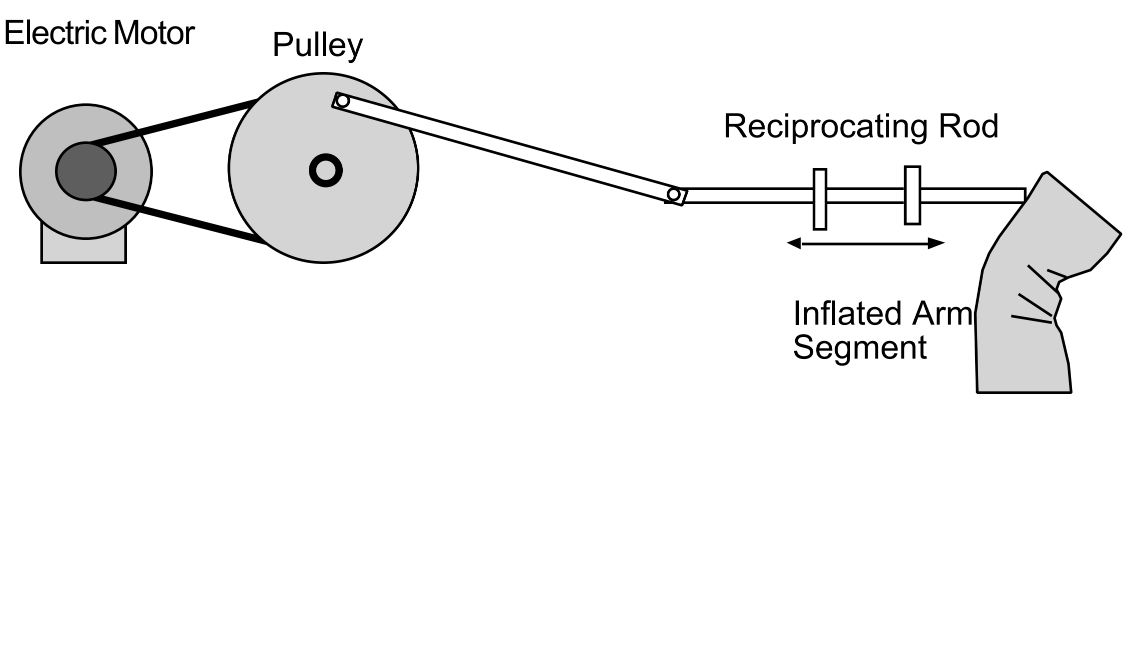
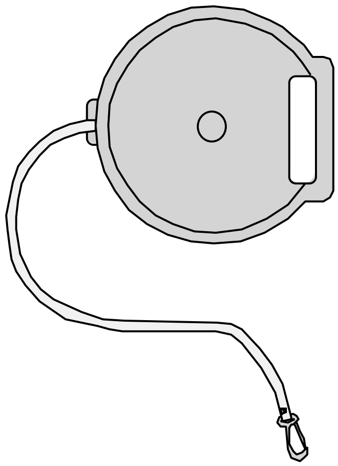
Idea Bank

Use these ideas as suggestions for additional testing and measurement apparatus and for techniques that could be employed for constructing suit parts.

1. Suit Arm and Leg Bending Tester



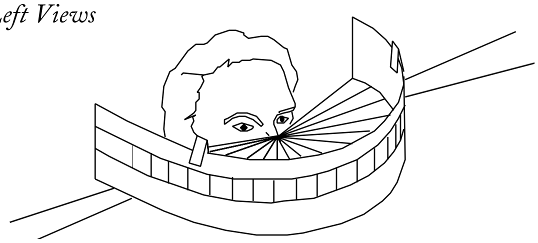
2. Tethers

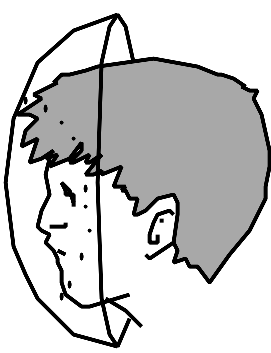


3. Field of Vision Tester for Helmet Vision Design

Determine how much visibility is needed for a space suit helmet by measuring the field of vision of students. Two different ways for doing this are shown.

