

MISSION PREP

Teachers' Activity Guide

Another in the Series of
Challenger Learning EdVentures™
from



UK Edition prepared by the University of Leicester, England
2nd Edition edited by the National Space Centre, England 2006

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Activities 1

Acids and Alkalis

How do scientists conduct experiments to classify liquids as acidic or alkaline?

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Dear Educator



Dear Classroom Educator,

Just imagine consoles instead of desks ... computers instead of blackboards ... and multimedia databases instead of libraries. Textbooks are replaced with task cards, instructions with procedures. Pupils become scientists and engineers. Their lessons become missions. Their classroom ... a Challenger Learning Centre. Pupils are immersed in a realistic Mission Control and Space Station environment: computer consoles, communication headsets, continuous messages on the loud speakers, electronic messages, team-mates they can only see on video monitors, emergency sounds and flashing lights, and hands-on activities at science stations.

Challenger Centre has specifically designed these simulation programmes to provide pupils with an authentic encounter with science and technology. The science is presented in the context of a realistic space exploration. The technology is used as a tool to communicate with team-mates, to solve problems and make decisions vital to each mission's success. The simulation creates a co-operative learning atmosphere underpinned by teamwork, communication, problem-solving and decision-making. Embedded throughout the simulations are opportunities for pupils to apply the skills they have learned in the classroom. Key to each pupil's learning experience at a Challenger Learning Centre is the preparation that takes place in the classroom in the weeks leading up to a mission. This "Mission Prep" guide contains classroom activities designed specifically to help familiarise pupils with the skills they will employ to complete their mission successfully.

Regardless of their cultural background, economic situation, gender, learning style or academic level, every Challenger Learning Centre simulation provides pupils with an opportunity to succeed. Every mission is successful! Pupils leave with a renewed spirit of camaraderie and boosted self-esteem.

Teachers will find that each activity has been correlated with National Curriculum programmes of study and is formatted so that key ideas can be found easily. The activities have been designed to provide as much flexibility as possible so that you can use them in a way that is appropriate for your classroom.

At Challenger Centre, we believe that exploration lies at the heart of learning. We also believe that there are no tools, no programmes, no techniques that will ever replace the direct intervention of a great teacher in a pupil's life. By integrating the classroom preparation into the mission simulation, we are confident your pupils will discover what fun learning can be. Inspiring. Exploring. Learning. It's Our Mission.

Best Regards,
The Challenger Centre Team

Challenger Centre's Educational Pedagogy



Challenger Centre's educational pedagogy promotes scientific literacy by encouraging exploration and inquiry and exciting young people about knowledge and learning. Challenger Centre believes exploration is the essence of learning. Our goal is to give teachers the tools to create a "learner-centred" environment and to provide materials that are a framework for embedding subject content in a meaningful and motivational context.

Using our interdisciplinary, inquiry based approach that incorporates National Curriculum objectives, Challenger Centre strives to:

- ▮ increase student interest in science, mathematics and technology.
- ▮ give abstract concepts concrete meaning.
- ▮ help students develop co-operation, communication, critical thinking and problem solving skills in realistic contexts.
- ▮ increase student autonomy and responsibility for their own learning.
- ▮ encourage students to develop positive perspectives about learning.
- ▮ increase student commitment to learning.
- ▮ help students pose questions and find pathways to answers..

Challenger Centre programmes are designed to reflect academic standards such as the National Curriculum for science mathematics and other subjects. Below is a grid showing where Mission Prep activities provide opportunities to cover aspects of the programmes of study:

	Science			Maths				D&T		English	Geography	
	Planning procedures Obtaining evidence Analysing and concluding Evaluating evidence Life processes & cells Humans as organisms Living things in environment Classifying materials Patterns of behaviour Waves The Earth & beyond Energy resources & transfer Solving problems Communicating Reasoning Computation Solving numerical problems Using functional relationships Using formulae Using properties of shape Using properties of position Using measures Evaluating representations of data Collecting data Representing data Interpreting data Develop specification Consider needs Generate proposals Outline planning Evaluate ideas Meeting the need Evaluate fitness for purpose Appropriate use of resources Consider environmental impact Explain, describe, etc. Explore, hypothesise Argue, debate, persuade Develop thinking Analyse Grid references											
Acids and Alkalis	● ●		● ●						●			●
Co-ordinates	●			● ●				● ●	●			● ●
Latitude & Longitude	●			● ●				● ●				● ●
Chromatography	● ● ●		● ●						● ●			●
Electro-Magnetic Spectrum	● ● ●		●	●				●		●		●
Reading Scales	● ● ●		●		● ●		●		●			●
Temperature	● ● ● ●		●	●		●		●	● ● ● ●			● ● ● ●
Pulse & Blood Pressure	● ● ● ●	● ●		●				●	● ● ● ●			● ● ● ●
Mission Survival	● ● ● ●	● ●		●	●				● ● ● ●	● ● ● ●		● ● ● ●
Communication	● ● ● ●	● ●		●	●			●	● ● ● ●	● ● ● ●		● ● ● ●
Mission Badge	● ● ● ●	● ●		●	●			●	● ● ● ●	● ● ● ●		● ● ● ●
Press Conference	● ● ● ●	● ●		●	●			●	● ● ● ●	● ● ● ●		● ● ● ●

Voyage to Mars

Mission Overview



The Earth date is now 2076, and a routine Voyage to Mars has brought the latest human crew into Martian orbit. Mission Control at Houston, Texas, has transferred responsibility for the incoming flight to Mars Control at Chryse Station. The crew arriving from Earth on the Mars Transport Vehicle has been specially trained to replace the existing crew of astronauts who have manned Mars Control for the past two years, and to continue their scientific explorations.

It was 100 years ago when Viking 1 & 2 made the first United States' robot landings on Mars in the late 1970s, giving humans their first close-up look at the Martian surface.

With its small robotic rover named "Sojourner", Mars Pathfinder landed on July 4, 1997, and this renewed interest in Earth's neighbouring planet. The suitcase-sized "Sojourner" rekindled the human spirit of exploration as it crawled around an ancient flood plain on Mars, sniffing rocks and snapping pictures which provided the most detailed look, ever, at the Red Planet's surface.

The success of Pathfinder and its little hitchhiker set the stage for an armada of robotic spacecraft that over the next three decades paved the way for the first human landings on Mars. The data collected during the early years of the new Millennium by robotic explorations and spacecraft in Martian orbit

have guided planning for the human explorations.

