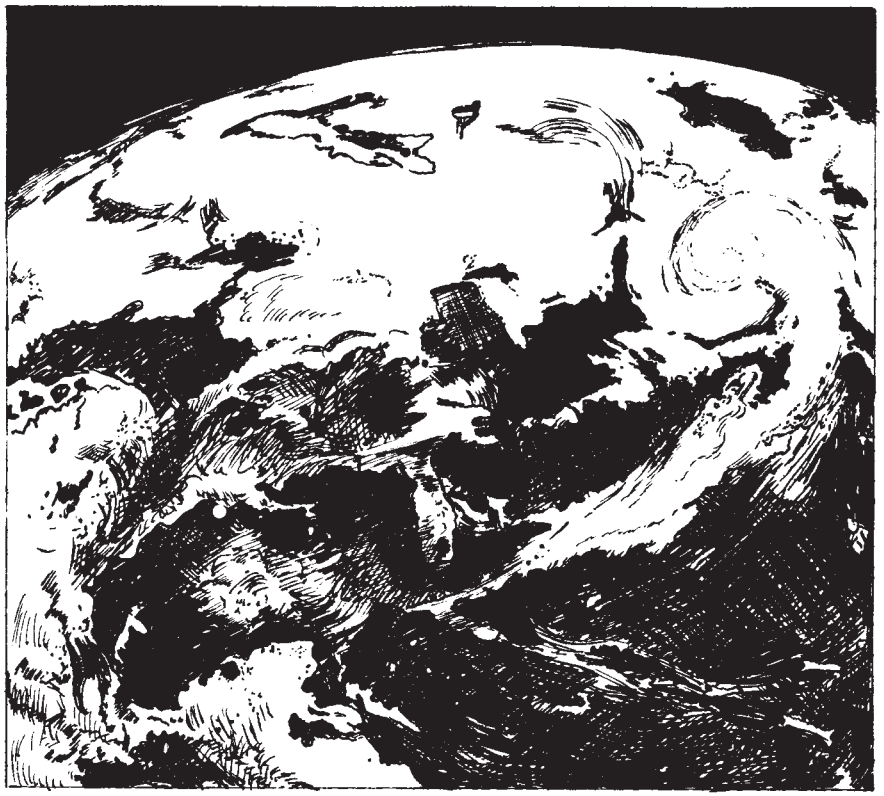
MINERAL RESOURCES



- IRON, COBALT, NICKEL, COPPER, LEAD, TIN, ZINC, ALUMINUM, TITANIUM, GOLD, SILVER, DIAMONDS, SULPHUR, ETC.

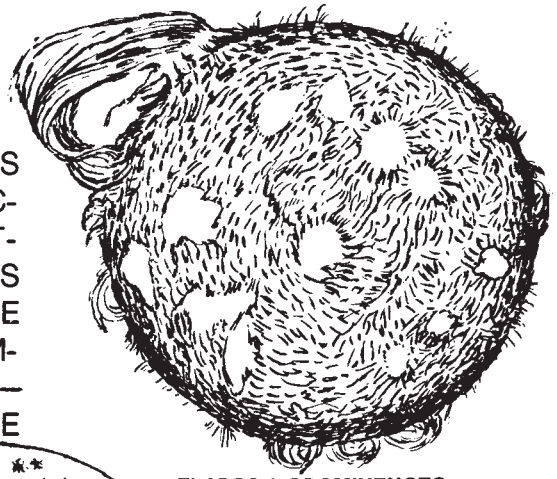
ANALYSIS OF UNDEVELOPED LANDMASSES AND OCEAN FLOORS REVEALS VAST QUANTITIES OF MINERAL RESOURCES. AN EXAMPLE IS THE CONTINENT OF ANTARCTICA WHICH CHALLENGES FUTURE GENERATIONS TO RETRIEVE THE MINERAL DEPOSITS LYING UNDER ITS ICE.

WEATHER

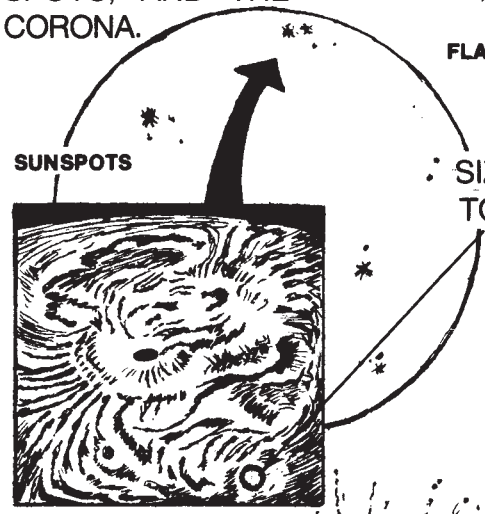


THE SUN

THREE ASPECTS OF THE SUN'S ACTIVITIES AFFECTING EARTH'S WEATHER ARE FLARES & PROMINENCES, SUNSPOTS, AND THE CORONA.