Test for Right and Left Views

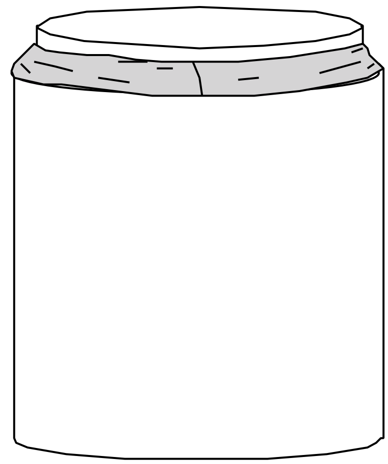




Omnidirectional test. Use clear plastic punch bowl and place dots at limit of vision.

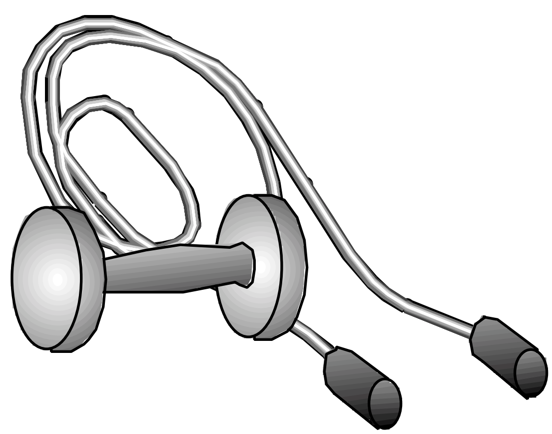
4. Connector Seal Test

Place Martian sediment simulant or other dry sandy sediment in the jar. Place plastic tape over the zone where the lid comes together with the jar. Shake the jar several hundred times and then remove the tape to see if any sediment made its way through the jar and lid threads to stick to the tape.

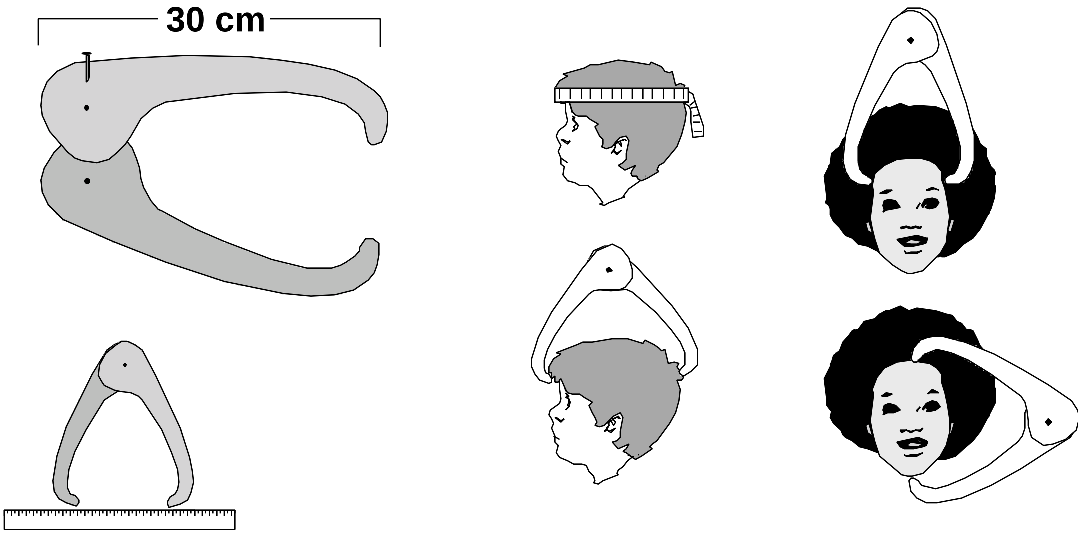


5. Weightlifting

Research an exercise routine that can be used to strengthen the upper body. This is the area of the body that receives the greatest workout during a spacewalk in Earth orbit. Design exercises for strengthening the lower torso and for planetary surface exploration.

