

SPACE

FACT VS FICTION

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Topics to Discuss

- Gravity
- Living in space
- Space Solar Power
- Star Trek Devices

Gravity

- **Shooting down satellites**
- **Falling into the sun**
- **Dropping bombs from satellites**
- **Weightlessness, zero gravity & free fall**
- **Escaping Earth's gravity**
- **Zero-gravity rooms at NASA**
- **Extraterrestrial Sports**

Shooting Satellites Down



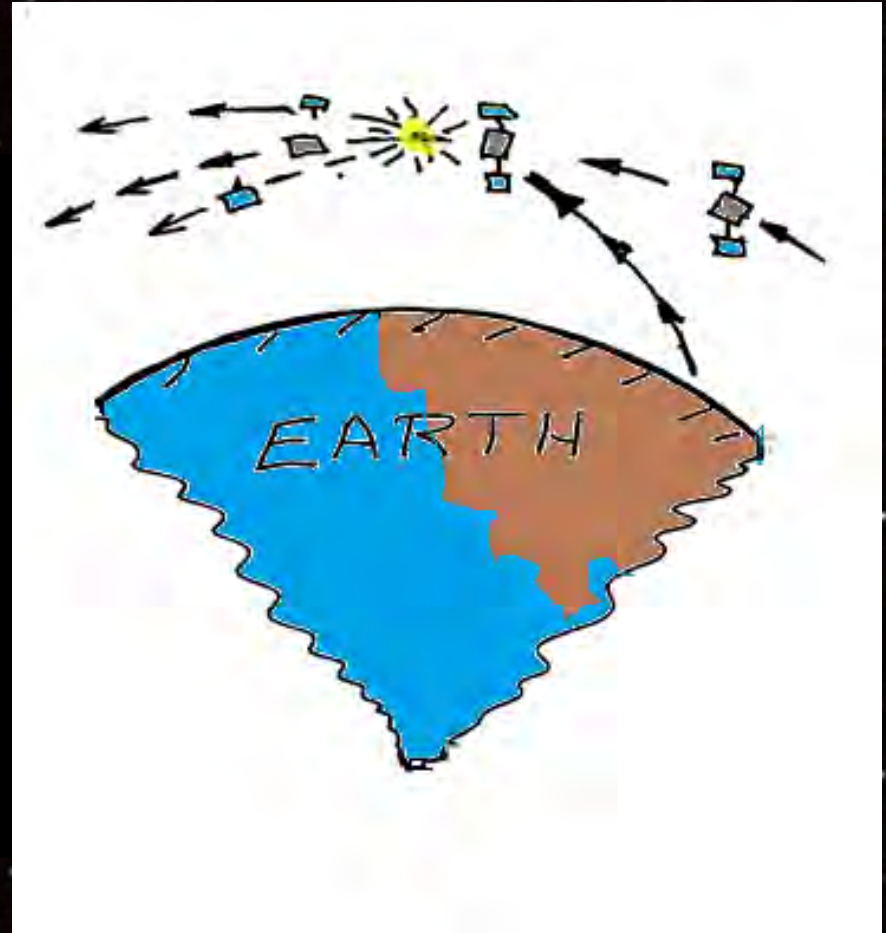
● **Fiction:**

Satellites would fall to Earth if we were to “shoot them down”

Satellite “Shoot Down”

- **Fact:**

Satellites shattered in a “shoot down” would just stay in orbit – making more space debris



Dropping Bombs from Satellites

- **Fiction:**

Satellites are good bomb platforms – other countries could drop bombs on us from satellites

- **Fact:**

The bombs are also in orbit. When “dropped”, they would fly right along with the satellite that dropped them

Falling into the Sun



- **Fiction:**

If we are not careful, our spacecraft could fall into the Sun

Falling into the Sun

- **Fact:** It is much easier to escape the solar system than to fall into the Sun
 - It takes about 20,800 mph to reach Low Earth Orbit from Earth's surface
 - From Low Earth Orbit to the Sun requires a speed of 48,340 mph (**69,140 mph total**)
 - From Low Earth Orbit to solar system escape requires a speed of 19,636 mph (**40,436 mph total**)

Weightlessness, Zero-Gravity, and Free Fall



Zero-Gravity or Weightlessness

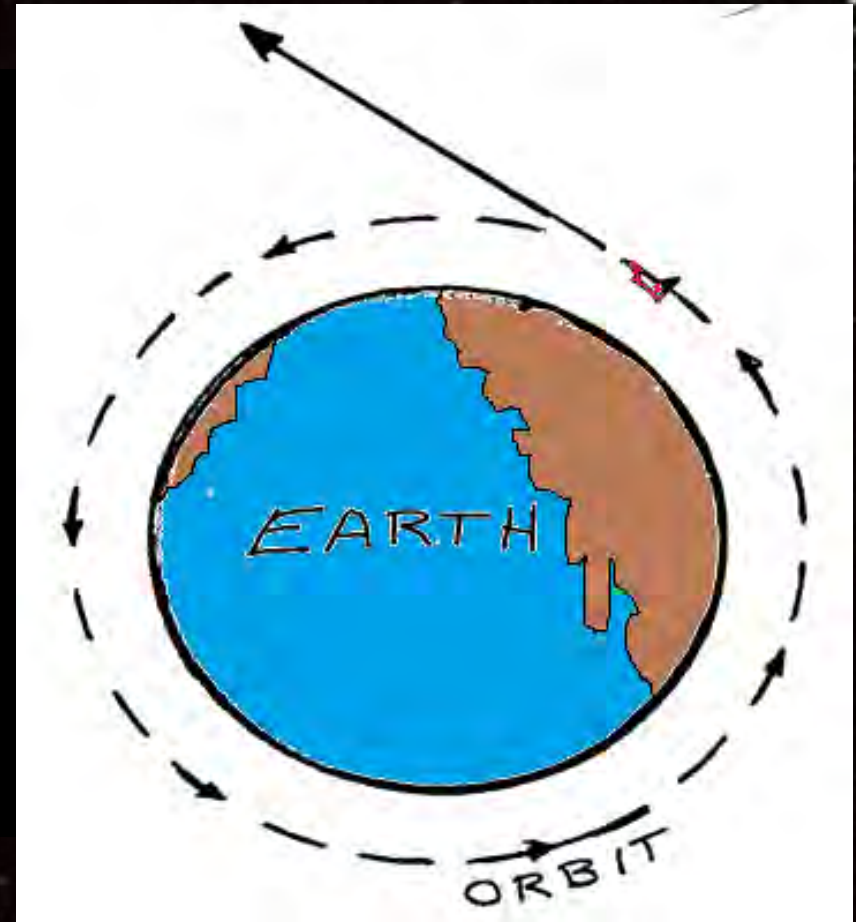
- **Fiction:**

In orbit, there is zero gravity.

Things and people are weightless.

Consequence of Zero-Gravity

- **Fact:**
In true zero-gravity, orbits are impossible. Things in orbit would move away from the Earth in a straight line. All astronauts would be “Lost in Space”.



Escaping Earth's Gravity

- **Fiction:**
In orbit, we have escaped Earth's gravity
- **Fact:**
There is gravity in orbit
- **Fact:**
If we get far enough away from Earth, the gravity of the Sun makes Earth's gravity negligible

Zero-Gravity Rooms at NASA

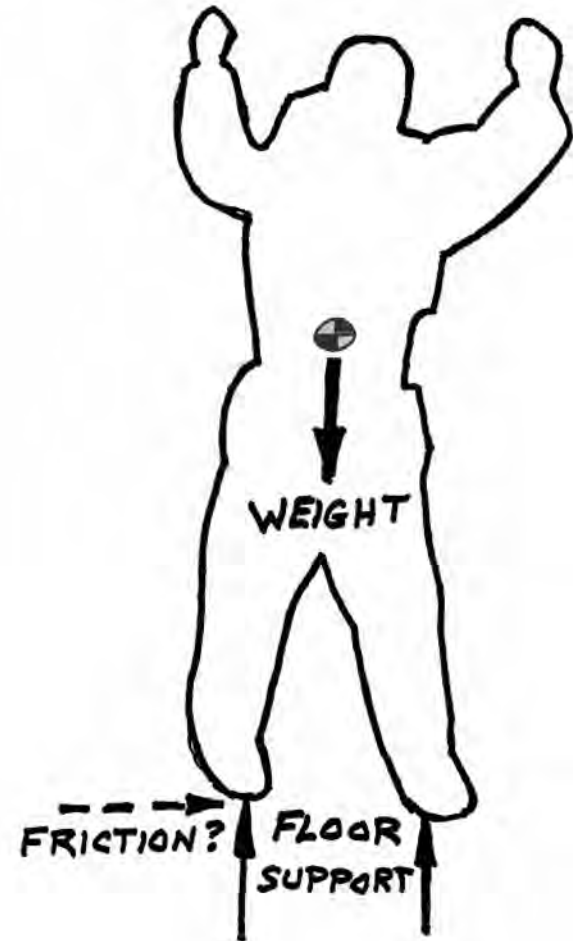
- **Fiction:**

There is a “room” at NASA where the astronauts can go to experience “**zero gravity**”.

