

A Ride on the Space Shuttle Teacher's Guide



The following teacher's guide is designed to help you prepare your students for their upcoming presentation of *A Ride on the Space Shuttle* when Northern Stars Planetarium visits your school. Enclosed you will find some basic information about the Space Shuttle. You will find vocabulary, study questions, and diagrams that can be labeled and/or colored. Please be aware that some of the material in this guide may seem a bit old or young for your particular class, this is because this presentation is adapted for several different grade levels. Please use only what you feel is appropriate for your student's age level.

Program Outline:

1. Shuttle launch montage
2. Student Quiz
3. Examine the parts of the Space Shuttle and their uses
 - A. Solid Rocket Boosters
 - B. External Tank
 - C. Orbiter
 - a. The crew module
 - b. The cargo bay
 - c. The engines, wings, and tail
4. The many uses of the Shuttle
5. Astronaut Training
6. *Challenger* Accident
7. What a flight is like
 - A. Lift off
 - B. Effects of weightlessness
 - C. Jobs that need to be done
 - D. Eating, personal hygiene, working, & sleeping
8. A few significant recent missions
9. Views of Earth and Space
10. Star and Constellation point-out
11. Landing the Shuttle

The Space Shuttle Fleet

Enterprise The first Space Shuttle. It was built in 1977 and never flew in space. It was used to test landing procedures after being released from a piggy back position on a specially equipped Boeing 747. Today it is owned by the Smithsonian Institute and can be viewed at Dulles Airport, near Washington, D.C.

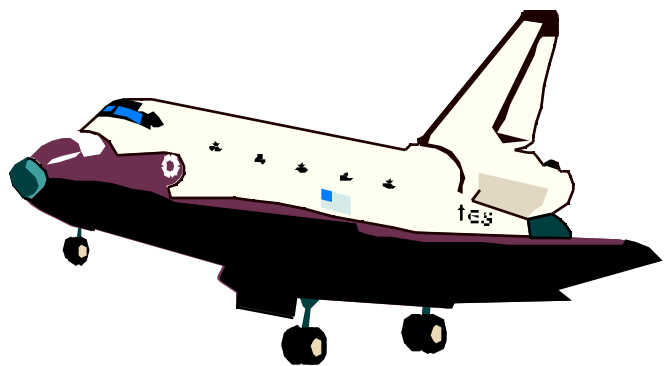
Columbia The first Shuttle to fly into space. Its first flight was on April 12, 1981. *Columbia* flew 28 missions into space. *Columbia* was destroyed when it burned up on re-entry from orbit on February 1, 2003. The accident appears to have been the result of a falling piece of foam from the external tank hitting a wing during liftoff. The damaged tiles along the wing allowed excessive structural heat during re-entry and the orbiter disintegrated, taking the lives of the seven astronauts on board.

Challenger The second Shuttle to fly into space. Its first flight was on April 4, 1983. It was originally built as a test project, similar to *Enterprise*, but was later modified for space flight. It flew on nine missions before it exploded due to a solid rocket booster malfunction 73 seconds after launch on January 28, 1986. Seven astronauts died in that accident, including Christa McAuliffe, a school teacher from New Hampshire who was to be the first "Teacher in Space".

Discovery The third Shuttle to take flight. Its first flight was on August 30, 1984. *Discovery* has flown more than 25 missions into space. It is still in active service.

Atlantis The fourth Shuttle to actively fly. Its first space flight was on October 3, 1985. *Atlantis* has flown more than 20 missions into space. It is still in active service.

Endeavor This Shuttle was built to replace *Challenger*. Its first launch was on May 7, 1992. *Endeavor* has flown more than 12 missions into space. It is still in active service.



Vocabulary

Cargo Bay The area behind or aft of the living quarters. It comprises the largest part of the Space Shuttle. There are two huge doors that open during flight. From this area, satellites are launched.

Challenger Accident On January 28, 1986 the Space Shuttle *Challenger* exploded 73 seconds into the flight. The explosion was due to a leak from one of the Solid Rocket Boosters. The explosion killed all seven astronauts on board, including Christa McAuliffe, who was to be the first "Teacher in Space".

Cockpit The forward section of the Space Shuttle's living area. This is where the pilot actually flies the Shuttle.

Constellation A group of stars that form a picture in the night sky. There are 88 official constellations in the night sky.