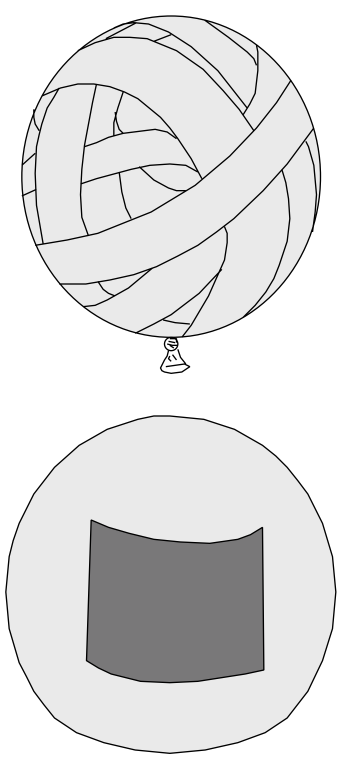


6.Measurements for Space Helmet



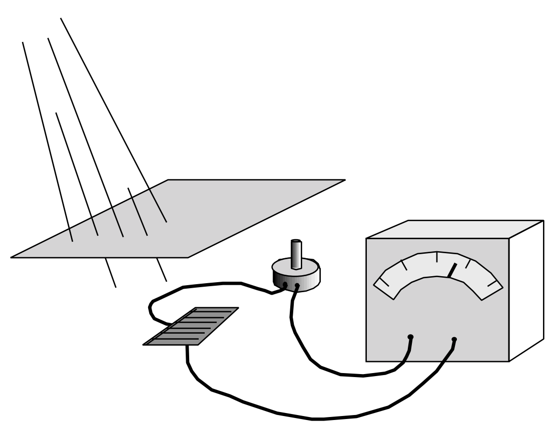
7. Paper Maché Space Helmet

Inflate a large round balloon to a diameter greater than student heads. Cover the balloon with four layers of paper maché. Paper maché can be made with newspaper strips and a 50/50 solution of white glue and water or with premixed wallpaper paste. Let each layer dry before applying the next one. When completely dry, deflate and remove the balloon and cut appropriate holes with a scissors. Paint as desired.



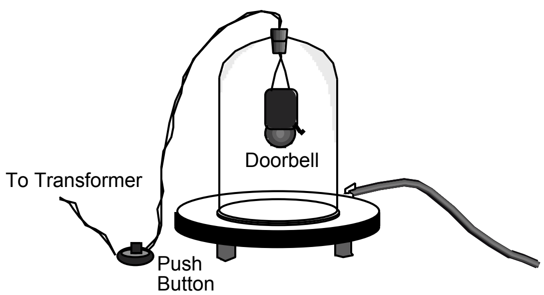
8. Visor Light Transmission Tester

Connect a solar cell to a potentiometer and a millammeter. These items are available from an electronic parts store. Adjust the potentiometer so a light source you are measuring does not drive the needle off the scale. Place potential space helmet visor material between the light source and the solar cell to evaluate the material's light-filtering properties.



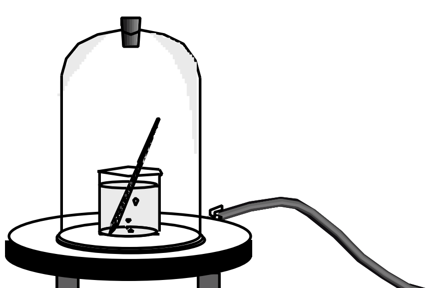
9. Vacuum Experiment - 1

Obtain an electric doorbell,push button, and doorbell transformer. Insert the wires to the doorbell through a single-hole rubber stopper. The stopper should fit the upper hole in the bell jar. Fill the rest of the stopper hole with hot glue from a hot-glue gun to seal the wires in place. Evacuate the bell jar and ring the doorbell. While holding the button, gradually let air back into the jar. The bell cannot be heard ringing when the jar is evacuated even though the clapper can be seen to be moving. This demonstration explains why spacesuits have 2-way radios. Sound is not conducted through a vacuum.