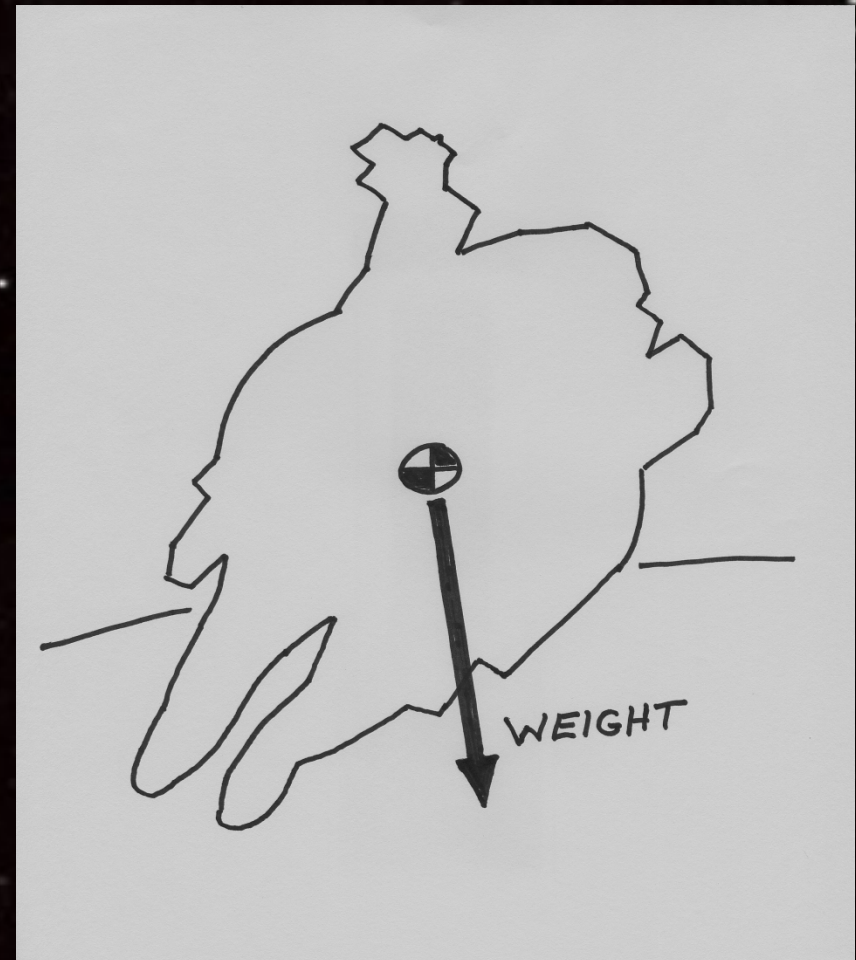
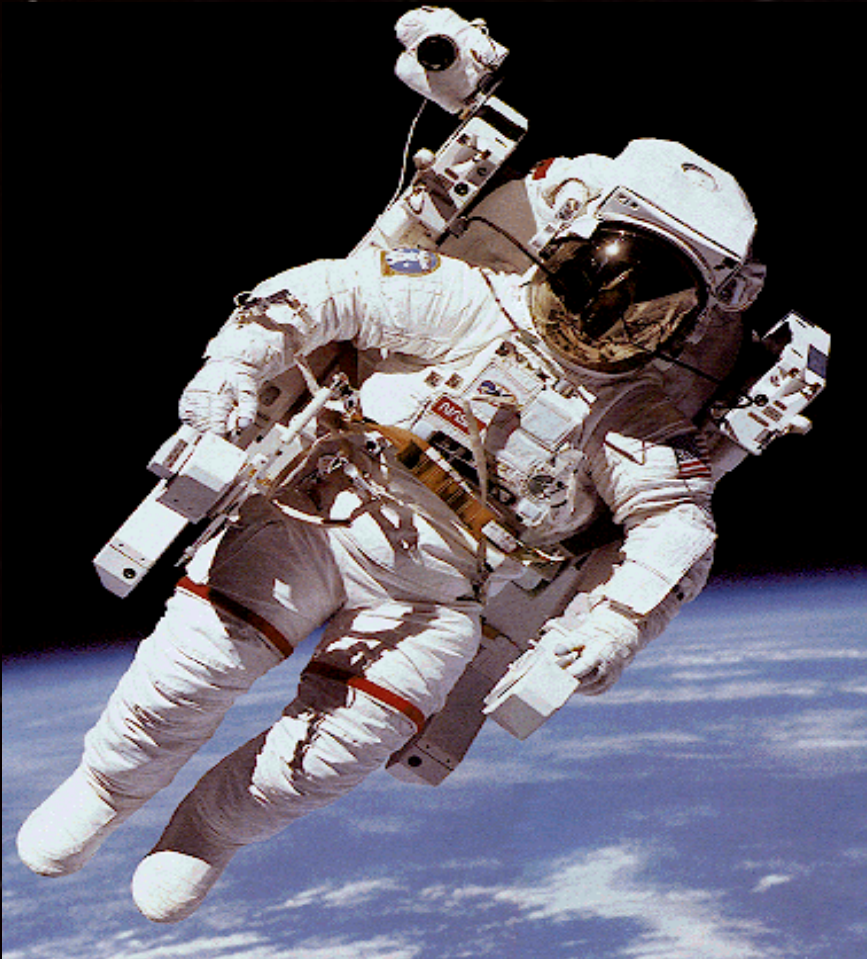
- **Fact:**

“**Zero Gravity**” is **free fall**, we can **free fall** for seconds off of a diving board, minutes in Sub-orbital flight, etc., but never standing in a room on Earth.

Forces On Earth



Forces In Space



ON ORBIT ENVIRONMENT

- No contact forces on adjacent objects (free fall)
- No up or down references
- No "dropping of objects" (they float in free fall)
- No natural convection (heat does not "rise")
- Air circulation is a major factor (it must be forced)