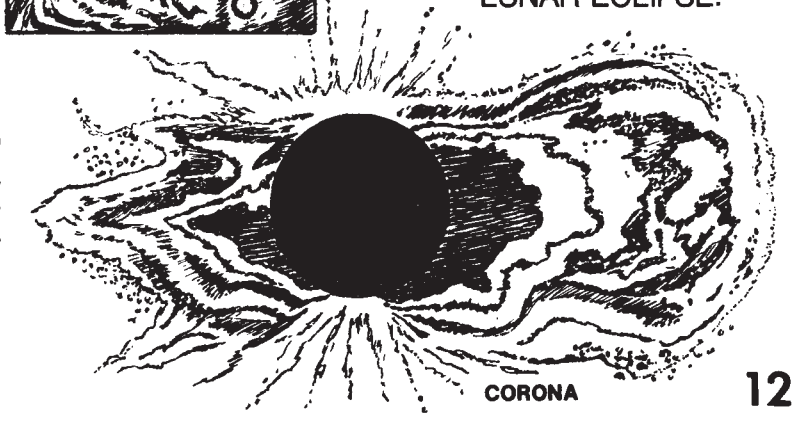
FLARES & PROMINENCES



SIZE OF THE EARTH, TO SCALE

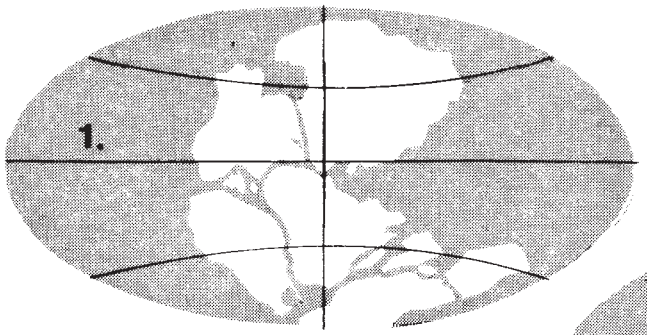
THE CORONA CANNOT BE SEEN EXCEPT BY BLOTTING OUT THE SUN WITH A CORONAGRAPH OR DURING A LUNAR ECLIPSE.

EARTH'S WEATHER IS CAUSED BY THE SUN. STUDIES OF THE SUN AND OBSERVATIONS OF THE EARTH ARE VERY IMPORTANT TO OUR UNDERSTANDING OF WEATHER.



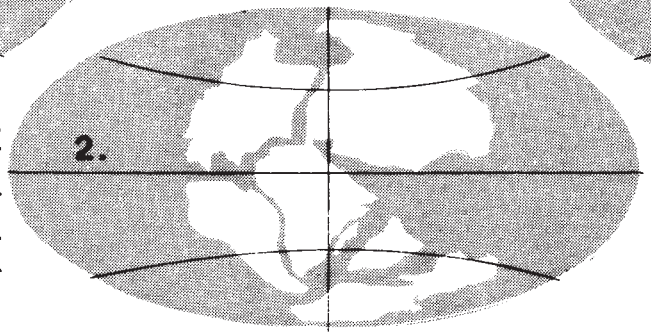
CORONA

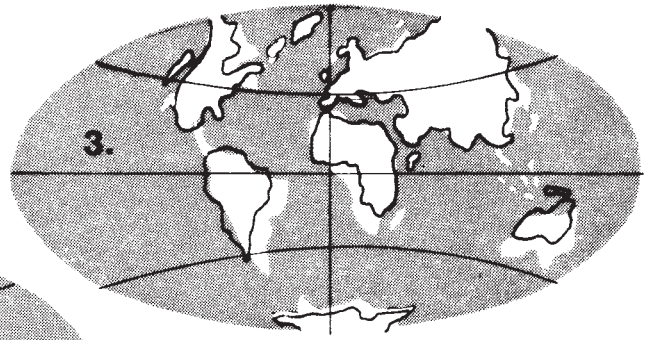
MAPPING AND THE CONTINENTAL DRIFT



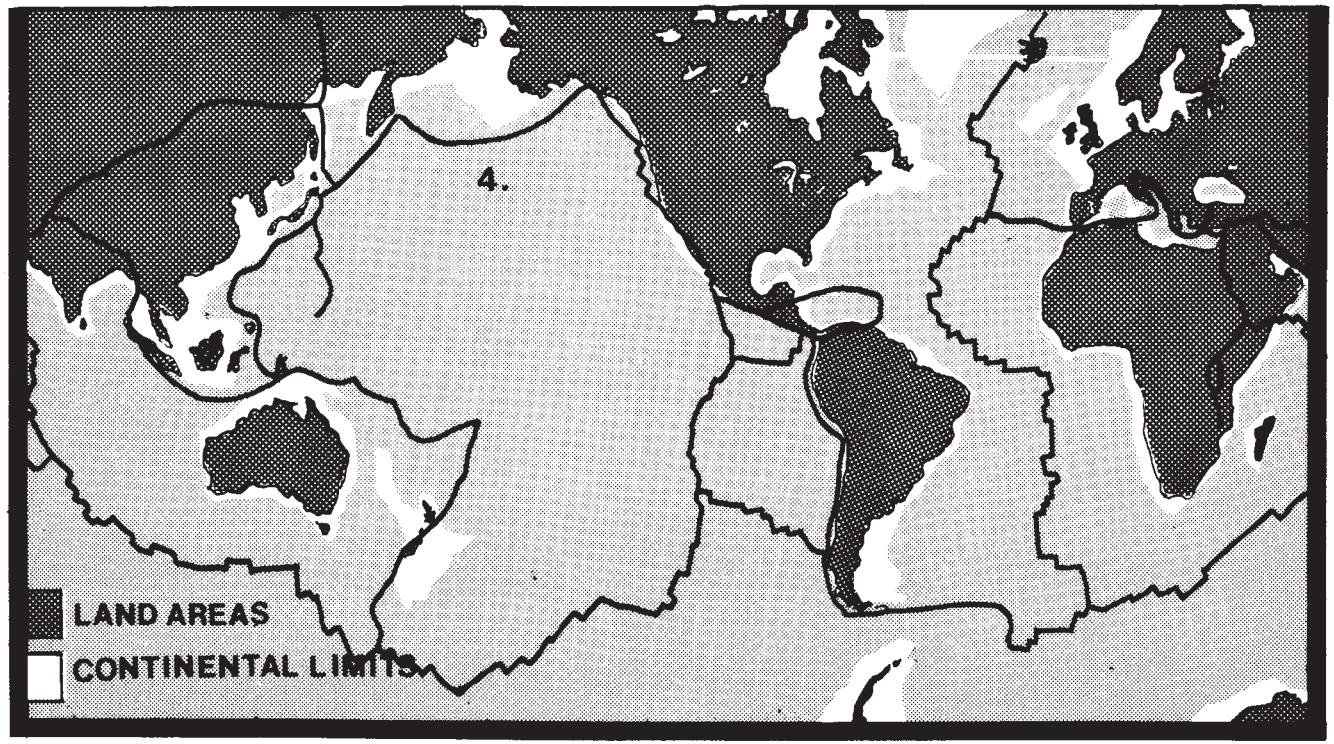
1. 225-280 MILLION YEARS AGO. ONE LANDMASS. ABUNDANT LIFE ON LAND & IN WARM WATERS. GREAT OIL FIELDS FORMING. FUTURE ANTARCTICA WITH A MODERATE CLIMATE.

