

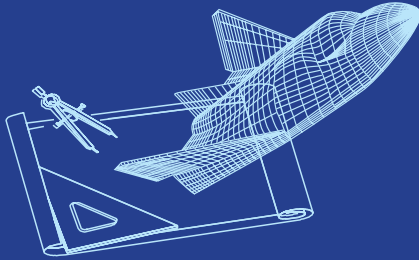
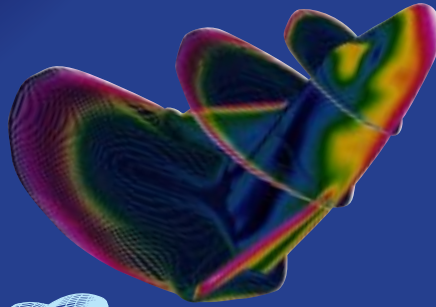
How to Design a Spaceship

Take a trip into space:

Where would you go?

What kind of spaceship
would you design?

How would you build it?



Mission Purpose

Design

Analyses

Fabrication

BLASTOFF!

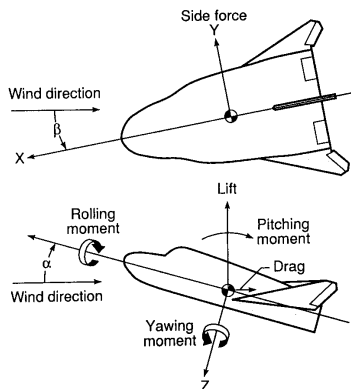


If you could take a trip into space, where would you go? What kind of spaceship would you design? How would you build it?

These questions are asked at NASA's Langley Research Center. There, engineers are finding the answers they need to design vehicles for space missions. It can take them many years of dedicated research to find the right type of design and the right materials to withstand the incredible hot and cold of space travel. Their designs must pass many hours of rigorous testing and be built easily and affordably. It's a tough job to design a spaceship!

What is a Spaceship?

A spaceship is a vehicle designed to travel to and orbit in space. The payload, or what is carried into space – a telescope, sensor device, or people – is contained within the launch vehicle which lifts the payload into space. Today, launch vehicles have several stages that drop off during the launch, but in the future, the launch vehicle or spaceship will have only one stage.



5 STEPS TO BLASTOFF

✓ STEP ONE: *Mission Purpose*

What is the purpose of the mission? What is the payload? How big is the payload and how much support does it need? These have to be determined before anything else. Then engineers can decide if the mission is possible.

✓ STEP TWO: *Design*

What kind of payload and its special needs determine the overall design – the shape, size and configuration – of the launch vehicle. If people are going, there are very special requirements.

The spaceship must be designed to include all of the support systems for the mission, such as power, oxygen, propellants.

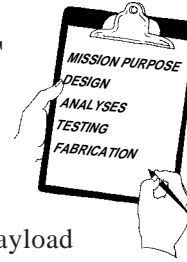
✓ STEP THREE: *Analyses*

NASA Langley engineers look very closely at the structure of a launch vehicle. They must analyze its aerodynamic capabilities. Aerodynamics has to do with the motion of air on the vehicle as it is moving through the Earth's atmosphere and the effects on the vehicle.

Engineers analyze flight performance, identify heating requirements and capabilities. They also select appropriate new materials for the job, and consider how to minimize cost and weight. Every pound of structure takes up to 10 more pounds to get it into space – and back. And every pound of structure raises the cost of the mission.

✓ STEP FOUR: *Testing*

Once the launch vehicle has been designed by computer, it must be tested. It is time to build actual parts of the vehicle and test them for performance, vibration and heat resistance.



Some tests are done in a wind tunnel where air is blown across a part at high speeds. A small-scale model of the whole spaceship is tested to measure how the air flows over it. This helps to determine how the design and configuration are working.

Components which do not meet performance requirements are then redesigned and retested.

✓ STEP FIVE: *Fabrication*

Once a final design passes all tests, a full-scale model or mock-up is fabricated. From there a prototype, or flight vehicle, may be built, then tested in flight for many hours to assure the quality of design. If it passes all the test flights, it is ready to be manufactured and assembled for operational use.

Are you ready for your mission? Do you think your spaceship would pass the tests? It all starts with an idea. So get a pencil and start sketching. The sky's the limit!

Classroom Activities

1. After designing a spaceship, make a model of it in clay. Coat it with oil tinted with food color. Place it in a large box or surround it with a cardboard fence. Aim a fan or hair dryer at it, creating a wind tunnel. See how the oil has traveled. You have determined some aerodynamic characteristics of your model.
2. Research the steps involved in the design and construction of the current space shuttle. Find out how long it took and how many hours of testing it required before actual missions.
3. Compare the steps in designing a spaceship to designing a car. (See past issues of car magazines or contact the Research and Development department of any auto manufacturer.)