Studies of the ancient flood plains and incredible canyons are part of an effort to find out what happened to the water that once flowed across Mars. We are keen to find out if the planet once had a more Earth-like environment: if so, to find out why it changed and if this change could happen on Earth. The crew on the Martian surface has collected and analysed a great number of geological samples of rock and soil, as well as data gathered by probes travelling to the moons of Mars.

The Mars Control team has the task of selecting entry and departure trajectories so the landing and, later on, the lift-off of the Mars Transport Vehicle can occur.

The crew on the Mars Transport Vehicle has the task of launching probes targeted at the Martian moons. A probe will be launched to Phobos before the crew lands and then another to Deimos before the flight back to Earth.

Both the relief crew and the planet-based crew will have tight deadlines to gather

important data and communicate information to their teams, to the spacecraft, and to the Mars base. The crews will also learn to appreciate the "luxuries" of planet Earth such as air, water and food when compared with a barren planet such as Mars.



Rendezvous with a Comet

Mission Overview



“Small body” missions to explore objects such as comets took place after the start of the new Millennium. These included STARDUST with its capture of cometary material from comet Wild-2 in 2004 and the return of that material to Earth in 2006. The samples provided by STARDUST established detailed baseline data on comets which is still used today. Nowadays, in the middle of the 21st century, teams of scientists are routinely using small, manoeuvrable space stations to venture out into Earth’s “neighbourhood” as part of a long-term study of small bodies in the Solar System. Primary targets include comets and asteroids which scientists believe are the oldest, most primitive bodies in the Solar System. These may preserve the earliest record of the material that formed Earth and its planetary neighbours.

During this mission, team members work as scientists and engineers aiming to Rendezvous with a Comet as part of this continued study of our Solar System. These rendezvous missions are critical in helping scientists to verify and understand better the data collected by earlier missions.

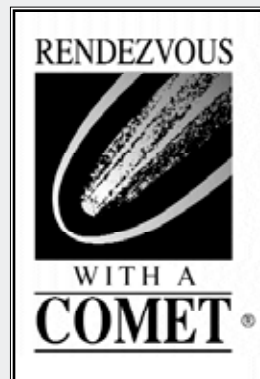
The onboard astronauts, working with their counterparts in Mission Control, have the task of sending a probe to intercept and collect new data on a well-studied short-period comet before heading on for a continued study of the asteroid

Ceres, the largest known asteroid, 623 miles (1,003 km) in diameter.

Comet Encke provides an excellent target because its short period (3.3 years) has allowed it to be observed from Earth at more apparitions (or appearances) than any other comet, including the famous Comet Halley. Encke continues to puzzle scientists because, even though it has been in a short-period orbit for thousands of years, the comet continues to have a high level of activity as the Sun’s heat boils off its dirty ices into gases and dust. This is the first probe to rendezvous with Encke since 2003 and the fly-by of the comet-chasing CONTOUR spacecraft.

The small, manoeuvrable space stations used for these rendezvous missions require lots of maintenance and care, providing plenty of challenges for the crews in space and on the ground. Navigating into the correct position for probe launches, not to mention sending a probe through the material surrounding an active comet, also requires concentration and teamwork to collect vital scientific information and complete the mission successfully.

Small bodies in the Solar System are highly unpredictable objects and have been known to surprise scientists from time to time, so crew members will also need to be on their toes and be ready to make quick decisions.



Encounter Earth

Mission Overview

For the century and a half since the 1970's, environmental scientists have collected data from all over the Earth's surface. They analyse this raw data to obtain a global view of Earth's environment on a daily, seasonal, annual, and long-term basis. A common data collection technique is the use of Earth-based probes. Probes are placed at many different locations on Earth's surface to measure important environmental conditions such as ocean temperatures, currents and vegetation, as well as land vegetation, troposphere temperatures and ground moisture.

The information collected by these probes is transmitted to a low Earth orbiting (LEO) satellite. The LEO satellite then transmits the probe information to ground-based stations such as the Jet Propulsion Laboratory in Pasadena, California, or to a Geosynchronous Orbiting (GEO) satellite, which in turn transmits the information to the ground-based stations.

In the summer of the year 2137, the LEO satellite collecting probe data has malfunctioned and must be replaced. The elite 'ERS-I Emergency Response Squad' composed of 8 teams trained in satellite design and environmental survey has been called in. One half of the ERS-I crew has been stationed on a LEO Spacelab and is working diligently to construct a new satellite to deploy into orbit for data collection. Since the Earth-based probes are designed to

transmit data on a regular basis to the LEO satellite, they contain very little data storage capacity. While the ERS-I Satellite Team is constructing the new satellite, the data collection teams (GEOsphere, HYDROsphere, ATMosphere, BIOSphere, and ECOSphere) must collect and transmit to Mission Control data from areas near the probes.

The other half of the ERS-I crew has been stationed on Earth in the 'Ops Centre' of Mission Control. These team members analyse the probe data and compare it with historical data in order to correlate relationships. The team at Mission Control, along with their Spacelab team-mates, also examines sensor data for environmental conditions that might pose a threat to planet Earth and its inhabitants.

The transmission of data and information is undertaken by two teams, COM (COMMunication) and DAX (Data Acquisition and EXamination). DAX has the additional duty of conducting research to aid the investigation of the data collection teams.

Once the LEO satellite is constructed and deployed, it can resume the job of data collection and transmission. The ERS-I Emergency Response Squad can return to Earth with a greater knowledge about their home planet and a sense of accomplishment, having completed a successful mission.



Return to the Moon

Mission Overview



The new Millennium is still young, but humans are preparing to Return to the Moon, spurred on by the confirmation of frozen water on the lunar surface by Lunar Prospector in 1998. Composed of hydrogen and oxygen, the elements that make up water, the lunar ice provides a basic resource for long-term human presence on the lunar surface.

Lunar Prospector was followed by a series of successful robotic missions designed to establish whether the frozen water could be harvested. Once collected, this water can be used to produce drinking water, oxygen for life support of a lunar base, nutrients as the basis for agriculture, components needed for rocket fuel, or when combined with lunar soil, the basics for construction materials. Not only did those robotic missions successfully prove the concept, but since then additional robotic missions have landed and begun manufacturing these essential resources.

As part of the Return to the Moon mission, this crew of astronauts will - for the first time since the Apollo 17 mission in 1972 - land on the surface of the Moon. This time the astronauts are there to establish a permanent base with the goals of:

1. establishing an observation program to study the Earth and other Solar System bodies without the interference of the Earth's atmosphere,
2. testing the feasibility of a self-sustaining, off-planet settlement, and
3. serving as a staging area for additional human exploration of our Solar System.