2. 150-180 MILLION YEARS AGO. DINOSAURS APPEAR, WARM DAY PERIOD WITH SUBTROPICAL CONDITIONS.





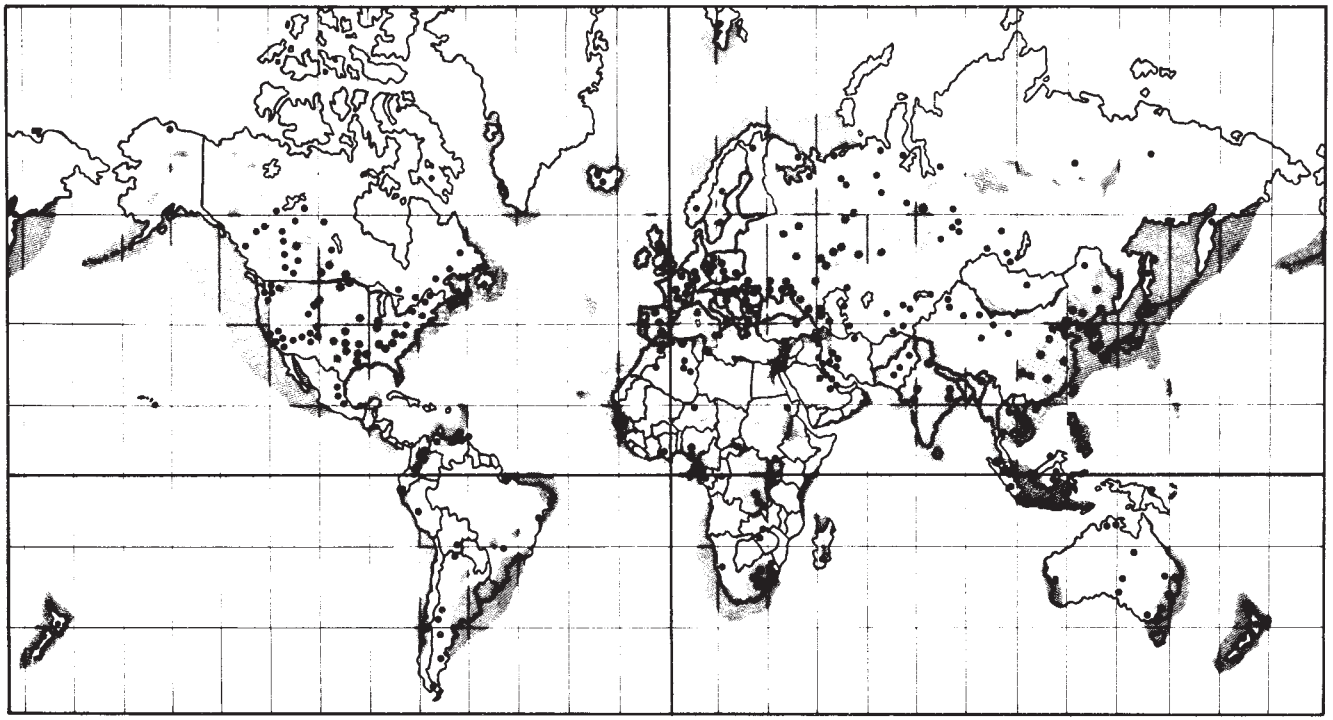
3. TODAY & TOMORROW. SOLID LINE INDICATES LAND MASSES 50 MILLION YEARS FROM NOW. CONTINENTS "FLOAT" ON 7 MAJOR CRUSTAL PLATES IN CONSTANT MOTION. (SEE 4.)



4. VOLCANOES OCCUR WHERE EARTH'S PLATES MEET, EARTHQUAKES HAPPEN WHEN ONE PLATE OVERRIDES ANOTHER, AND NEW OCEAN FLOORS FORM WHERE PLATES SEPARATE. ACCURATE MAPPING OF EARTH'S SURFACE AIDS US IN PREDICTING VOLCANOES AND EARTHQUAKES AND GIVES US INVALUABLE CLUES ON THE LOCATION OF NEW MINERALS AS THEY MAKE THEIR WAY FROM EARTH'S INTERIOR TO THE SURFACE.