NASA's “Zero-g” Simulators

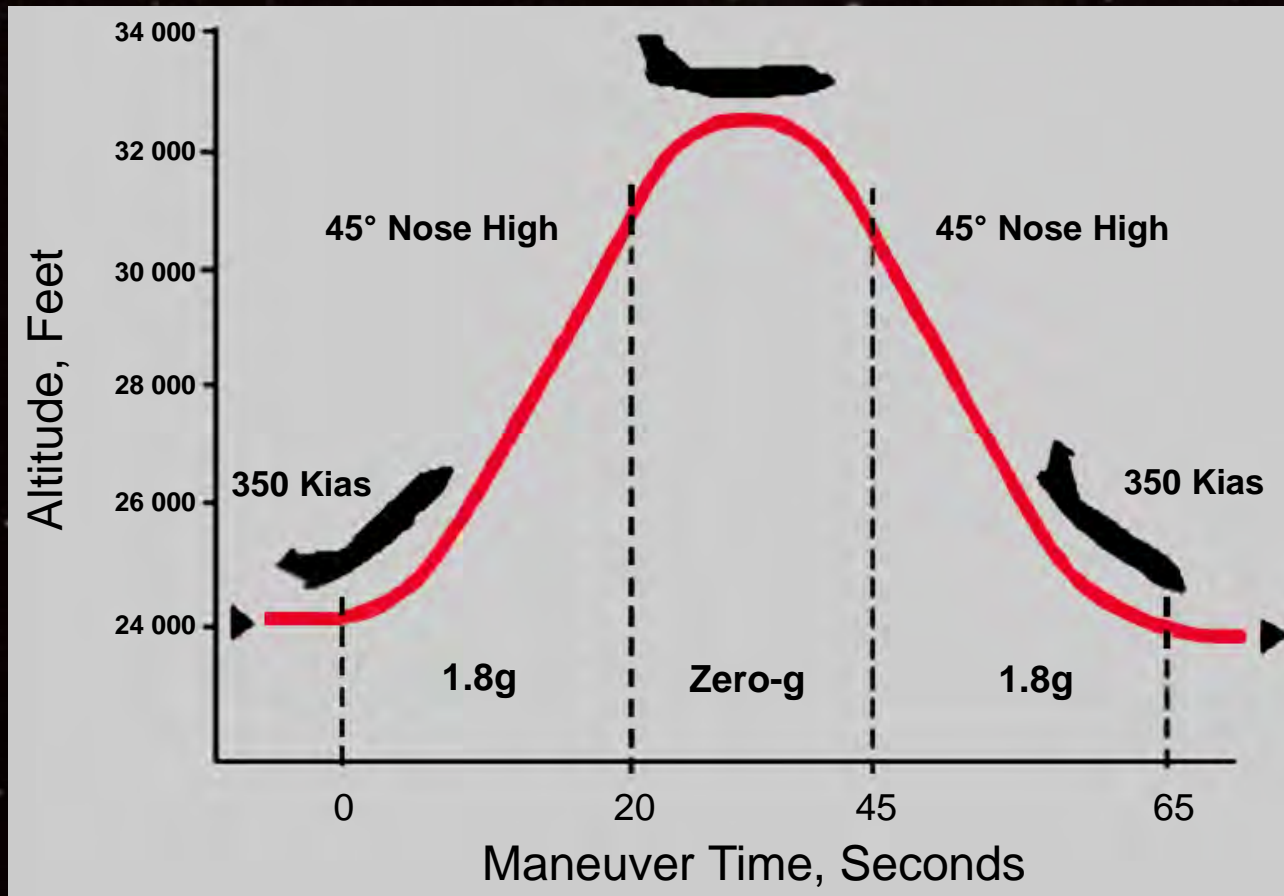


KC -135A, C-9, Now Commercial



Neutral Buoyancy Laboratory

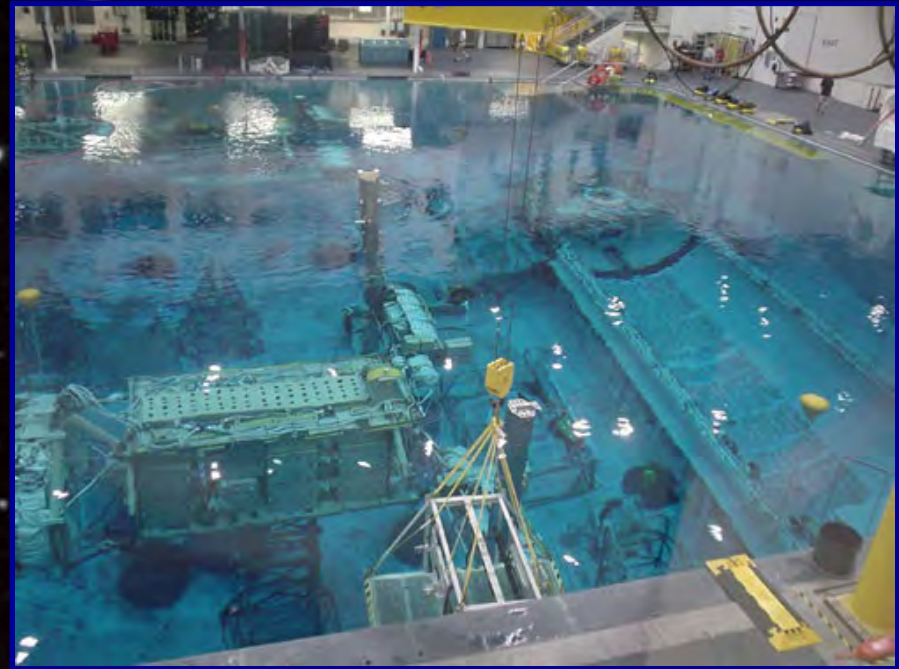
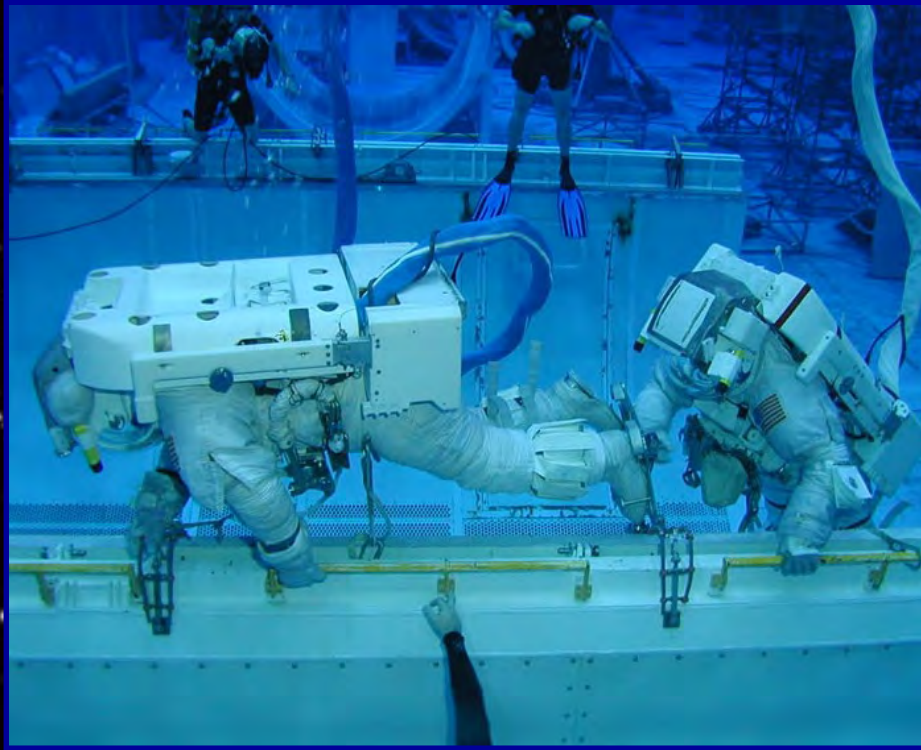
Flight Profile