The Return to the Moon mission begins with the spacecraft in Earth orbit and the Mission Control team monitoring the crew's status. The crew aboard the spacecraft will leave Earth orbit and travel to the Moon using the latest in transport technology to reduce the travel time. In addition to verifying the best site for the establishment of the lunar base, during the course of the mission, the crew will build and launch a probe to the lunar surface, recover a probe that is stranded in space and repair the damaged probe.

Some information has been previously obtained from the potential lunar base sites. A detailed study has determined that the base site must contain soils, metals and potentially useful resources such as helium-3. Rock and soil samples, soil composition and seismic information have been gathered by previous missions from a portion of the potential sites. Experiments on soil and rock samples from other possible sites must be performed in order to determine the best site for the lunar base.

The crew will navigate their spacecraft to the Moon and plot an acceptable orbit. Together the crew will place their spaceship

into lunar orbit and make the important decision about the location of the first permanent lunar base. To gather the data needed to analyse potential lunar base sites, the crew will have to function as a team and utilise their best communication and analytical skills.



Mission Preparation Tips



Several weeks before the mission:

- Find out which mission your class will fly and get the activity guide for that mission. Select the activities which will give pupils the specific skills they need for that mission.
- Go through this “Mission Prep” guide and do whatever activities will help your class to brush up on skills they need to fly any Challenger Learning Centre mission.

A few weeks before the mission:

- Complete the Crew Manifest on page xviii and make two copies to bring with you to the Challenger Learning Centre on the day of your flight.
- As you fill out your manifest, assign two students to each team, one at Mission Control and one at the Spacecraft. Put two more students at Navigation and Probe, then fill in the other positions as needed.
- Be sure to use the correct “Positions Available” form and the correct Crew Manifest for your mission. There is one common form for “Voyage to Mars”, “Return to the Moon” and “Rendezvous with a Comet”. “Encounter Earth” has its own special forms.
- Review the Mission Overview with your students.

Day of the Mission:

- Bring two copies of the crew Manifest.
- Bring the agreed final design for your Mission Badge.

Further advice and information can be obtained from the National Space Centre:
www.spacecentre.co.uk



Assembling Your Teams

In preparation to fly a mission at a Challenger Learning Centre, pupils 'apply' for available positions and are appointed by their teacher to their roles. Challenger Centre believes the classroom teacher is best suited to allocate each pupil to a team role which matches their abilities and interests. To ensure a positive learning experience for every pupil, please give careful consideration as you assign pupils to the teams. Each mission requires the cooperative effort of eight teams. Half way through a mission, teams will do a 'crew swap' so that each team will experience Mission Control as well as the Spacecraft.

Every Challenger Learning Centre provides an authentic setting in which to apply skills developed in the classroom and also a dynamic, multi-sensory environment in which to learn. The Team Descriptions on the next page outline the roles and responsibilities of each Team and the Challenger Centre has also added additional information about the skill requirements and the learning styles likely to suit each role. To help you and your pupils to decide the most appropriate Team Roles, encourage them to read the 'Team Descriptions' and 'Positions Available' before they complete their 'Job Application'. You may find colleagues willing to help with this process in English and PSE lessons. Use the pupils' applications and other information you have about them, such as their skill levels or preferred learning styles, and match these with the requirements of the team roles.

Research shows that almost everyone uses all of their senses to learn. That same research shows that while most people use a combination of particular sensory styles to process information, one style usually dominates and dictates their preferred method of learning: kinaesthetic, visual, tactual and/or auditory. Kinaesthetic learners learn best by hands-on physical involvement. Visual learners may prefer reading, taking notes and making lists. Tactual learners may work best at their own pace in a comfortable secure environment. Auditory learners may prefer group discussions and listening to lectures.

Encourage pupils to:

1. Review the team descriptions and positions available for their mission.
2. Complete a Job Application on their own.
3. Submit completed applications to their teacher for position assignments.

Team Descriptions



Voyage to Mars, Return to the Moon, Rendezvous with a Comet

COMMUNICATIONS TEAM: As a member of the Communications Team you will be responsible for all verbal communication between Mission Control and the Space Station.

Skills: Proficiency in reading and speaking/listening, ability to work under stress, ability to prioritise

Likely preferred learning style: auditory

MEDICAL TEAM: As a member of the Medical Team you will monitor and analyse auditory and visual response time, respiration rate, skin temperature and heart rate of Space Station personnel.

Skills: Proficiency in data entry, interest in biological sciences, computation (averaging)

Likely preferred learning style: visual

ISOLATION TEAM: As a member of the Isolation Team you will be responsible for conducting research and data analysis involving radioactivity, meteoroids and hazardous materials.

Skill: Good hand-eye co-ordination, use of measurement devices (balance), reasoning, patience

Likely preferred learning style: kinaesthetic

LIFE SUPPORT TEAM: As a member of the Life Support Team you will perform water supply tests, analyse data from pH tests and read solar panels.

Skills: problem solving ability, interest in environmental and biological sciences

Likely preferred learning style: visual or kinaesthetic

DATA TEAM: As a member of the Data Team you will be responsible for data entry, compiling and summarising data from the Research Program and from the video link between Mission Control and the Space Station.

Skills: Proficiency in reading and speaking/listening, ability to work in stressful situations

Likely preferred learning style: visual or auditory

NAVIGATION TEAM: As a member of the Navigation Team you will send and receive messages, calculate trajectories and analyse and determine angles for launch co-ordinates.

Skills: Data entry skills, mathematical competence, interest in astronomy

Likely preferred learning style: visual or auditory

PROBE TEAM: As a member of the Probe Team you will be responsible for the assembly, deployment and monitoring of a space probe.

Skills: Developed mechanical skills, proficiency in maths and reading, analytical problem solving, deduction skills, self motivation

Likely preferred learning style: kinaesthetic

REMOTE TEAM: As a member of the Remote Team you will operate the robotic arm and collect and analyse mass, volume and chromatography data.