PUBLISHED BY NATIONAL HEADQUARTERS
CIVIL AIR PATROL
MAXWELL AIR FORCE BASE ALABAMA

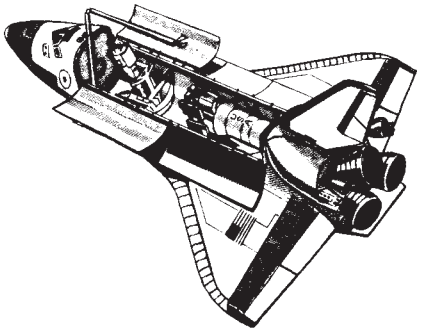
DISCOVERING OURSELVES

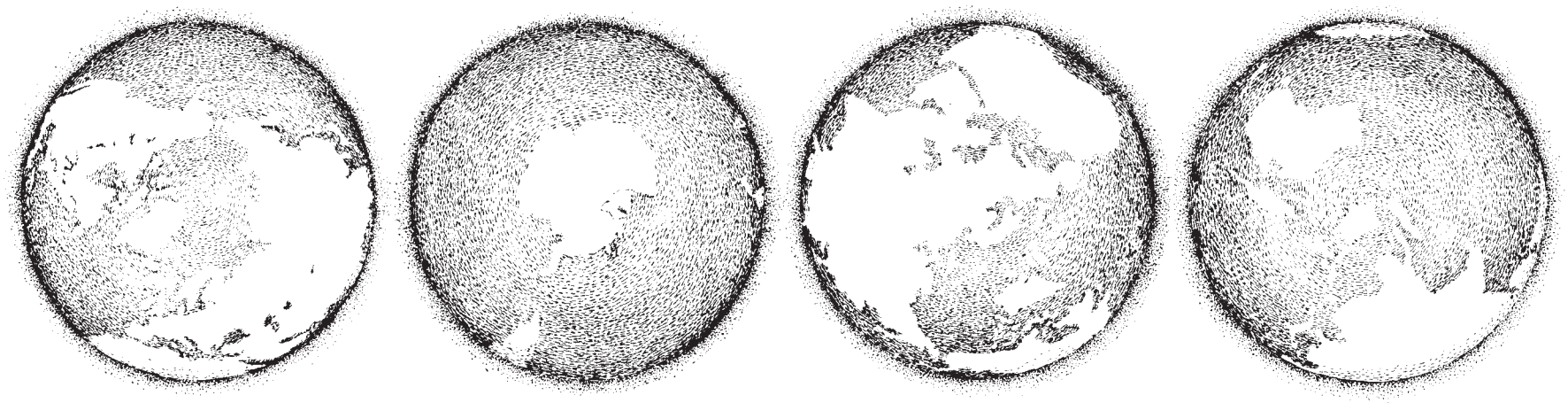


THE EARTH IS DIVIDED INTO LANDMASSES SURROUNDED BY THE OCEANS. FOUR-FIFTHS OF THE EARTH STILL LIES UNTOUCHED. THIS INCLUDES MOST OF THE OCEAN DEPTHS, THE POLES, AND SOME OF THE UNDEVELOPED LANDMASSES.

LEGEND

- MAJOR FOOD SOURCES, BOTH PLANT AND ANIMAL.
- ENERGY SOURCES (OIL, GAS, COAL, URANIUM, GEOTHERMAL, ETC.)





FROM THE SPACE SHUTTLE ORBITER, UNRESTRICTED BY BOUNDARY LINES, MAP PROJECTIONS, AND SURFACE TECHNOLOGIES, A THREE-DIMENSIONAL EARTH IS VIEWED. THE CAMERAS AND OTHER DEVICES USED ON THE ORBITER ARE CAPABLE OF DETECTING ASPECTS OF THE EARTH AND ITS ENVIRONMENT THAT WERE NOT AVAILABLE TO THE EARTHBOUND BEFORE SPACE TRAVEL.