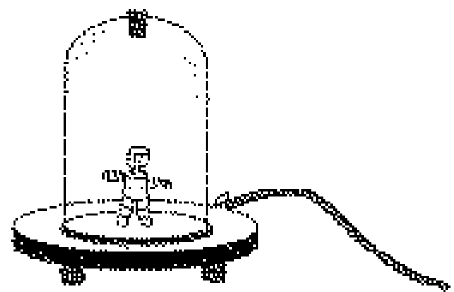
10. Vacuum Experiment - 2

Show how fluids like water boil when they are exposed to a vacuum. Place water in a beaker and evacuate the bell jar. The demonstration will take place more rapidly if warm water is used. Place a thermometer in the beaker to record the boiling temperature.



11. Vacuum Experiment - 3

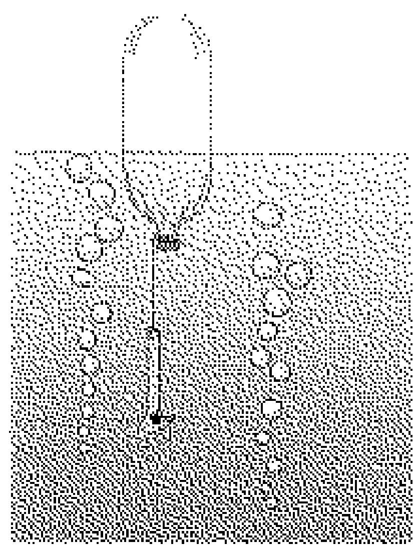
Construct a marshmallow astronaut out of regular size and mini marshmallows and toothpicks. Evacuate the bell jar and observe how the marshmallows expand. Living tissue will also inflate in a vacuum because of gas bubbles forming in the fluids of cells.



Note: The vacuum pump, vacuum plate, and bell jar needed for the activities on this page are common pieces of science equipment found in many junior and senior high schools. This equipment is available from school science supply catalogs.

12.Underwater Training

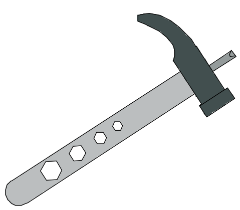
If a swimming pool is available, practice underwater EVA training. Have students wear a dive mask



and assemble PVC water pipe parts underwater. Make a weighted panel that has bolts protruding from it. Use a chrome steel wrench to try to turn the bolts while free floating in the water. Make tools appear weightless by attaching a string to the handles and to empty two liter soft drink bottles. Invite a local SCUBA shop to participate in the activity. The shop owners might be willing to supply dive equipment and serve as safety divers during the simulation.

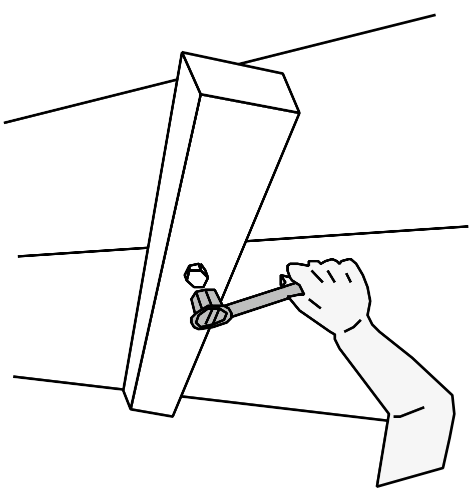
13. Design A Tool

Have students design and construct a prototype multipurpose tool for use on spacewalks. The tool should combine the functions of single purpose tools such as hammers, screw drivers, wrenches, etc. The tool should also make provisions for attachment to tethers and easy gripping.