Skills: Developed mechanical and observation skills, proficiency in reading

Likely preferred learning style: kinaesthetic or visual

Encounter Earth

Communications Team (COM): Team members will be responsible for all verbal messages transferred between Mission Control and the Spacelab.
Skills: Reading, speaking & listening, ability to prioritise
Likely preferred learning style: auditory

Biosphere Team (BIO): These team members will determine whether vegetation is directly related to the ground moisture and/or temperature. During emergencies, team members may simulate the amount of light that passes through volcanic ash and determine the effect of an oil spill in the ocean.
Skills: Computer keyboard operation, maths capability (measurement, averaging and estimation)
Likely preferred learning style: visual or kinaesthetic

Ecosphere Team (ECO): Team members will determine whether population density is directly related to lights observed at night. During emergencies, team members will determine the effect of SO₂ on plants and use a microscope to determine if water is drinkable.
Skills: keyboard competence, maths, observation and mechanical skills
Likely preferred learning style: visual or kinaesthetic

Hydrosphere Team (HYDRO): Team members will determine whether ocean temperatures and/or currents are directly related to ocean vegetation. During emergencies, team members will perform pH tests on the water supply and test water for total dissolved solids and chlorine.
Skills: keyboard competence, maths, measurement and observation skills
Likely preferred learning style: visual or kinaesthetic

Data Acquisition and Examination Team (DAX): Team members will be responsible for data that must travel between Mission Control and the Spacelab. They will also be the primary researchers for the Spacelab and Mission Control crews.
Skills: keyboard competence, maths, measurement, and observation skills
Likely preferred learning style: visual or auditory

Atmosphere Team (ATM): Team members will determine whether rainfall and/or temperature are directly related to cloud cover. During emergencies, team members will determine the amount of dissolved oxygen in the water and do qualitative analysis of gas using a spectroscope.
Skills: keyboard competence, maths, measurement, observation and colour recognition skills
Likely preferred learning style: visual

Satellite Team (SAT): Team members will determine the correct communication frequencies for Earth probes, satellites and Earth laboratories. They will build and deploy a new low Earth orbiting satellite to replace a non-functioning satellite.
Skill: keyboard competence, maths, mechanical, reading and deductive reasoning skills
Likely preferred learning style: kinaesthetic

Geosphere Team (GEO): Team members will determine whether ocean temperatures and/or currents are directly related to sea level. During emergencies, team members will use robots to collect soil samples to be tested for pH and determine the effect of flooding on different land areas.
Skills: keyboard competence, maths, measurement and observation skills
Likely preferred learning style: visual

Positions Available

Voyage to Mars, Return to the Moon, Rendezvous with a Comet

Title: COMMUNICATIONS OFFICER

Description: As a member of the Communications Team the applicant will be responsible for all communication between Mission Control and the Space Station.

Requirements: Proficiency in reading and oral communications, ability to work in high stress situations.

Salary: Based on level of education.

Title: MEDICAL TECHNICIAN

Description: As a member of the Medical Team the applicant will monitor and analyse response time, respiration rate, skin temperature and heart rate of Space Station personnel.

Requirements: Data entry skills, a strong interest in biological sciences.

Salary: Based on level of education.

Title: ISOLATION SPECIALIST

Description: As a member of the Isolation Team the applicant will be responsible for conducting research and data analysis of radioactivity, meteoroids, and hazardous materials.

Requirements: Good mechanical skills, proficiency in maths, excellent eye-hand co-ordination.

Salary: Based on level of education.

Title: LIFE SUPPORT SCIENTIST

Description: As a member of the Life Support Team the applicant will perform tests and analyse data from pH, water and oxygen tests as well as experiment with solar panels.

Requirements: Good problem solving skills, interest in environmental and biological sciences.

Salary: Based on level of education.

Title: DATA OFFICER

Description: As a member of the Data Team the applicant will be responsible for the data and video link between Mission Control and the Space Station.

Requirements: Proficiency in reading and oral communications, ability to work in high stress situations.

Salary: Based on level of education.

Title: NAVIGATOR

Description: As a member of the Navigation Team the applicant will send and receive messages and analyse and determine angles for launch co-ordinates.

Requirements: Data entry skills, good maths skills, interest in astronomy.

Salary: Based on level of education.

Title: SPACE PROBE TECHNICIAN

Description: As a member of the Probe Team the applicant will be responsible for assembly, deployment and monitoring of a space probe.

Requirements: Good mechanical skills, proficiency in maths and reading. Applicant must be self-motivated.

Salary: Based on level of education.

Title: ROBOTIC SCIENTIST

Description: As a member of the Remote Team the applicant will operate the robotic arm and collect and analyse mass, volume and chromatography data.

Requirements: Good mechanical and observation skills, proficiency in maths.

Salary: Based on level of education.

Encounter Earth

Positions Available

Title: COMMUNICATIONS OFFICER

Description: As a member of the Communications Team the applicant will be responsible for all communication between Mission Control and the Spacelab.

Requirements: Proficiency in reading and oral communications, ability to work in high stress situations.

Salary: Based on level of education.

Title: DATA OFFICER

Description: As a member of the Data Acquisition and Examination Team the applicant will be responsible for the data and video link between Mission Control and the Spacelab.

Requirements: Proficiency in reading and oral communications, ability to work in high stress situations.

Salary: Based on level of education.

Title: BIOLOGICAL TECHNICIAN

Description: As a member of the Biosphere Team the applicant will conduct research on vegetation, including research on the effects of volcanoes and oil spills on the biosphere.

Requirements: Data entry, proficiency in maths and measurement.

Salary: Based on level of education.

Title: ECOSPHERE SPECIALIST

Description: As a member of the Ecosphere Team the applicant will study population density and the effects of carbon dioxide on the ecosystem.

Requirements: Data entry, proficiency in maths, good observational and mechanical skills.

Salary: Based on level of education.

Title: OCEANOGRAPHER

Description: As a member of the Hydrosphere Team the applicant will study ocean currents, temperatures, ocean vegetation and test for pollutants.

Requirements: Data entry, proficiency in maths, good observational and mechanical skills.

Salary: Based on level of education.

Title: ATMOSPHERIC SCIENTIST

Description: As a member of the Atmosphere Team the applicant will study rainfall, temperatures and cloud coverage.

Requirements: Data entry, proficiency in maths, good observational and mechanical skills.

Salary: Based on level of education.

Title: SATELLITE SPECIALIST

Description: As a member of the Satellite Team the applicant will build and deploy a new satellite and repair a non-functioning satellite.

Requirements: Good mechanical skills, proficiency in maths and reading. Applicant must be self-motivated.

Salary: Based on level of education.

Title: HYDROLOGIST

Description: As a member of the Geosphere Team the applicant will monitor ocean currents, temperatures and sea level. Hydrologists will also use a robot to collect soil samples and test for pH.

Requirements: Data entry, proficiency in maths, good observational and mechanical skills.

Salary: Based on level of education.