SPACE SHUTTLE MISSIONS PART I

STS-1 ORBITER: COLUMBIA LAUNCHED: April 12, 1981 LANDED: April 14, 1981 PAYLOAD: • Developmental Flight Instrumentation Pallet	**STS-2** ORBITER: COLUMBIA LAUNCHED: November 12, 1981 LANDED: November 14, 1981 PAYLOAD PROVIDED BY: • Office of Space and Terrestrial Applications	**STS-3** ORBITER: COLUMBIA LAUNCHED: March 22, 1982 LANDED: March 30, 1982 PAYLOAD PROVIDED BY: • Office of Space Science	**STS-4** ORBITER: COLUMBIA LAUNCHED: June 27, 1982 LANDED: July 4,1982 PAYLOAD PROVIDED BY: • Department of Defense	**STS-5** ORBITER: COLUMBIA LAUNCHED: November 11,1982 LANDED: November 16,1982 FIRST OPERATIONAL FLIGHT PAYLOAD: • Satellite Business Systems Satellite • Canadian Telecommunications Satellite	**STS-6** ORBITER: CHALLENGER LAUNCHED: April 4, 1983 LANDED: April 9, 1983 FIRST PERSON TO STAND DURING ENTRY MISSION SPECIALIST MUSGRAVE PAYLOAD: • Tracking and Data Relay Satellite • Continuous-flow Electrophoretic System	**STS-7** ORBITER: CHALLENGER LAUNCHED: June 18, 1983 LANDED: June 24, 1983 FIRST WOMAN MISSION SPECIALIST SALLY RIDE PAYLOAD: • German Shuttle Pallet Satellite • Canadian Telecommunications Satellite • Indonesian Communications Satellite
STS-8 ORBITER: CHALLENGER LAUNCHED: August 30, 1983 LANDED: September 5, 1983 • FIRST NIGHT TAKEOFF • FIRST BLACK MISSION SPECIALIST GUION BLUFORD PAYLOAD: • Payload Deployment and Retrieval System • Payload Flight Test Article • Indian National Satellite System	**STS-9** ORBITER: COLUMBIA LAUNCHED: NOVEMBER 28, 1983 LANDED: DECEMBER 8, 1983 PAYLOAD: • Spacelab 1	**STS-10** ORBITER: CHALLENGER LAUNCHED: February 3 1984 LANDED: February 11, 1984 PAYLOAD: • German Shuttle Pallet Satellite • Indonesian Communications Satellite • Western Union Telegraph Communications Satellite	**STS-11** ORBITER: CHALLENGER LAUNCHED: April 6, 1984 LANDED: April 13, 1984 PAYLOAD: • Long-duration Exposure Facility • Solar Maximum Repair Mission	**STS-12** ORBITER: DISCOVERY LAUNCHED: August 30, 1984 LANDED: September 5, 1984 PAYLOAD: • Satellite Business Systems Satellite • At&T Communications Satellite • Hughes Geosynchronous Communications Satellite	**STS-13** ORBITER: CHALLENGER LAUNCHED: Oct 5, 1984 LANDED: Oct 13, 1984 • First Seven-member Crew PAYLOAD: • Earth Radiation Budget Satellite • Large-format Camera • Orbiter Refueling System	**STS-14** ORBITER: DISCOVERY LAUNCHED: November 8, 1984 LANDED: November 16, 1984 PAYLOAD: • Canadian Telecommunications Satellite • Hughes Geosynchronous Communications Satellite
STS-15 ORBITER: DISCOVERY LAUNCHED: January 24, 1985 LANDED: January 27, 1985 FIRST FULLY MILITARY MISSION PAYLOAD PROVIDED BY: • Department of Defense	**STS-16** ORBITER: DISCOVERY LAUNCHED: April 12, 1985 LANDED: April 19, 1985 • Canadian Telecommunications Satellite • Hughes Geosynchronous Communications Satellite	**STS-17** ORBITER: CHALLENGER LAUNCHED: April 29, 1985 LANDED: May 6, 1985 PAYLOAD: • Spacelab 3	**STS-18** ORBITER: DISCOVERY LAUNCHED: June 17, 1985 LANDED: June 24, 1985 PAYLOAD: • Mexican Communications Satellite • Arab Communications Satellite • AT&T Communications Satellite	**STS-19** ORBITER: CHALLENGER LAUNCHED: July 19, 1985 LANDED: August 6, 1985 PAYLOAD: • Spacelab 2 • Plasma Diagnostics Package Subsatellite	**STS-20** ORBITER: DISCOVERY LAUNCHED: August 27, 1985 LANDED: September 3, 1985 PAYLOAD: • Salvaged Leasat 3 • Australian Communications Satellite • American Satellite Company Communications Satellite • Hughes Geosynchronous Communications Satellite	**STS-21** ORBITER: ATLANTIS LAUNCHED: October 3, 1985 LANDED: October 7, 1985 PAYLOAD PROVIDED BY: • Department of Defense
STS-22 ORBITER: CHALLENGER LAUNCHED: October 30, 1985 LANDED: November 6, 1985 FIRST EIGHT-MEMBER CREW PAYLOAD: • Spacelab D-1 • Global Low-Orbit Message Relay Satellite	**STS-23** ORBITER: ATLANTIS LAUNCHED: November 26, 1985 LANDED: December 3, 1985 PAYLOAD: • Experimental Assembly of Structures in EVA • Assembly Concept for Construction of Erectable Space Structures • Mexican Communications Satellite • RCA Communications Satellite • Australian Communications Satellite	**STS-24** ORBITER: COLUMBIA LAUNCHED: January 12, 1986 LANDED: January 18, 1986 PAYLOAD: • Materials Science Laboratory • RCA Communications Satellite	**STS-25** ORBITER: CHALLENGER LAUNCHED: January 28, 1986 EXPLODED DURING LAUNCH	**STS-26** ORBITER: DISCOVERY LAUNCHED: September 29, 1988 LANDED: October 3, 1988 PAYLOAD: • Tracking and Data Relay Satellite	**STS-27** ORBITER: ATLANTIS LAUNCHED: December 2, 1988 LANDED: December 6, 1988 PAYLOAD: • La Crosse Imaging Radar Satellite	**STS-29** ORBITER: DISCOVERY LAUNCHED: MARCH 13, 1989 LANDED: MARCH 18, 1989 PAYLOAD: • Tracking and Data Relay Satellite
STS-30 ORBITER: CHALLENGER LAUNCHED: May 4, 1989 LANDED: May 8, 1989 PAYLOAD: • Magellan Venus Orbiter	**STS-28** ORBITER: COLUMBIA LAUNCHED: August 8,1989 LANDED: August 13, 1989 PAYLOAD PROVIDED BY: • Department of Defense	**STS-34** ORBITER: ATLANTIS LAUNCHED: October 18,1989 LANDED: October 25, 1989 PAYLOAD: • Galileo • IMAX-02 • Shuttle Solar Backscatter Ultraviolet Instrument	**STS-33** ORBITER: DISCOVERY LAUNCHED: November 22, 1989 LANDED: November 28, 1989 PAYLOAD PROVIDED BY: • Department of Defense	**STS-32** ORBITER: COLUMBIA LAUNCHED: January 9, 1990 LANDED: January 19, 1990 PAYLOAD: • SYNCOM IV-05 • IMAX-03	**STS-36** ORBITER: ATLANTIS LAUNCHED: February 28, 1990 LANDED: March 5, 1990 PAYLOAD PROVIDED BY: • Department of Defense	**STS-31** ORBITER: DISCOVERY LAUNCHED: April 24, 1990 LANDED: April 30, 1990 PAYLOAD: • Hubble Space Telescope • IMAX-04
STS-41 ORBITER: DISCOVERY LAUNCHED: October 6, 1990 LANDED: October 10, 1990 PAYLOAD: • Ulysses • Shuttle Solar Backscatter Ultraviolet Instrument • Intelsat Solar Array Coupons	**STS-38** ORBITER: ATLANTIS LAUNCHED: November 15, 1990 LANDED: November 20, 1990 PAYLOAD PROVIDED BY: • Department of Defense	**STS-35** ORBITER: COLUMBIA LAUNCHED: December 2, 1990 LANDED: December 10, 1990 PAYLOAD: • ASTRO-01 • Broad Band X-Ray Telescope	**STS-37** ORBITER: ATLANTIS LAUNCHED: April 5, 1991 LANDED: April 12, 1991 PAYLOAD: • Gamma Ray Observatory • EVA Developmental Flight Experiments • Ascent Particle Monitor	**STS-39** ORBITER: DISCOVERY LAUNCHED: April 28, 1991 LANDED: May 6, 1991 PAYLOAD: • Radiation Monitoring Equipment • Air Force Programs • Strategic Defense Initiative Experiment	**STS-40** ORBITER: COLUMBIA LAUNCHED: Jun 5, 1991 LANDED: Jun 14, 1991 PAYLOAD: • Spacelab Life Sciences-1 (SLS-1) • Medical Experiments • 12 Getaway Specials	**STS-43** ORBITER: ATLANTIS LAUNCHED: August 2,1991 LANDED: August 11,1991 PAYLOAD: • Tracking and Data Relay Satellite-5 • Air Force Program; • Space Station Heat Pipe Advanced Radiator Element II