External Fuel Tank The large fuel tank that is attached to the Shuttle during launch and supplies the Shuttle's main engines with the fuel they need at lift off. The fuel tank is divided into two compartments for the two fuels; the bottom half contains 383,000 gallons of liquid hydrogen, while above sits another compartment that holds 143,000 gallons of liquid oxygen. This is the only part of the Space Shuttle system that is not used over again.

International Space Station or ISS This structure, assembled in space, provides scientists with a continual presence in space from which to conduct long-term experiments. The Space Shuttle provides modules for its construction and expansion, as well as supplies for those living on board the ISS.

Manned Maneuvering Unit or MMU A sort of "jet pack" worn by astronauts during space walks. It gives them free maneuvering ability while space walking.

Payload The payload is whatever the Shuttle is carrying into space. Typical payloads are satellites, experiments, space probes, components to the International Space Station, etc.

Remote Manipulator Arm A mechanical arm that is operated from inside the crew module. It can be used to work on a payload, to capture a damaged satellite, or to aid in many various experiments or constructions. It was designed and funded by Canada.

Solar Max The popular name of the Solar Maximum Satellite that was originally launched in February 1980 to study the Sun. Nine months later it failed. In 1984, the Shuttle *Challenger* retrieved Solar Max and astronauts made the first repair in space of a broken satellite. It was then placed back into orbit.

Solid Rocket Boosters or SRBs The two rockets attached to the side of the Shuttle during launch. They use solid rocket fuel, rather than liquid fuel. They represent the first use of solid fuel rockets in manned space flight. The rockets can be refueled and used over after each launch.

Space Shuttle the Space Shuttle is the first reusable space vehicle. Its official name is the **Space Transportation System** or **STS**. It takes off like a rocket, and lands like an airplane on a runway. It routinely flies carrying seven astronauts. It has been likened to a space truck, because the majority of the vehicle's capacity is set aside for cargo, such as satellites, space probes, experiments, and components.

Study Questions

1. Name the three major parts of the Space Shuttle.
2. What makes the Space Shuttle different from all previous manned spacecraft?
3. What is the sequence of events that take place during a Shuttle launch?
4. Why is the base of the Shuttle sprayed with thousands of gallons of water just seconds before lift off?
5. How long does it take the Space Shuttle to reach space after lift off?
6. How fast does the Shuttle fly in orbit?
7. Why do the cargo bay doors have to be opened once the Shuttle is in orbit?
8. Why did the Shuttle flights come to a stop for more than two years after the *Challenger* accident of 1986?
9. Why does the toilet on the Shuttle have leg restraints?
10. Describe how the Shuttle lands back on the ground.
11. Why does the Shuttle have wings?
12. Why is the Shuttle covered with thousands of heat shielding tiles?
13. How many astronauts are needed to fly the Space Shuttle?
14. How many astronauts can fly on Space Shuttle at once?
15. Who was the first American woman to fly in space?
16. Has the United States allowed any non-U.S. citizens to fly on the Shuttle?



Answers: 1. Orbiter, External Fuel Tank, Solid Rocket Boosters. 2. Reusable, lands like an airplane, carries more people, uses both solid and liquid fuels. 3. Main Engines ignite at T-6 seconds, at zero the solid rocket boosters ignite, at 2 minutes the SRBs are ejected, at 8 minutes the external tank is released and the Shuttle is in space. 4. To quiet noise and vibration. 5. 8 minutes. 6. 17,590 m.p.h.. 7. There are cooling panels on the inside of the doors that cool the Shuttle after launch. 8. To find out the cause of the accident and make necessary changes. 9. To hold you in place while you use the toilet! 10. Like a glider on a runway. 11. The wings are only utilized during landing, for gliding through the air to the runway. 12. They keep the Shuttle from incinerating due to the intense heat created from friction upon re-entry into Earth's atmosphere. 13. 2 astronauts. 14. The record is 8 astronauts, but 7 is much more common. 15. Sally Ride aboard *Challenger* on June 18, 1983. 16. Yes, people from numerous other countries have flown aboard the Shuttle, including West Germany, Russia, Canada, France, Saudi Arabia, Mexico, Japan, and more.

Word Search

C H A L L E N G E R D M S D
S E N G I N E S L Q H F A F
P X H F L O A T W I N G T E
A T S R B O Z P O Z D M E X
C E R P K G P R N X V E L P
E R O C A R G O B A Y M L E
S N C G A C S B R Q S H I R
U A K H S Z E E F B Y A T I
I L E V T R G S M G I V E M
T T T C R M S X H P G T L E
P A Y L O A D X F U E L O N
D N V A N L P I L O T H M T
C K Y U A H U K L D Q T F Z
C L X N U L Z M M U O Y L L
R E Q C T Y O C B G H N P E
X D E H D A V D T I L E A A
E M I S S I O N E N A S T L

Find the following words in the puzzle above, either vertically, horizontally, or diagonally. Good Luck!