Job Application

Please review all the available positions and list your top three choices.

1st Choice _____

2nd Choice _____

3rd Choice _____

Personal Data

Name: _____ Date: _____

School: _____ Year Group: _____

Teacher's Name: _____

Relevant Skills and Experience

What makes you best qualified for this position?

What experiences and skills make you the best candidate for this position?

Crew Manifest

Mission _____		Date _____	
School _____		Teacher _____	
Teams		Mission Control Crew	
		Spacecraft Crew	
Communications 2 Members 1@ Mission Control 1@ Spacecraft	_____	_____	_____
Data 2 Members 1@ Mission Control 1@ Spacecraft	_____	_____	_____
Navigation 2-4 Members (Minimum 2) 1@ Mission Control 1@ Spacecraft	_____	_____	_____
Medical 2-4 Members (Minimum 2) 1@ Mission Control 1@ Spacecraft	_____	_____	_____
Probe 2-4 Members (Minimum 2) 1@ Mission Control 1@ Spacecraft	_____	_____	_____
Remote 2-6 Members (Minimum 2) 1@ Mission Control 1@ Spacecraft	_____	_____	_____
Life Support 2-6 Members (Minimum 2) 1@ Mission Control 1@ Spacecraft	_____	_____	_____
Isolation 2-6 Members (Minimum 2) 1@ Mission Control 1@ Spacecraft	_____	_____	_____

NOTE: This page is for use with the Return to the Moon, Voyage to Mars and Rendezvous with a Comet missions. Crew members will begin at their assigned locations and then switch at the halfway point.

Encounter Earth Crew Manifest

Mission _____ Date _____
 School _____ Teacher _____

Teams	Mission Control Crew	Spacecraft Crew
COM (Communications) 2 Members 1@ Mission Control 1@ Spacecraft	_____	_____
DAX (Data) 2 Members 1@ Mission Control 1@ Spacecraft	_____	_____
SAT (Satellite) 2-4 Members (Minimum 2) 1@ Mission Control 1@ Spacecraft	_____ _____	_____ _____
HYDRO (Hydrosphere) 2-4 Members (Minimum 2) 1@ Mission Control 1@ Spacecraft	_____ _____	_____ _____
GEO (Geosphere) 2-6 Members (Minimum 2) 1@ Mission Control 1@ Spacecraft	_____ _____	_____ _____
BIO (Biosphere) 2-6 Members (Minimum 2) 1@ Mission Control 1@ Spacecraft	_____ _____ _____	_____ _____ _____
ATM (Atmosphere) 2-6 Members (Minimum 2) 1@ Mission Control 1@ Spacecraft	_____ _____ _____	_____ _____ _____
ECO (Ecosphere) 2-6 Members (Minimum 2) 1@ Mission Control 1@ Spacecraft	_____ _____ _____	_____ _____ _____

NOTE: This page is for use with the Encounter Earth mission. Crew members will begin at their assigned locations and then switch at the halfway point.

Acids and Alkalis

Mission requirements

On a Challenger Mission, team members will be expected to:

- Organise and conduct tests and record results
- Recognise an indicator's colour in acid, in neutral and in alkaline solutions
- Interpret data
- Classify compounds
- Work effectively through verbal instructions

Background

Scientists use many skills to assist them in their research. Among many things, they need to be able to conduct tests, and analyse and classify the data. For example, scientists use the pH scale for acidity and alkalinity to identify and classify compounds.

Acids are chemical compounds that react with some metals to produce hydrogen gas. An acid will neutralise compounds such as bases (which include alkalis). A base (or an alkali when dissolved in water) will neutralise an acid. A substance that is neither an acid nor a base is considered neutral. A simple indicator such as Cabbage Juice Indicator can be used to show by a colour change whether a solution is acidic or alkaline.

For more precise analysis, the pH scale is used as a measure of how acidic or alkaline a solution sample is. Neutral solutions have a pH of 7. Pure water is an example of a neutral substance. Acidic solutions have a pH less than 7 and alkaline solutions have a pH of more than 7. Universal Indicator can be used to test the pH of a solution. It may be in the form of a liquid or paper that has been soaked in the indicator liquid.

Overview

In this activity, students test common solutions using a simple indicator and they interpret this data and classify the solutions as acidic, alkaline or neutral.

Key Question

How do scientists conduct experiments to classify liquids as acidic or alkaline?

Key Ideas

- Interpreting colour changes in a simple indicator
- Classifying acidic, alkaline and neutral substances

Materials & Preparation

Each pair of students needs:

- Small plastic beakers - 20 ml
- Plastic pipettes (2)
- Large plastic beakers - 250 ml
- Test tubes with bung
- Safety goggles - 1 per person
- Aprons - 1 per person
- Test tube rack
- Labels

To be shared by the class:

Solutions: water, household bleach, household ammonia, vinegar, milk, lemon juice, tomato juice, weak tea, and liquid soap

Needed for preparation:

- A head of red cabbage
- Measuring cylinder (250 ml)
- Cutting board and knife
- Strainer
- Non-aluminium pan

Prepare the red cabbage indicator as follows:

1. Cut a red cabbage into eight parts. Place cabbage in a non-aluminium pan, cover with water and boil for 10-15 minutes. (You may wish to use distilled water to ensure neutral pH.)
2. Pour the pan contents through a strainer and discard the cabbage leaves.
3. Cool the juice and store covered in the refrigerator. Freeze the juice in ice cube trays for later use.



4. Prepare the bleach, ammonia, soap and vinegar solutions by mixing 1 teaspoon of each liquid with 250 ml of water.
5. Label one large beaker 'water' and half fill it with water.
6. Label the other large beaker 'indicator' and half fill it with the cabbage juice indicator.
7. Label the small beakers 1-9. and half fill each with a different solution.
8. Label the test tubes 1-9.

Management

This activity will take one class period. Be sure to follow all safety rules for working with chemicals. (Goggles and aprons should be worn to protect eyes and clothes from splashes of chemicals.)

1. Encourage students to look at the list of household products on the chart below and for each solution, to predict and record if they think it acidic or neutral or the opposite of acidic - alkaline.
2. Students use a pipette to put 10 drops of solution '1' into the test tube labelled '1'.
3. Students use a second pipette to add two drops of indicator into the same tube. The pipette should be placed back into the beaker of indicator.
4. Students seal the test tube with a bung and gently shake it to mix the solutions. If no colour change is observed a further drop of indicator should be added, the tube resealed and gently shaken again. This may be repeated until 10 drops have been added.
5. Students should record the colour on the chart provided and comment on the solution being acid, alkaline or neutral.
6. Students should clean their solution pipette in the water cup and repeat steps 2-5 for each of the solutions.
7. Afterwards, students will clean up their test tubes and the work area.