SPACE SHUTTLE MISSIONS PART II

STS-48

ORBITER: **DISCOVERY**
LAUNCHED: September 12, 1991
LANDED: September 18, 1991

PAYLOAD:
- Upper Atmosphere Research Satellite
- Investigations into Polymer Membrane Processing
- Middock 0-Gravity Dynamics Experiment

STS-44

ORBITER: **ATLANTIS**
LAUNCHED: November 24, 1991
LANDED: December 1, 1991

PAYLOAD:
- Dedicated Department of Defense Mission
- Defense Support Program Satellite
- Ultraviolet Plume Instrument
- Bioreactor Flow and Particle Trajectory Experiment

STS-42

ORBITER: **DISCOVERY**
LAUNCHED: January 22, 1992
LANDED: January 30, 1992

PAYLOAD:
- International Microgravity Laboratory-1
- Investigations into Polymer Membrane Processing
- Radiation Monitoring Experiment

STS-45

ORBITER: **ATLANTIS**
LAUNCHED: March 24, 1992
LANDED: April 2, 1992

PAYLOAD:
- Atmospheric Laboratory for Applications and Science-1
- Space Tissue Loss-1
- Visual Function Tester-2; Radiation Monitoring

STS-49

ORBITER: **ENDEAVOR**
LAUNCHED: May 7, 1992
LANDED: May 16, 1992

PAYLOAD:
- Crew Captured and Redeployed Stranded Intelsat VI Satellite
- First Space Flight to Have Three Crew Members Simultaneously Working Outside Shuttle

STS-50

ORBITER: **COLUMBIA**
LAUNCHED: June 25, 1992
LANDED: July 9, 1992

PAYLOAD:
- Microgravity Laboratory-1
- Crystal Growth Furnace
- Zeolite Crystal Growth
- Space Acceleration Measurement System
- Astroculture-1

STS-46

ORBITER: **ATLANTIS**
LAUNCHED: July 31, 1992
LANDED: August 8, 1992

PAYLOAD:
- European Space Agency's European Retrievable Carrier
- NASA/Italian Space Agency Tethered Satellite System
- Ultraviolet Plume Instrument
- Air Force Program

STS-47

ORBITER: **ENDEAVOUR**
LAUNCHED: September 12, 1992
LANDED: September 20, 1992

PAYLOAD:
- Spacelab-J;
- Israel Space Agency Investigation about Hornets
- Solid Surface Combustion Experiment
- Air Force Program
- Ultraviolet Plume Instrument

STS-52

ORBITER: **COLUMBIA**
LAUNCHED: October 22, 1992
LANDED: November 1, 1992

PAYLOAD:
- Laser Geodynamic Satellite II
- Microgravity Payload-1
- Space Acceleration Measurement System
- Attitude Sensor Package
- Modular Star Sensor

STS-53

ORBITER: **DISCOVERY**
LAUNCHED: December 2, 1992
LANDED: December 9, 1992,

PAYLOAD:
- Classified DoD Payload Deployed
- Cryogenic Heat Pipe Experiment
- Orbital Debris Radar Calibration Spheres Visual Function Test