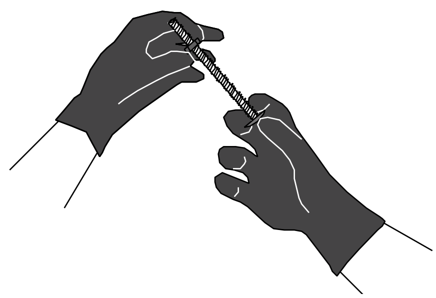
14. Torque

Place a student on a swivel office chair or on a rotating platform like a child's Sit and Spin®. Have two other students hold a 2 by 4, with a bolt partially screwed into it, over the first student. The first student will find it difficult to turn the bolt with a wrench without spinning as well. Relate this to the challenges astronauts have on spacewalks when they try to do a similar job. To turn a bolt or move some massive object in space, an astronaut is attached to a stable work platform.



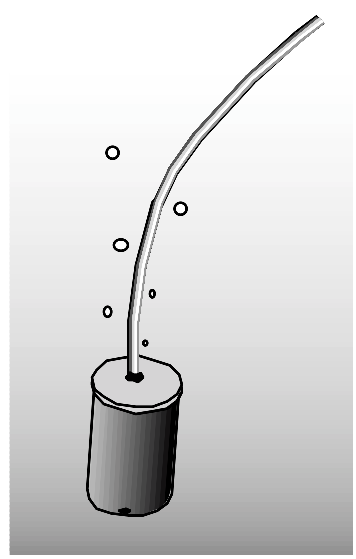
15. Glove Work

Use rubber-coated work gloves from a hardware store to demonstrate the importance of spacesuit gloves that are comfortable to wear. Have students attempt to screw a bolt into a nut or assemble plastic snap toys into a structure. Discuss how these gloves can be improved to make them easier to use.



16. Neutral Buoyancy

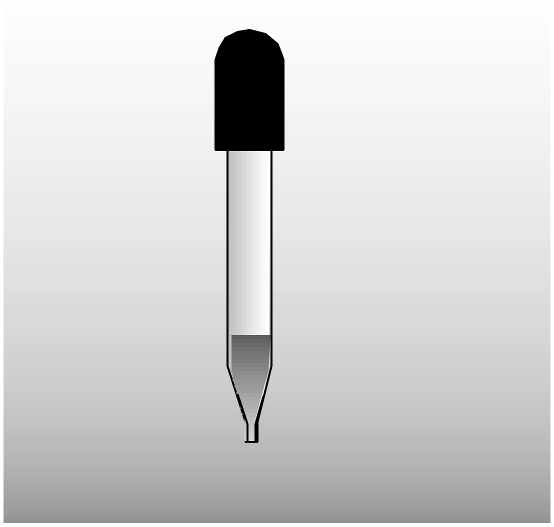
Astronauts simulate microgravity for spacesuit training in a deep swimming pool. Their spacesuits are specially weighted to produce neutral buoyancy.



You can investigate neutral buoyancy by creating a small submarine out of a plastic film canister, aquarium tubing, pennies, and hot glue. Punch tow holes at the base of the canister and a hole in the lid. Hot glue the end of the aquarium tube into the hole in the lid. Add several pennies to the canister so that when you place it in a water-filled aquarium, the canister just floats. Suck air out of the tube to cause the canister to sink. Try to get the canister to hover half way from the bottom to the surface.

17. Neutral Buoyancy - 2

Neutral buoyancy can also be investigated with a Cartesian diver. Fill a plastic soft drink bottle with water. Insert an eyedropper that is partially filled with water. Cap the bottle and squeeze the bottle's sides to increase the pressure in the bottle. The trapped air in the eyedropper will compress and the eye dropper will sink. Try to get the eyedropper to hover midway in the bottle.