Discussion

1. For the acidic solutions, what characteristics do they have in common?
2. For the alkaline solutions, what characteristics do they have in common?
3. What types of solutions tended to be neutral?
4. Were you surprised by any of your findings? If so, how?
5. Suggest other liquids you would expect to be alkaline, acidic and neutral.
6. What other ways are there to test for acids and alkalis?
7. Why is it important to know if substances are acids or alkalis?

Further Activities

1. Use Universal Indicator and compare the results.
2. Make indicator paper by cutting white blotting paper into strips and soaking the strips in the red cabbage indicator and allowing to dry.
3. Experiment to find other plants, fruits or vegetables that can be used as indicators for acids, alkalis and neutral substance (e.g. onion skins, blackcurrant juice)
4. Do some research on acid rain.
5. Collect water samples from local water sources and test for pH .
6. Do some research on the importance of maintaining pH in swimming pools and salt water aquaria.

Acids and Alkalis

Key Question

How do scientists conduct experiments to classify liquids as acidic or alkaline?

Student Procedures

1. Look at the list of household products on the chart below. For each solution, record your prediction of whether you think it is acidic, alkaline or neutral.
2. Use a pipette to put 10 drops of solution "1" (water) into the test tube labelled 1.
3. Use a second pipette to put two drops of indicator into the same test tube. Place this pipette back into the beaker of indicator.
4. Insert a bung and gently shake the test tube to mix the solutions. If the colour is the same as that of the indicator, try adding another drop and gently shaking again. Do not add more than a total of 10 drops of indicator.
5. Record your results on the chart below. Indicate whether the solution is acidic, alkaline or neutral.
6. Clean your solution pipette in the water cup and repeat steps 2-5 for each of the solutions.
7. Test your own ideas for numbers 10 and 11.

Data Log for Classification of Solutions			
Solution Name	Prediction	Colour	Acidic, Alkaline, or Neutral
1. water			
2. bleach water			
3. lemon juice			
4. tomato juice			
5. milk			
6. ammonia water			
7. weak tea			
8. vinegar water			
9. soap			
10.			
11.			

indicator + acid = pink

indicator + alkali = green

indicator + neutral = purple

S T U D E N T W O R K S H E E T

X & Y Coordinates

Mission Requirements

On a Challenger Mission, team members will be expected to:

- Determine coordinates and intersections
- Read graphs
- Interpret data
- Identify integers and rational numbers

Background

One piece of information that is essential to us on a daily basis is our location. We may not realize how often we use this type of information, but a little reflection on your conversations and actions over the past 24 hours will reveal a great dependency on being able to state your location accurately. For example, if you speak to a friend on the phone, he or she may ask from where you are calling. This can be as simple as saying, "I'm at Susan's house now, but I'm leaving for home in half an hour." Or you might say, "I am at 334 West Street in Hometown, Leicestershire, United Kingdom." To be more explicit, you might add, "In the Western Hemisphere of planet Earth,

the third planet from a star called the Sun, in the Milky Way Galaxy."

Another way to specify a location is by using a coordinate system. Probably the most-used system is the rectangular, or Cartesian coordinate system. In this system, a grid divides a surface into four quadrants. (See image below.) Locations are given by stating a pair of numbers or coordinates. The first number represents a horizontal value, X. This value can be either positive or negative. The second number represents a vertical value, Y, and it too can be either positive or negative. By finding where the horizontal and vertical values intersect, you can determine any location on the grid.

Overview

In this activity students use an X and Y coordinate system to locate missing spacecraft on a coordinate grid sheet.

Key Question

How are the X and Y axes used to find a specific location?

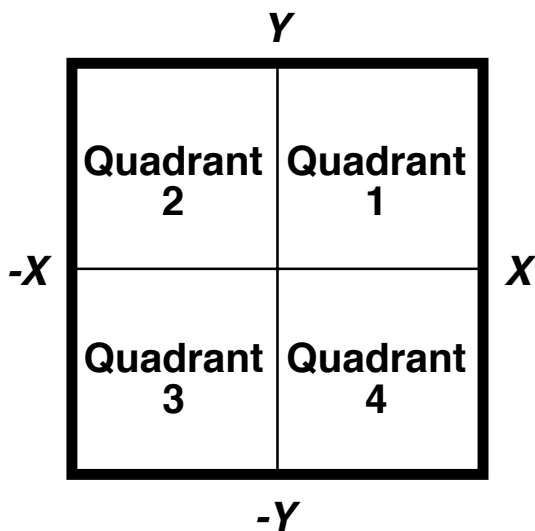
Key Ideas

- Precise locations can be specified using an X-Y coordinate grid.
- The X axis is horizontal; the Y axis is vertical.
- Locations on a grid are found by calling out a pair of coordinates.

Materials & Preparation

Each student needs:

- Grid Sheet
- Pencil
- Paper
- Red marker
- A book or other object to serve as a shield



1. Make copies of the grid sheets.
2. Make an overhead projection transparency of the grid.

Management

This activity can be completed in one class period.

With the whole class, discuss coordinate systems and quadrants. Using an overhead projector, show the grid to the class and practise identifying points with students. For example (4, 6) means finding where the X=4 line and Y=6 line intersect. If negative values are specified the point will be located in the 2nd, 3rd or 4th quadrants. For example (-4,6) is in the 2nd quadrant whereas (4,-6) is in the 4th quadrant.

It is important to stress that the coordinates locate a point rather than a square.

For the main activity students should work in pairs. Each pair needs a tall book or some sort of screen that can hide the grids from each other's view.

Discussion

1. In a coordinate pair, which number represents the X coordinate? Y coordinate?

2. Look at each quadrant. Which quadrants have positive X values? Negative Y values? Positive X, positive Y? Negative X, positive Y?
3. Suggest an alternative method of locating the spacecraft on the paper if you didn't have a coordinate system.
4. Can you think of a situation when the X-Y coordinate system might not be easy to use?
5. Can you think of any real-life examples of coordinate systems?

Further activities

1. Reduce the size of the spacecraft on the grid. How does this affect the time it takes to locate all of the spacecraft? What happens if you increase the grid size?
2. Research several different coordinate systems, specifically those used in astronomical research. Give a report on right ascension and declination as it applies to positions of astronomical objects.
3. Design a system to locate missing spacecraft that would make use of a three- dimensional field. This would require a Z-axis.