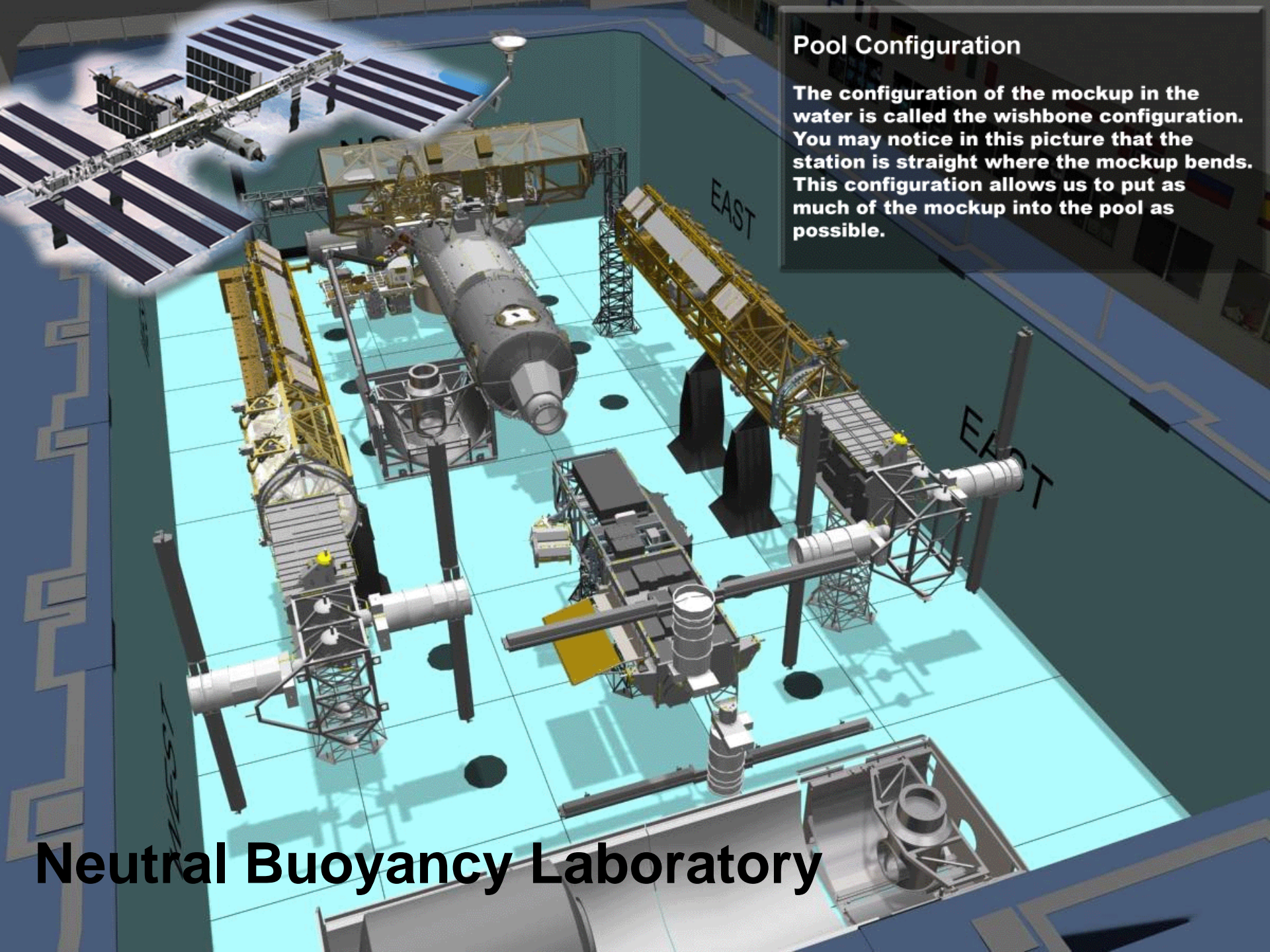


Vomit Comet - **Weightless Wonder** – **Zero G**

Neutral Buoyancy Laboratory

Johnson Space Center, Houston Texas





Pool Configuration

The configuration of the mockup in the water is called the wishbone configuration. You may notice in this picture that the station is straight where the mockup bends. This configuration allows us to put as much of the mockup into the pool as possible.

Neutral Buoyancy Laboratory

Neutral Buoyancy Laboratory is a big deep pool!

- 102 ft. wide by 202 ft. long
- 40 ft. deep
- Capacity
 - Volume = 824,160 cubic feet
 - 6.2 million gallons of water
 - 49.6 million pounds of water

Space Olympics

How Gravity Affects

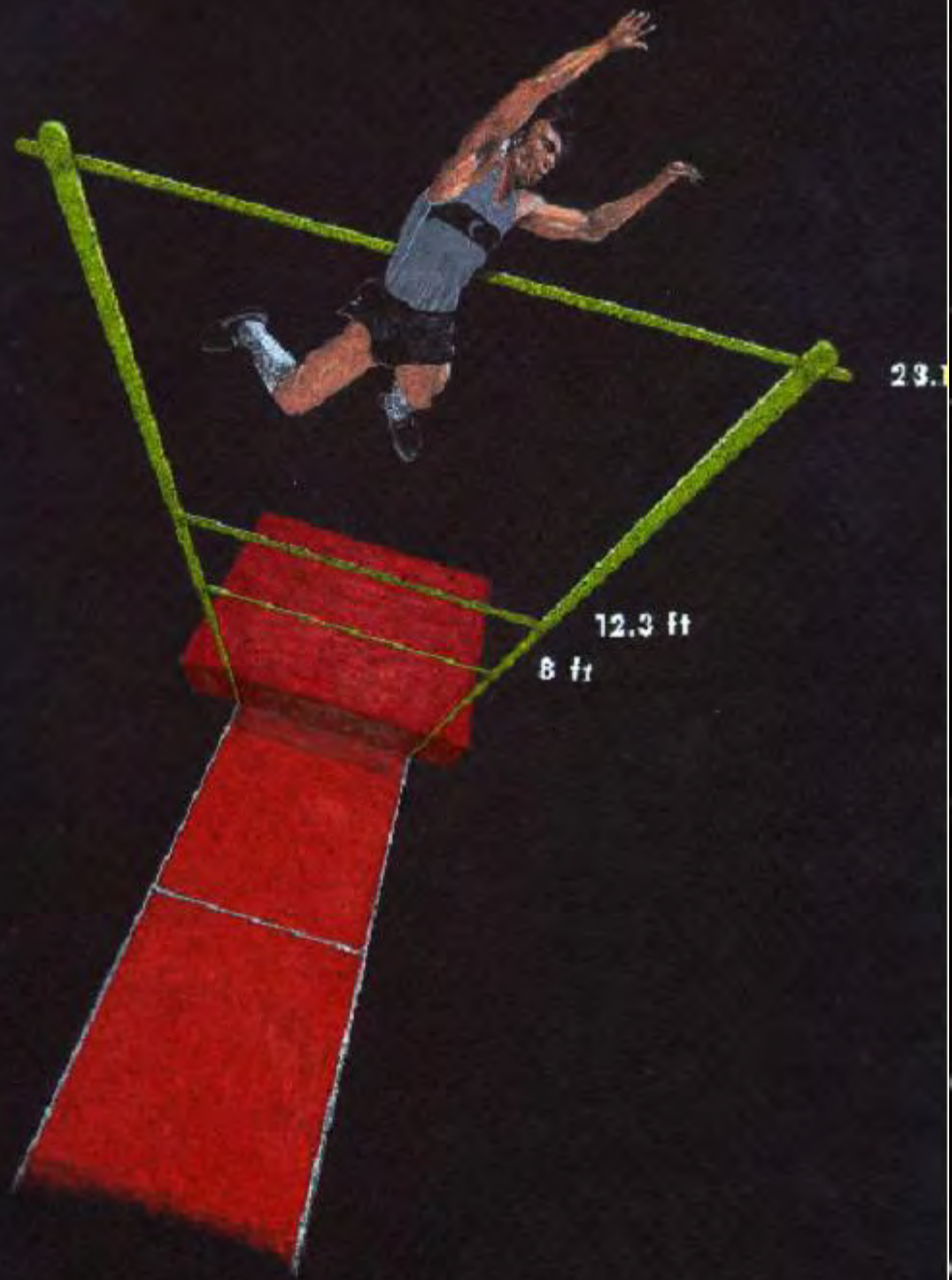
Sports

Sports Sites



Gravity, Reaction Forces, & Friction

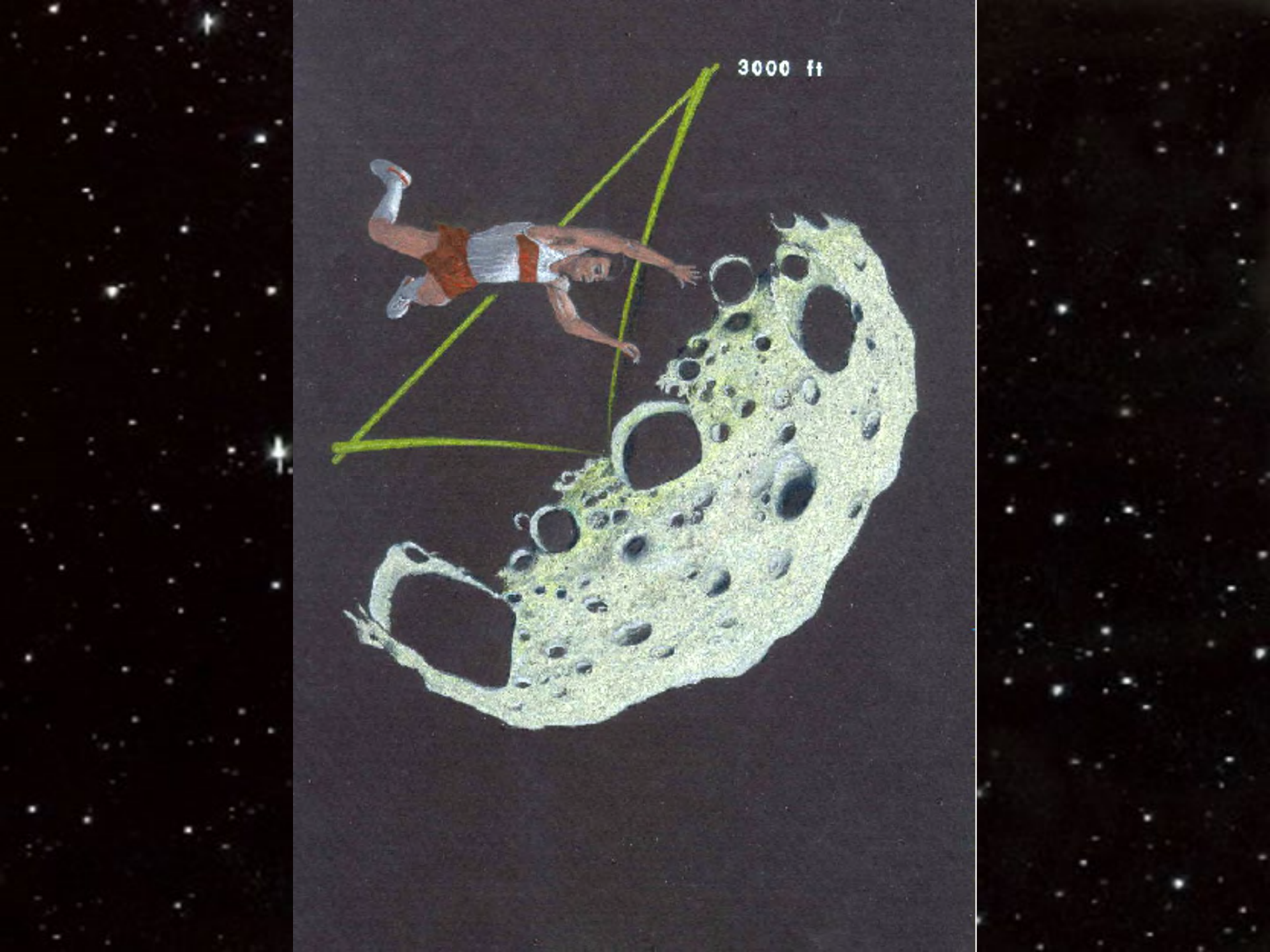
- Earth 100 % (of what we know)
- Mars 40 %
- Moon 17%
- Phobos 0.1% (1/1000 of what we know)