ASTRONAUT

EXTERNAL TANK

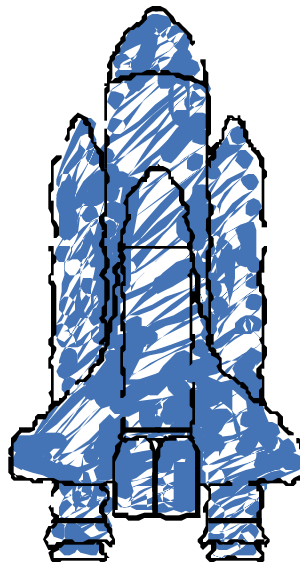
ENGINES CARGO BAY

CHALLENGER ROCKET

ORBIT SATELLITE

PILOT MMU

TILE FLOAT WING



SPACE SHUTTLE

PAYLOAD

NASA COLUMBIA

LAUNCH FUEL

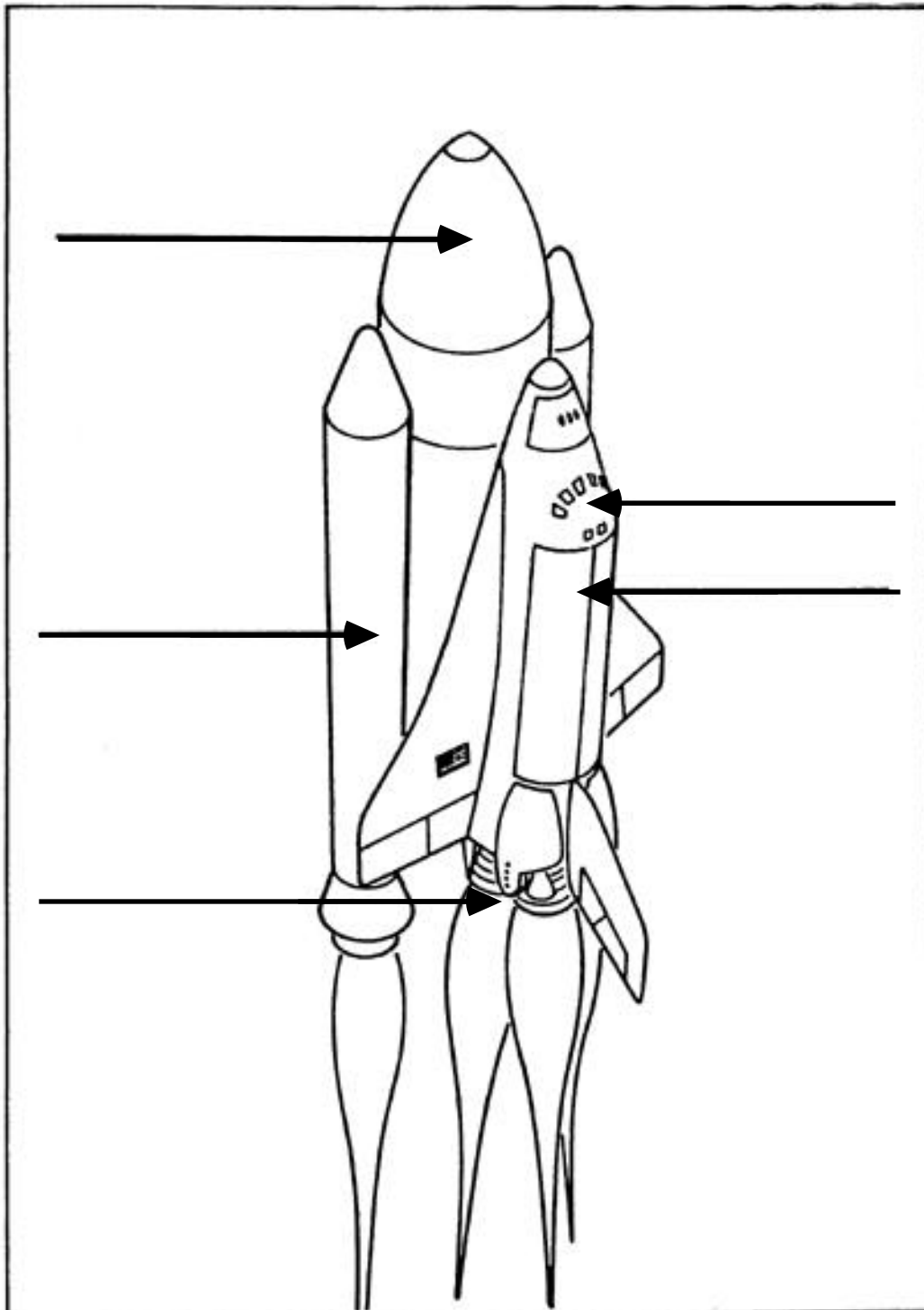
SRB MISSION

EXPERIMENT GLIDE

SPACESUIT PROBE

Color & Label the Parts of the Space Shuttle

Parts: External Tank / Solid Rocket Boosters / Cargo Bay / Main Engines / Crew Compartment



THE SPACE SHUTTLE

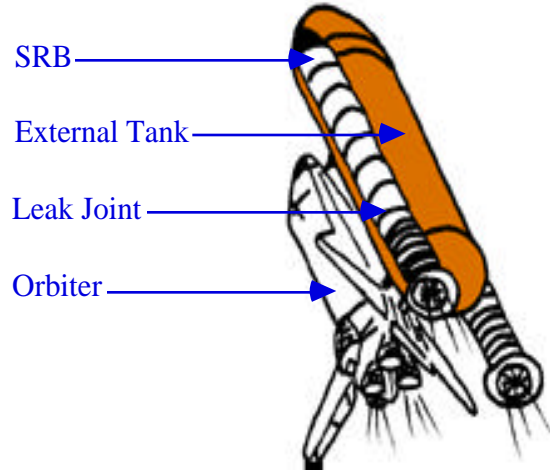
A Point of Discussion : *The Challenger* Accident

Whenever a discussion of the Space Shuttle arises, kids are often loaded with questions about *Challenger* and why it “blew up”. This page is designed to give you some background information about the accident.

Crew: Francis “Dick” Scobee, Commander
Michael Smith, Pilot
Ellison Onizuka, Mission Specialist
Judy Resnik, Mission Specialist
Ronald McNair, Mission Specialist
Gregory Jarvis, Payload Specialist
Christa McAuliffe, “Teacher in Space”

Date: January 28, 1986 11:38 a.m.

What Happened: The ground temperature was 36°F, fifteen degrees cooler than any previous launch. This caused a lot of ice to build up around the Shuttle. Within one second after ignition a black puff of smoke was seen coming from a joint on the right Solid Rocket Booster (SRB). At 45 seconds three bright flashes were seen near the right wing. At 72 seconds the lower strut holding the right SRB broke loose and the SRB began to twist and turn. At 73 seconds a flame from the right SRB cut into the External Tank, releasing massive amounts of hydrogen. The twisting SRB then punctured the upper oxygen tank of the External Tank. At this point, at Mach 1.92 (nearly twice the speed of sound) and at an altitude of 46,000 feet, *Challenger* burst into a large ball of fire. The Orbiter then broke apart into several pieces. The SRBs flew off separately into the air, while the remains of the Orbiter fell into the Atlantic Ocean more than eight miles below.



Analysis: Scientists and Engineers believe that the cold temperatures that morning made the joints between the sections of the SRBs contract. The joints were supposed to be sealed by a special gasket called an “O-Ring”. The O-Ring seal didn’t hold in the cold weather and a plume of fire escaped through the broken seal and eventually ignited the External Tank.

Design Changes Made as a Result of the Accident:

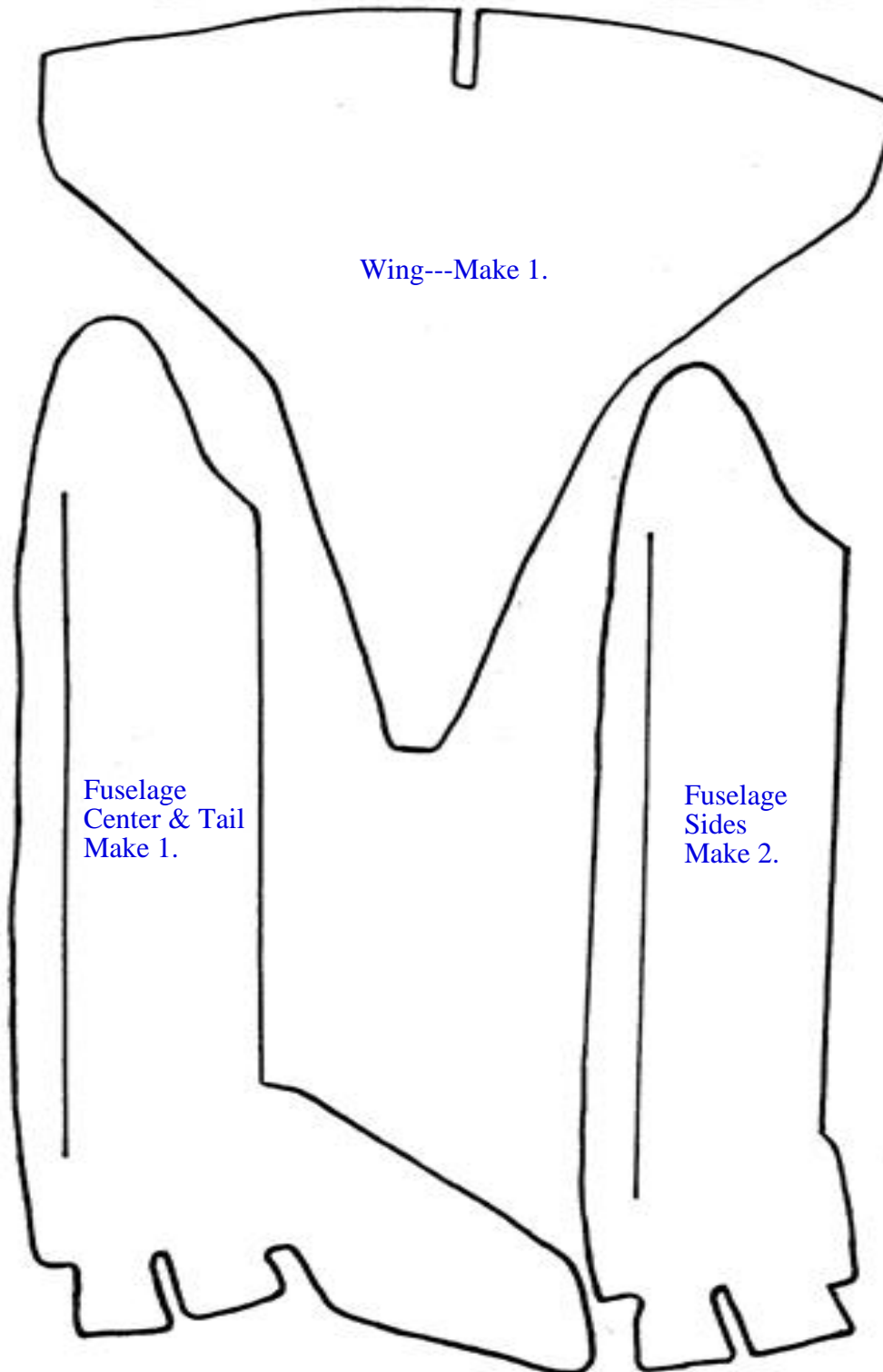
1. The joints between the sections of the SRBs were redesigned with more O-Rings.
2. More stringent safety standards were set.
3. New minimum temperature standards were set for launches.
4. The chain of command was restructured for launch decisions.
5. Many systems were updated throughout the Shuttle fleet.
6. *Challenger* would be replaced by a new Shuttle named *Endeavor*.

“The future is not free: the story of all human progress is one of a struggle against all odds. We learned again that this America, which Abraham Lincoln called the last, best hope of man on Earth, was built on heroism and noble sacrifice. It was built by men and women like our seven star voyagers, who answered a call beyond duty, who gave more than was expected or required, and who gave it little thought of worldly reward....The future doesn’t belong to the faint hearted. It belongs to the brave. The *Challenger* crew was pulling us into the future, and we’ll continue to follow them.”

---President Ronald Reagan, January 31, 1986

Make a Flying Model of the Space Shuttle!

Fashion parts from styrofoam meat trays or light cardboard. Glue body segments together with white glue. When dry, smooth and round the edges with sandpaper or an emery board. Cut the wing slot with a sharp knife. A nose weight fashioned from modeling clay or paper clips may be helpful. Design, courtesy of NASA.



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(Usage Guide: Y=Young Student Book / T=Teacher Resource / A=Adult or Older Student Level)

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