X & Y Coordinates

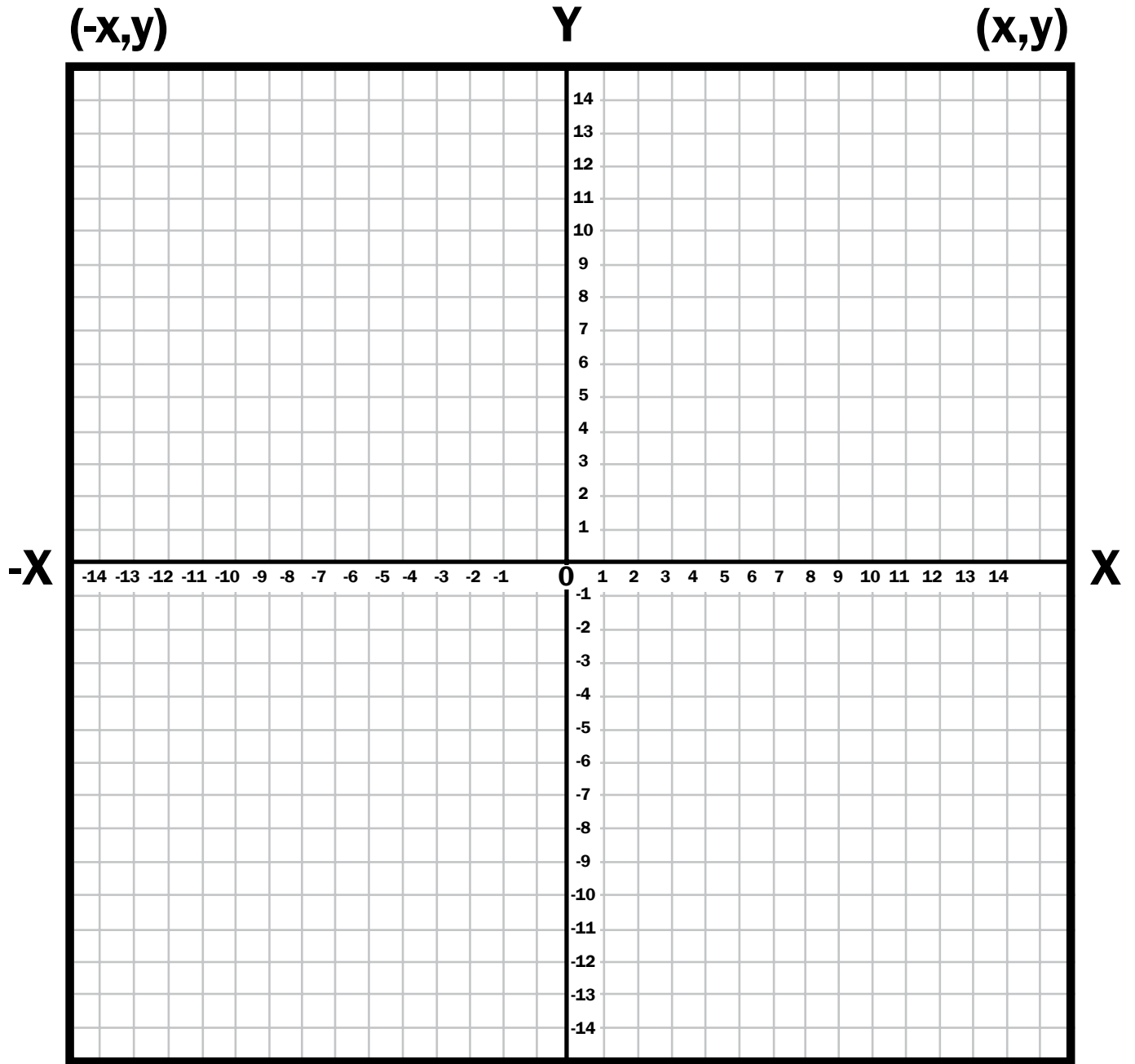
Key Question

How are the X and Y axes used to find a specific location?

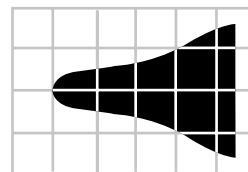
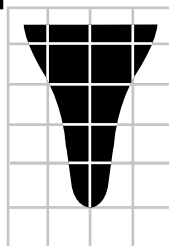
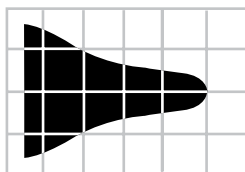
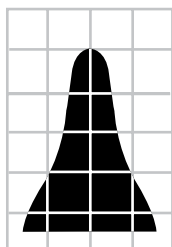
Student Procedures

1. This activity is done in pairs. Sit on the opposite side of a table or desk from your partner.
2. Place a book or other shield device in the centre of the desk. Make sure you cannot see your partner's grid.
3. Cut out the four spacecraft modules below the grid and stick one in each quadrant, taking care to line up the grid lines. They can point up or down or to the left or ~~right~~. Your partner will do likewise. The object of the game is to be the first person to find all of the missing spacecraft.
4. Decide which of you will go first. (For the sake of example, suppose that your partner goes first.)
5. Your partner will call out two numbers (the X and Y coordinates), representing a point on your grid.
6. Locate the coordinate on your grid. If this point falls within any part of a spacecraft, tell your partner that they have found a spacecraft. Your partner now has another turn to find a second point on the spacecraft. If at any time your partner's coordinate does not correspond to the location of a spacecraft, it is your turn to find a spacecraft on your partner's grid.
7. Keep track of the coordinates you have called (mark them with a different colour pen) so as not to repeat a number pair in a game.
8. To secure the location of a spacecraft, you must find two points on it. The game is complete when you have found all four spacecraft on each other's grid. Try again with new grid sheets.

Grid Sheet



(-X-y) **-Y** **(x-y)**



Latitude and Longitude

Mission Requirements

On a Challenger Mission, team members will be expected to:

- Use coordinate systems
- Use longitude and latitude
- Estimate position
- Measure distance

Background

The importance of identifying a specific location on Earth has long been a concern to travellers and explorers. This information was vital in planning for adequate supplies during voyages and for charting courses. Great effort was made by early mapmakers to show relationships between locations on Earth. Improvements in technology used for measuring distances led to increasingly more accurate maps.