23.1

12.3 ft

8 ft



3000 ft

100 METER RUN (NO STARTING BLOCKS, NO SPIKES)

Earth Surface Record 10.0 seconds

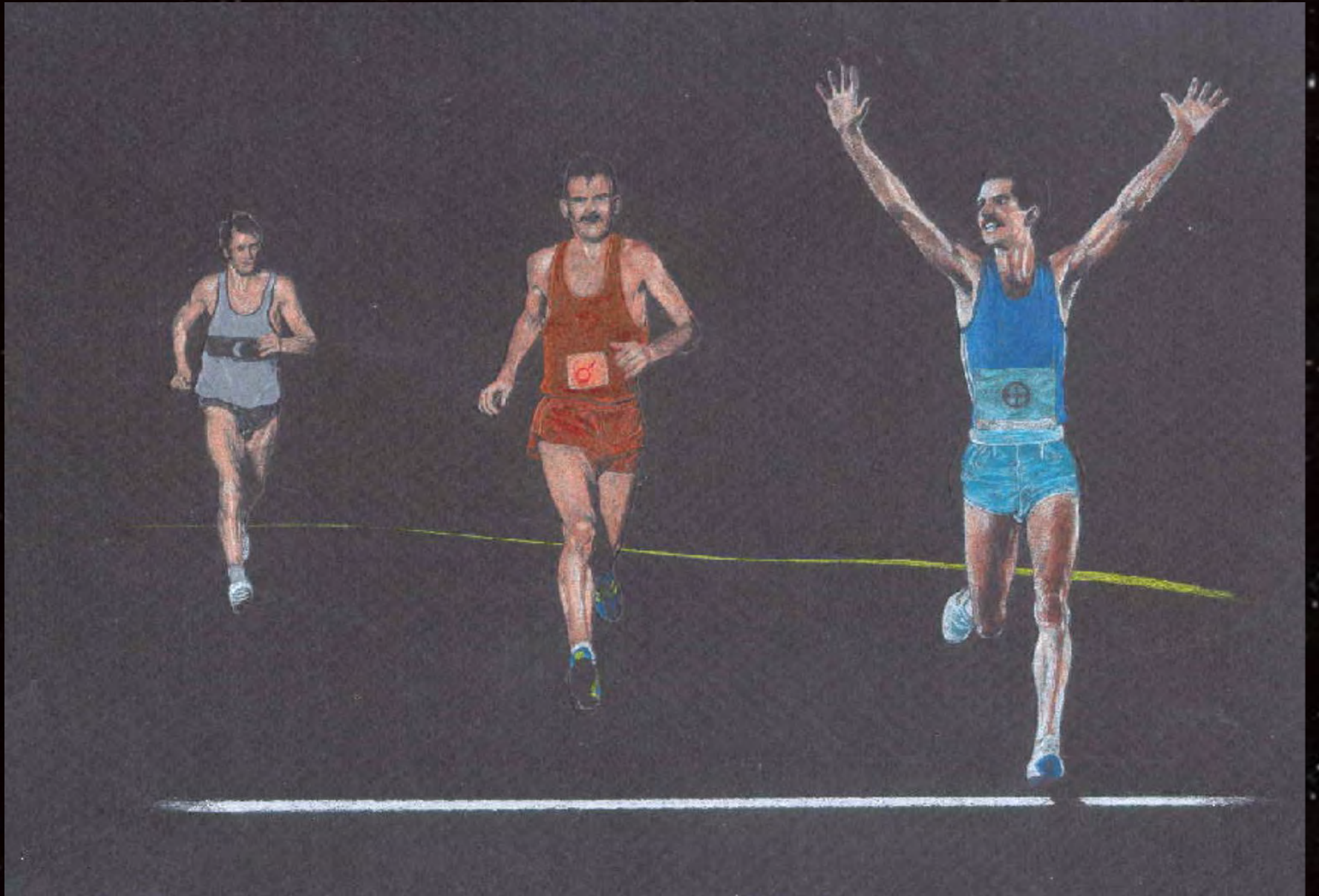
*Friction depends on weight

*Runner accelerates to Earth maximum speed

Mars Predicted Time 12.7 seconds

Moon Predicted Time 16.6 seconds

Phobos Predicted Time 100 seconds





100 METER RUN (STARTING BLOCKS, SPIKES)

Earth Surface Time 9.58 seconds

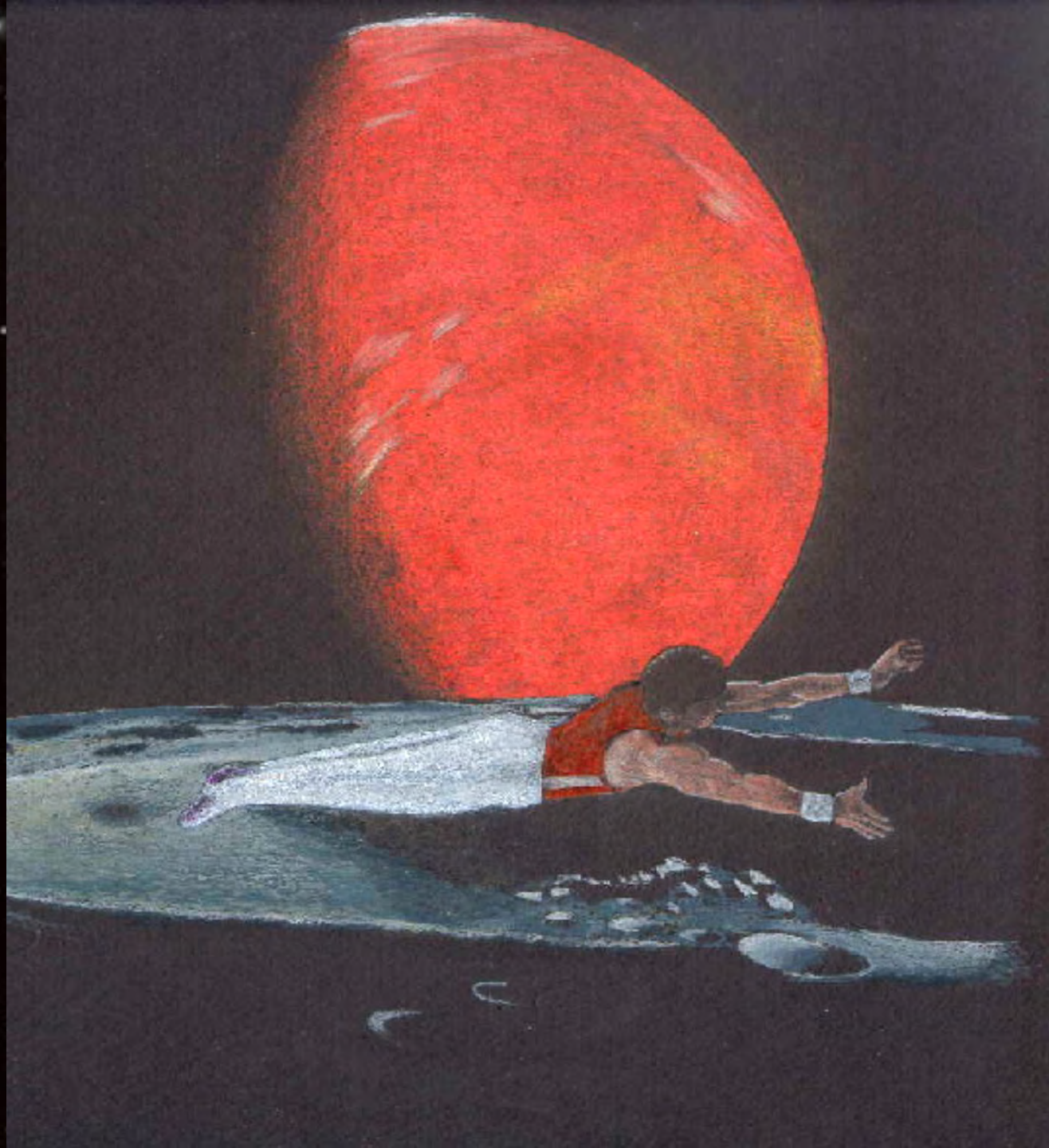
*Friction depends on “weight”