STS-54

ORBITER: **ENDEAVOUR**
LAUNCHED: January 13, 1993
LANDED: January 19, 1993

PAYLOAD:
- Tracking and Data Relay Satellite
- Diffuse X-ray Spectrometer
- Chromosome and Plant Cell Division in Space Experiment
- Extravehicular Activity

STS-56

ORBITER: **DISCOVERY**
LAUNCHED: April 8, 1993
LANDED: April 17, 1993

PAYLOAD:
- Atmospheric Laboratory for Applications and Science-2
- Solar Ultraviolet Experiment
- First Radio Contact Between Shuttle and Russian Space Station Mir Using Amateur Radio

STS-55

ORBITER: **COLUMBIA**
LAUNCHED: April 26, 1993
LANDED: May 6, 1993

PAYLOAD:
- Spacelab Flight under German Management
- Earth Observations
- 78-inch Crystal Produced
- Robotics Experiments
- Amateur Radio Contacts with Schools and Mir

STS-57

ORBITER: **ENDEAVOUR**
LAUNCHED: June 21, 1993
LANDED: July 1, 1993

PAYLOAD:
- First Commercially-developed Spacehab, Pressurized Laboratory
- Wastewater Recycling Experiments
- Captured European Retrievable Carrier Deployed on STS-46
- Air Force Program

STS-51

ORBITER: **DISCOVERY**
LAUNCHED: September 12, 1993
LANDED: September 22, 1993

PAYLOAD:
- Deployed Advanced Communications Technology Satellite and Orbiting and Retrievable Far and Extreme Ultraviolet Spectrograph-Shuttle Pallet Satellite
- Space Tools Evaluations

STS-58

ORBITER: **COLUMBIA**
LAUNCHED: October 18, 1993
LANDED: November 1, 1993

PAYLOAD:
- Life Science Research
- Cardiovascular Investigations
- Six Rodents Killed and Dissected, Giving First Tissue Samples Collected in Space Not Altered by Re-exposure to Earth's Gravity

STS-61

ORBITER: **ENDEAVOUR**
LAUNCHED: December 2, 1993
LANDED: December 13, 1993

PAYLOAD:
- First Servicing of Hubble Space Telescope with Five Back-to-back Space Walks Totaling 35 Hours and 28 Minutes Mission Specialist Tom Akers Set New U.S. Space-walking Record of 29 Hours, 14 Minutes

STS-60

ORBITER: **DISCOVERY**
LAUNCHED: February 3, 1994
LANDED: February 11,1994

PAYLOAD:
- First Russian Cosmonaut on Shuttle Materials Science and Life Science Investigations
- Space Dust Collection Experiment; Medical/ Radiological tests

STS-62

ORBITER: **Columbia**
LAUNCHED: March 4, 1994
LANDED: March 18, 1994

PAYLOAD:
- Microgravity Payload
- Dexterous End Effector
- Limited Duration Space Environment Candidate Material Exposure
- Protein Crystal Growth
- Biomedical Tests

STS-59

ORBITER: **ENDEAVOUR**
LAUNCHED: April 9, 1994
LANDED: April 20, 1994

PAYLOAD:
- Space Radar Laboratory
- Air Pollution Measurements
- Crystals Produced Through Physical Vapor Transportation
- First Flight of New Thermal Protection Tiles Placed on Orbiter

STS-65

ORBITER: **COLUMBIA**
LAUNCHED: July 8, 1994
LANDED: July 23, 1994

PAYLOAD:
- Payload Specialist Chiaki Mukai Became the First Japanese Woman to Fly in Space, also Set Record for Longest Flight to Date by Female Astronaut
- Microgravity Laboratory; Life Sciences, Space Biolgy, and Radiation Biology Experiments

STS-64

ORBITER: **DISCOVERY**
LAUNCHED: September 9, 1994
LANDED: September 20, 1994

PAYLOAD:
- First Flight of Lidar in-space Technology Experiment
- First U. S. Untethered Extravehicular Activity in 10 years
- Robot Operated Processing System

STS-68

ORBITER: **ENDEAVOUR**
LAUNCHED: September 30, 1994
LANDED: October 11, 1994

PAYLOAD:
- Space Radar Laboratory
- Commercial Protein Crystal Growth
- Biological Research
- Military Applications of Ship Tracks
- Cosmic Radiation Monitor

STS-66

ORBITER: **ATLANTIS**
LAUNCHED: November 3, 1994
LANDED: November 14, 1994

PAYLOAD:
- Global Ozone Level Experiments
- Solar Spectrum Measurement
- Cryogenic Infrared Spectrometers and Telescopes for the Atmosphere-shuttle Pallet Satellite Released and Recovered

STS-63

ORBITER: **DISCOVERY**
LAUNCHED: February 3, 1995
LANDED: February 11, 1995

PAYLOAD:
- First Flight of a Female Shuttle Pilot
- Second Flight of a Russian Cosmonaut on
- Shuttle, First Approach by Shuttle with Russian Space Station Mir
- Biotechnology and Advanced Materials Experiments

STS-67

ORBITER: **ENDEAVOUR**
LAUNCHED: March 2, 1995
LANDED: March 18, 1995

PAYLOAD:
- Longest Shuttle Flight to Date (6.9 million miles)
- Astro Observatory
- Hopkins Ultraviolet Telescope;
- First Advertised Shuttle Mission Connected to Internet