Glossary

AMU	Astronaut Maneuvering Unit
Apollo	NASA project that landed astronauts on the Moon
CCA	Communications Carrier Assembly
CCC	Contaminant Control Cartridge
Composite Material	Substance derived by combining two or more materials such as glass fibers and epoxy
DCM	Displays and Control Module
EEH	EMU Electrical Harness
EMU	Extravehicular Mobility Unit
EVA	Extravehicular Activity; Extravehicular Visor Assembly
Gemini	NASA project that pioneered space flight technologies for spacecraft rendezvous and docking and spacewalking
HHMU	Hand-Held Maneuvering Unit
HUT	Hard Upper Torso
IDB	In-Suit Drink Bag
ISS	International Space Station
Joule	One newton meter or 1 kg • m2/s2
Kilopascal	Metric pressure unit; one pound per square inch pressure equals 6.895 kilopascals
Kinetic Energy	Energy in motion
LCVG	Liquid Cooling-and-Ventilation Garment
MAG	Maximum Absorption Garment
Microgravity	An environment, produced by free-fall, that alters the local effects of gravity and makes objects seem weightless
Micrometeoroid	Tiny particle of space debris (natural or artificial) ravling at high speed through space

MMU	Manned Maneuvering Unit
Mercury	The NASA project that launched the first U.S. astronauts into space and demonstrated that humans could live and work in space
ORU	Orbital replacement unit
PLSS	Primary Life-Support System
Regolith	Sediment derived directly from igneous rock and not containing any organically-derived materials
RMS	Remote Manipulator System
SCU	Service and Cooling Umbilical
Skylab	First U.S. space station
SOP	Secondary Oxygen Pack
SAFER	Self-rescue rocket backpack device for use during spacewalks around the International Space Station
Space Shuttle	Reusable spaceship currently used for all U.S. manned space missions
Spacewalk	Extravehicular activity
Sublimation	Change of state of matter from a solid to a gas

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Grade Level	Application
K–8	Technology Education, Life Sciences, Physical Science, History

Go For EVA!

Educational Videotape Series

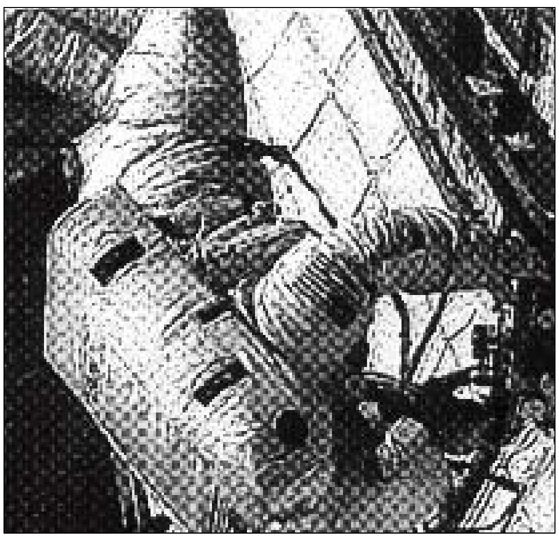

Image from the videotape ***Go for EVA!*** *ofthe* Liftoff To Learning Videotape Series.

Go For EVA! is from the *Liftoff to Learning Educational Videotape Series*, which allows students to study science, mathematics, and technology with crew members aboard Space Shuttle flights.

Go For EVA! discusses how spacesuits protect astronauts from the hostile space environment, explains what the components of the spacesuit are, describes how the suit functions, and shows what types of work astronauts perform while spacewalking. Actual footage of spacewalks–also known as Extravehicular Activities (EVAs)–illustrate how spacesuits allow astronauts to operate scientific apparatus, assemble equipment and structures, pilot the Manned Maneuvering Unit, take pictures, and service satellites and space hardware.

Length: 13:48

To obtain a copy of the **Go For EVA!** videotape and accompanying Video Resource Guide, or for more information on the *Liftoff to Learning Educational Videotape Series*, contact your local Educator Resource Center or the NASA Central Operation of Resources for Educators (CORE). See page 99 for details.

Suited for Spacewalking

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