*Runner accelerates to Earth maximum speed

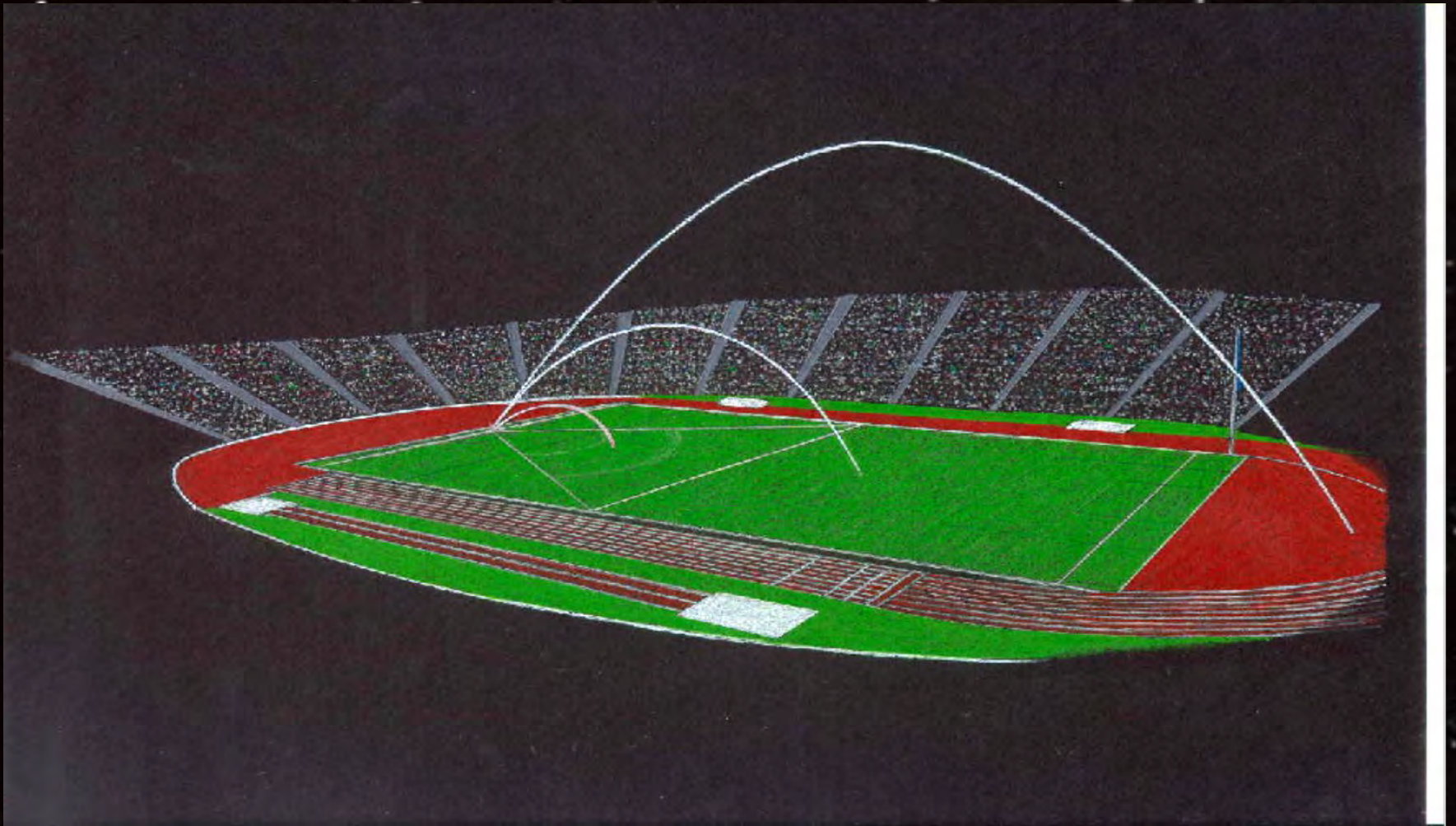
Mars Predicted Time 12.6 seconds

Moon Predicted Time 16.5 seconds

Phobos Predicted Time 20 seconds



16 POUND SHOT PUT



16 POUND SHOT PUT



16 POUND SHOT PUT

Earth Surface Distance 23.12 m (75.85 ft)

*Air drag doesn't affect throw

*Toss is at 45° for maximum range

Mars Predicted Distance 60.6 m (199 ft)

Moon Predicted Distance 118.3 m (388 ft)

Phobos Predicted Distance Orbit around Phobos

Living in Space:

Space is a hostile environment

- **Unexpected Motions**
- **Pressure (~ lack of pressure)**
- **Sounds in space**