STS-71

ORBITER: **ATLANTIS**
LAUNCHED: June 27, 1995
LANDED: July 7, 1995

PAYLOAD:
- First U. S. Space Shuttle-Russian Space Station Mir Docking and Joint On-orbit Operation
- Largest Spacecraft Ever in Orbit
- First On-orbit Chhangeout of Shuttle Crew
- Men/Equipment Transfer to Mir

STS-70

ORBITER: **DISCOVERY**
LAUNCHED: July 13, 1995
LANDED: July 22, 1995

PAYLOAD:
- Tracking & Data Relay Satellite Deployed
- Biological Research
- Microgravity, Protein Crystal Growth,
- SpaceTissue Loss, Microencapsulation Experiments

STS-69

ORBITER: **ENDEAVOUR**
LAUNCHED: September 9, 1995
LANDED: September 20, 1995

PAYLOAD:
- First Time Two Different Payloads Retrieved and Deployed During Same Flight
- Extravehicular Activity Practice for Space Station Activities
- Space Suit Design Modifications Evaluated

STS-73

ORBITER: **COLUMBIA**
LAUNCHED: October 20, 1995
LANDED: November 5, 1995

PAYLOAD:
- Fluid Physics, Materials Science, Biotechnology, Combustion Science, and Commercial Space Processing Experiments

STS-74

ORBITER: **ATLANTIS**
LAUNCHED: November 12, 1995
LANDED: November 20, 1995

PAYLOAD:
- Second Docking with Space Station Mir
- Experiment Samples from Mir Were Transferred to Shuttle for Return to Earth
- Equipment and Supplies Given to Mir

STS-72

ORBITER: **ENDEAVOUR**
LAUNCHED: January 11, 1996
LANDED: January 20, 1996

PAYLOAD:
- Retrieved Japanese Satellite
- Physiological and Anatomical Rodent Experiment
- Space Tissue Loss;
- Protein Crystal Growth
- Human Insulin Experiments

STS-75

ORBITER: **COLUMBIA**
LAUNCHED: February 22, 1996
LANDED: March 9, 1996

PAYLOAD:
- U.S./Italian Tethered Satellite System (Tether Snapped- Satellite Eventually Burned Up in Earth's Atmosphere)
- Isothermal Dendritic Growth and Space Acceleration Experiments

STS-76

ORBITER: **ATLANTIS**
LAUNCHED: March 22, 1996
LANDED: March 31,1996

PAYLOAD:
- Third Linkup Between Shuttle and Space Station Mir
- Shannon Lucid Becomes First U.S. Woman to Live on Mir
- European Space Agency's Biorack Experiments

STS-77

ORBITER: **ENDEAVOUR**
LAUNCHED: May 19, 1996
LANDED: May 29, 1996

PAYLOAD:
- Spacehab, Supporting Experiments in Biotechnology, Electronic Materials, Polymers, and Agriculture
- Global Positioning System
- Attitude and Navigation Experiments
- Aquatic Research

STS-78

ORBITER: **COLUMBIA**
LAUNCHED: June 20, 1996
LANDED: July 7, 1996

PAYLOAD:
- Life and Microgravity Spacelab
- Bone and Tissue Loss Study
- Sleep Study
- Fluid Physics
- Advanced Gradient Heating Facility
- Advanced Protein Crystallization Facility

STS-79

ORBITER: **ATLANTIS**
LAUNCHED: September 16, 1996
LANDED: September 19, 1996

PAYLOAD :
- First U.S. Crew Exchanged from Russian Space Station Mir, and Fourth Shuttle-Mir
- John E. Blaha Replaced Shannon W. Lucid
- Lucid's Stay on Mir Set a New World's Record for a Woman in Space---188 days
- Supplies Brought to Mir by Shuttle

STS-80

ORBITER: **COLUMBIA**
LAUNCHED: November 19, 1996
LANDED: December 7, 1996

PAYLOAD:
- Shuttle-Mir Flight Resupply Mission
- Deployed Orfeus-Spas II Satellite
- Story Musgrave, Age 61, Became the Oldest human to Fly in Space
- Space Vision System, Designed to Monitor Positions and Alignment of Structures in Space

STS-81

ORBITER: **ATLANTIS**
LAUNCHED: January 12, 1997
LANDED: January 22, 1997

PAYLOAD:
- Shuttle-Mir Docking, Returning John Blaha to Earth after 118 Days, Leaving Jerry M. Linenger on Mir
- Brought Back First Plants to Complete a Life Cycle in Space---A Crop of Wheat Grown from Seed to Seed

STS-82

ORBITER: **DISCOVERY**
LAUNCHED: February 11, 1997
LANDED: February 21, 1997

PAYLOAD:
- Servicing and Upgrading of the Hubble Space Telescope
- Discovery Fired Its Maneuvering Jets to Boost Hubble's Orbit an Additional Eight Miles Higher
- Five Space Walks Conducted to Replace Various Telescope Instruments

STS-83

ORBITER: **COLUMBIA**
LAUNCHED: April 4, 1997
LANDED: April 8, 1997

PAYLOAD:
- First Flight of Microgravity Science Laboratory
- Fire-related Experiments
- Due to Fuel Cell Problems, Mission Canceled on Day Four

AEROSPACE EDUCATION

ACHIEVEMENT AWARD

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has successfully completed

THE AEROSPACE EDUCATION LEARNING PACKET ON THE SPACE SHUTTLE

Given this _____ day of _____ 19____

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Teacher Principal