Unexpected Motions

- **Fiction:**

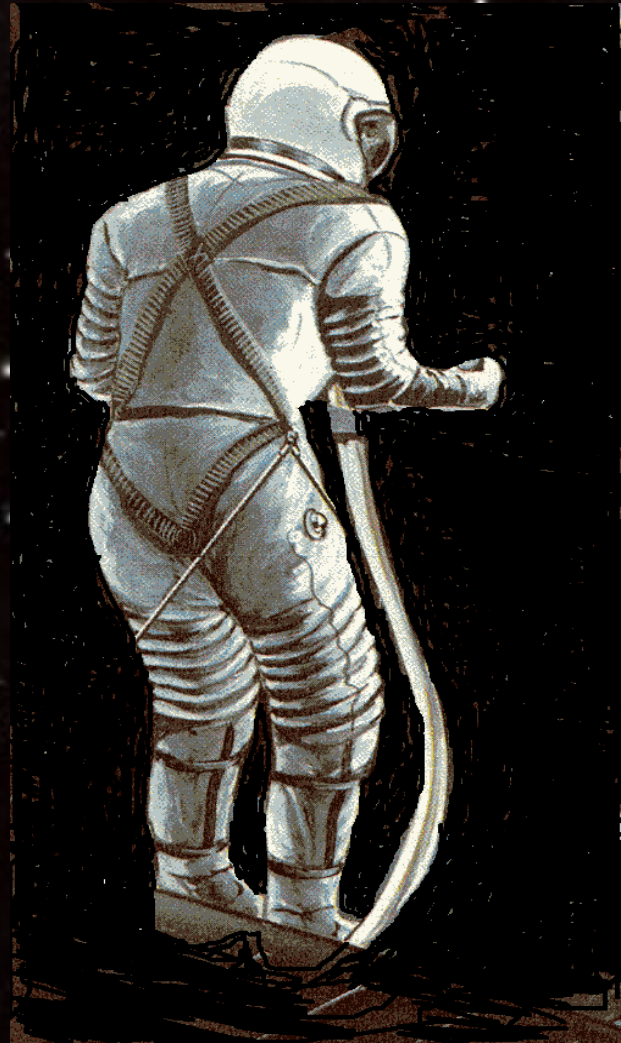
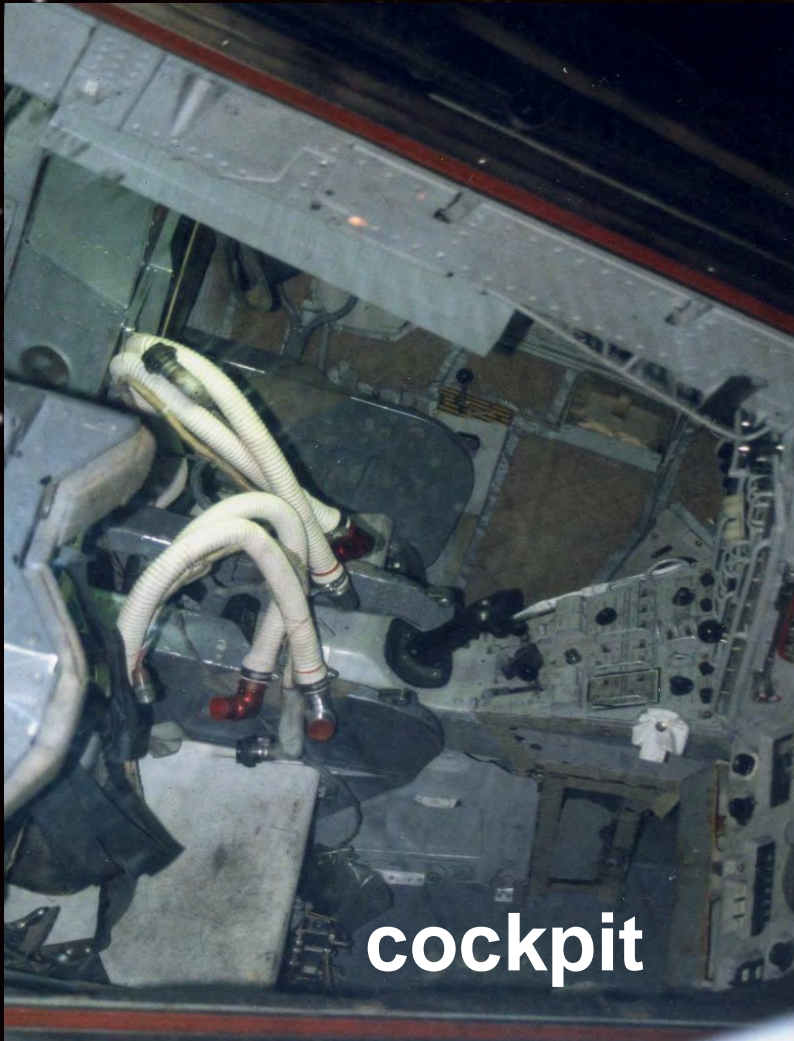
Earthbound intuition about how you move applies when you are in orbit

- **Fact:**

Orbit removes most normal and frictional forces → unexpected motion (or lack of motion)

Problems with moving in orbit

Gemini 9A photo “float”



Loose Items in Spacecraft

- **Fiction:**

If you lose something in a spacecraft, you have little hope of finding it, because it could drift anywhere

- **Fact:**

Always look in the same place

There is no air convection in orbit (Hot air does not rise)

- **Fiction:**

Fires burn well in orbit

- **Fact:**

Combustion gasses extinguish fire

- **Caution:**

Do not sleep in an unventilated area!

Pressure



Fiction:

If suit pressure fails, the astronaut explodes.

Loss of Pressure

- **Fact:**

Bends

Air leaves lungs

Suffocation

**No bulging eyes
or exploding people**



Sounds in Space



- **Sound comes from molecular collisions**
- **Collisions form pressure waves**
- **Waves of molecules strike eardrums**
- **We detect the impacts with our ears**

Sounds in Space

- **Fiction:**

There are no sounds in space

- **Fact:**

Space is not empty

Extremely thin “atmosphere”

Molecular collisions occur occasionally

There is “sound”, but we cannot hear it

Space Solar Power

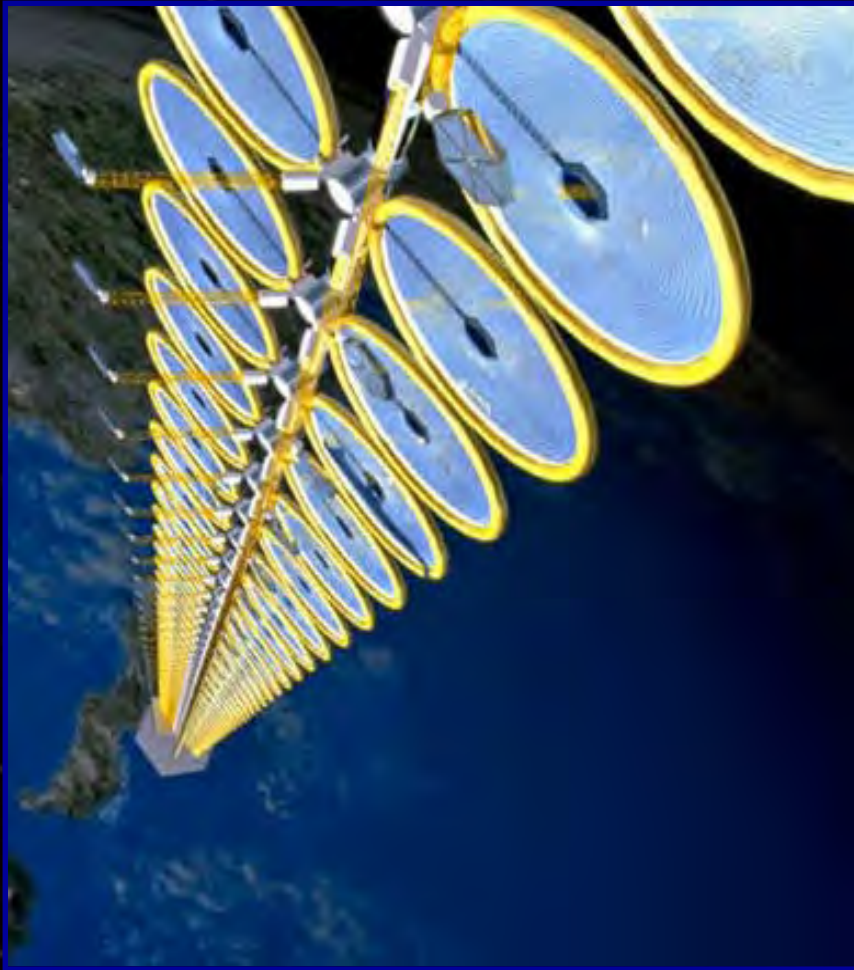
- **Fiction:**

An array of solar power satellites could supply all of Earth's electrical power needs

- **Fact:**

The technology exists but...
the size and mass of the system required would be prohibitive

Solar Power Satellite Concepts



Earth's Power Needs

- **US Power: ~ 6 kilowatts/person**
- **Europe: ~ 3 kilowatts/person**
- **Projected Earth Population in 2050: 8 to 10 billion**
- **Assume: ~ 3 kilowatts/person for everyone on Earth...**

Size of Required Solar Array



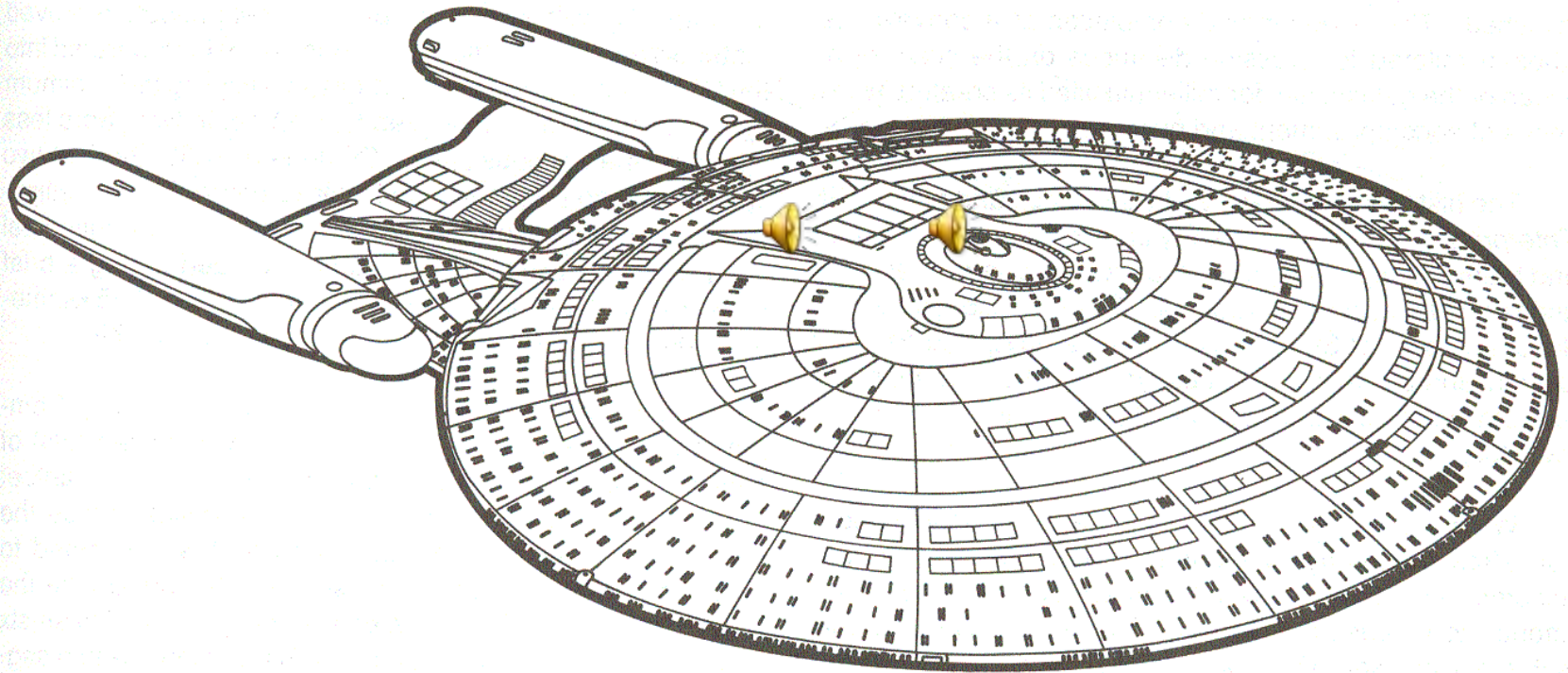
A satellite solar panel produces 1.3 kilowatts of energy per square meter

Solar Array Deployment

- **Requirement:** One SpaceX Falcon Heavy launch per day every day for over 1000 years
- **NOT** the answer...



Star Trek



USS Enterprise

Warp Drive

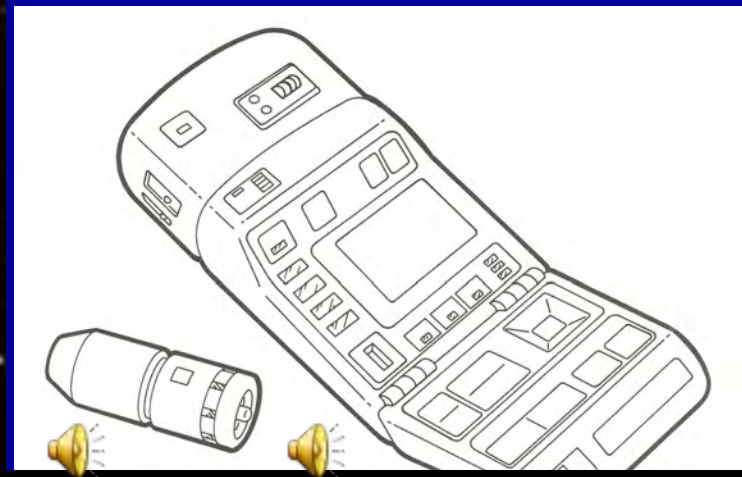
- **Fiction:**

By 2500, we will regularly travel faster than light – at “Warp” speeds

- **Fact:**

No known source for energy and flight times to stars are still too long

Medical Tricorder



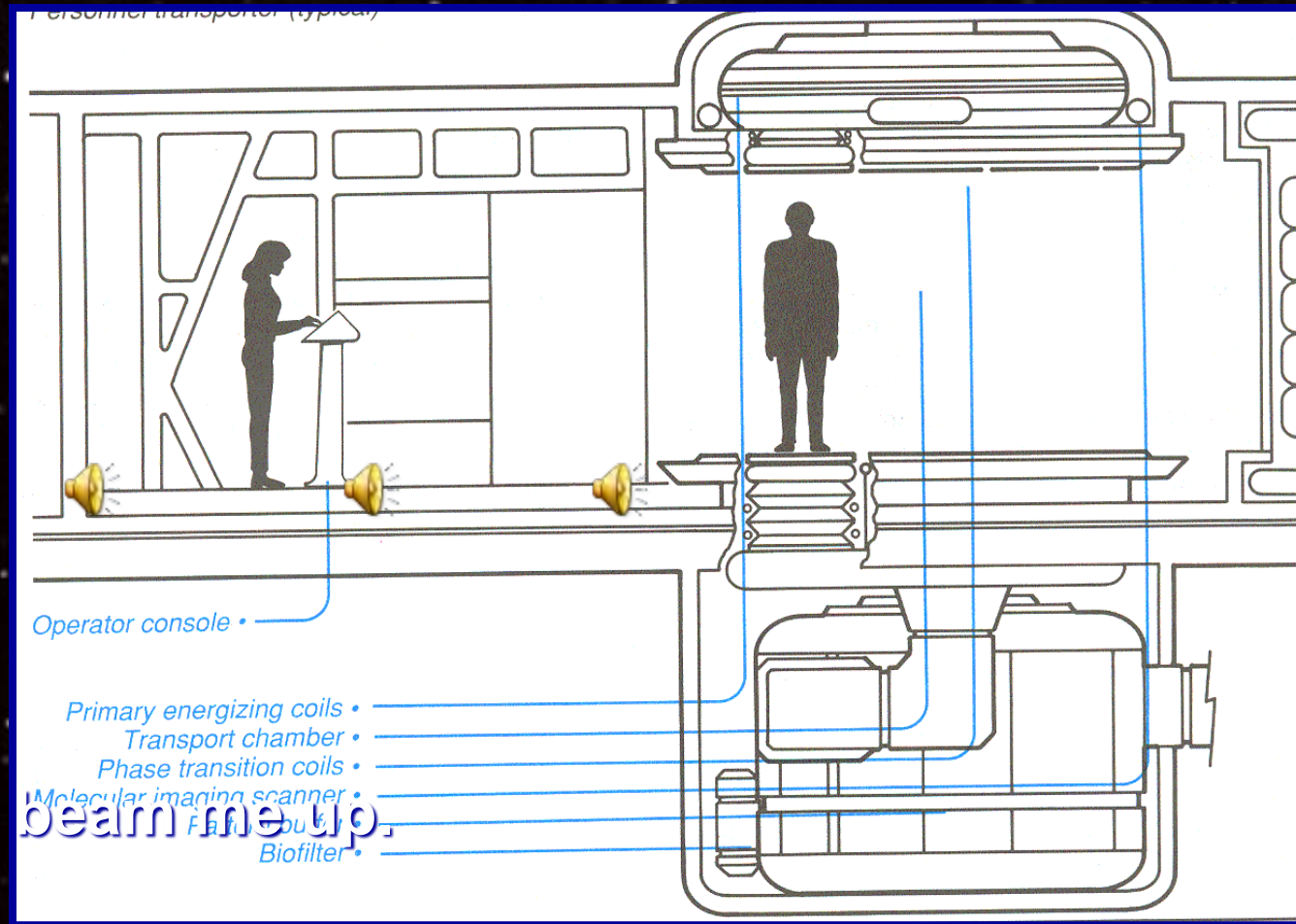
- **Fiction:**

Detects all anomalies without intruding into the body

- **Fact:**

We can hope for devices like this – and we're getting there

Transporter



- **Fiction:** Scottie, beam me up.
- **Fact:**

Major technical problems – revolution if solved

Credits



QUESTIONS ?

Building a Foam rocket



To finish, wrap another piece of duct tape



ISSAS
www.nasa.gov

1 Cut four slits 1/2 inch wide and 1/2 inch deep into the side of the launcher.

2 Use a rubber band to secure the launcher to the nose of the rocket.

Cut index cards into trapezoid shape. Cut slits as shown.



Slide fins together.



7 Slide fins into slits.



8 Close end with remaining narrow strip of duct tape.



For the complete lesson plan,
please visit NASA Rocket Guide:

https://www.nasa.gov/audience/foreducators/topnav/materials/lstbytype/Foam_Rocket.html