Astronomers and geographers use coordinate systems for designating positions. You may be familiar with the system of longitude and latitude used by geographers. The system is regularly used to define positions on the Earth's surface. Latitude lines circle the planet parallel to the equator ranging from '0 degrees' at the equator to '90 degrees' at the poles. When stating a latitude, you must specify north or south of the equator. For example, a latitude of '40 degrees North' relates to an Earth location on a line with New York in the United States; Madrid, Spain, in Europe; and Beijing, China, in the Far East. Looking to the other side of the equator, a latitude of '23 degrees South' refers to a location near Rio de Janeiro, Brazil, in South America, and Alice Springs in Australia.

Longitude lines on Earth run north to south from the North Pole to the South Pole. Zero degrees longitude is defined as the line that runs through Greenwich, England, near London. A complete circumference of the Earth corresponds to 360 degrees of longitude. The longitude for locations in North and South America is called west longitude. For example, New York is located at a longitude of '74 degree West'. Longitude for locations east of Greenwich (most of Europe, Asia,

and Africa) are designated 'East longitude'. For example, Tokyo, Japan, is at a longitude of '139 degrees East'.

By naming both the latitude and longitude, any position on Earth can be specified precisely. For example, Leicester, England, can be said to be located at a point where the 53 degree North latitude line crosses the 1 degree West longitude line, or 53°N 1°W for short. To gain further precision, latitude and longitude degrees are divided into smaller units called minutes and seconds.

Overview

Using a globe model of the Earth, students use the grid system provided by the lines of longitude and latitude to identify selected positions on the globe.

Key Question

How are lines of latitude and longitude used to help us locate position on the Earth?

Key Ideas

- Coordinate systems are useful in helping people locate positions.
- Lines of longitude and latitude are commonly used to find geographical locations.

Materials & Preparation

Each student needs:

- 30 cm diameter inflatable globe marked with lines of latitude and longitude
- Water-based felt tip markers: red, black, green, blue

Management

This activity may take one lesson to complete. Review with students the background information, particularly reasons for having a system of determining locations on Earth. Practise the correct use of the terminology for describing position by locating the latitude and longitude of several towns or cities. Take special care over

cities which do not lie directly on a marked line of latitude or longitude.

Organise students to work in pairs and assign cooperative roles. When the tasks are complete, the marks on the globes can be wiped off with a soft damp cloth.

Discussion

1. What is the difference between longitude and latitude?
2. In the coordinates 40° N, 120° W, which is longitude and which is latitude?
3. Find the coordinates of a big city close to where you live.
4. How does the globe model differ from the real Earth?
5. How do you explain where something is when it doesn't directly lie on a marked line of latitude or longitude?
6. Why is it important to have coordinate systems?

Further activities

1. Research and give an oral report about the methods used by astronomers to define coordinates in the sky.
2. Find several different maps of the Earth and compare them. Are some more accurate than others? What factors are involved in making a map that is accurate?
3. Find out about the Royal Greenwich Observatory and the Prime Meridian. What is meant by Greenwich Mean Time (GMT)?
4. Assuming that there are 60 minutes of arc in one degree, and 60 seconds of arc in one minute, how do these units relate to longitude and latitude coordinates?
5. Using maps in the library or the internet, find a few obscure or remote locations on Earth and note their latitude and longitude as specifically as possible. Challenge the students to find the coordinates of the location, providing only the name of the location as a clue.

Latitude and Longitude

Key Question

How are lines of latitude and longitude used to help us locate position on the Earth?

Student Procedures

1. Get with your partner and obtain your globe and felt tip pens.
2. Identify the lines of latitude ranging from 0 degrees at the equator to 90 degrees at the poles. Note that there are two set of lines, one north of the equator and the other south of the equator.
3. Identify the lines of longitude ranging from 0 degrees to 180 degrees. Note that some lines are east of Greenwich and others are west.
4. Draw six small shapes (such as a triangle, star, circle, or square) on the globe with a marker. Make each shape different. Place the shapes so that no more than three are placed at an intersection of two lines.
5. Write down the shapes and their coordinates here:

Shape	Latitude	Longitude

6. With your partner, take turns to call out one of the shapes and the coordinate it is located at. (For instance: "I have a triangle at 33 degrees N and 127 degrees W.") On your own globe, locate the position that your partner gave you. When you find it, draw in the shape your partner indicated.
7. Repeat step 6 until all 6 coordinates have been located.

Questions

1. Do the shapes drawn on your globe match those of your partner? If there are differences, go back to steps 4 and 5 to see where there was an error. Once it is fixed, describe what went wrong the first time.
2. How did you find the coordinates of the shapes that were not located at an intersection of the lines? Is this way of finding the coordinates very accurate? How could the globe be marked to improve accuracy?

Chromatography

Mission Requirements

On a Challenger Mission, team members will be expected to:

- Conduct scientific experiments
- Making careful observations
- Interpret the data collected
- Record and communicate data

Background

Chromatography is a technique used to separate complex mixtures of substances and to analyse their individual components. The word 'chromatography' comes from the Greek word for 'colour writing'. It is very useful for identifying unknown substances and has many scientific applications, such as monitoring particular chemicals in the environment and investigating evidence from a crime scene.

The principles of chromatography are usefully investigated using water-soluble inks. Although a particular ink may appear to be a single colour, it is usually a mixture of different coloured components called pigments. In liquid chromatography, the different pigments are revealed by causing them to separate on an adsorber such as filter paper. This can be demonstrated by placing a spot of ink on a piece of filter paper and dipping the edge of the paper into a solvent such as water. (A solvent is a liquid in which the components of the mixture can dissolve.) As the solvent gradually soaks into the paper, it carries the ink's different pigments to different heights, showing up as different bands of colour. How far the pigment is carried depends on how readily it dissolves (its solubility) and how strongly it tends to stick to the paper. The more soluble the pigment is in the solvent or the less it tends to adhere to the paper, the further it will be carried, separating it from the other pigments in the ink.

Overview

In this activity students use filter paper as an adsorber, water as a solvent and water-soluble ink as the mixture and demonstrate how

mixtures can be separated into their component parts.

Key Question

What can the process of chromatography reveal about the components in a mixture?

Key Ideas

- Water-soluble inks may appear to be a single colour, but they are usually mixtures of different pigments.
- A mixture of water-soluble inks can be separated out by the process of liquid chromatography.

Materials & Preparation:

Each team of 4 students needs:

- Filter paper or coffee filter paper
- Scissors
- Clear plastic glass or small jar
- Ruler
- Eye protection (for each student) when using alcohol

To be shared by the class:

- An assortment of water-soluble markers
- 50% solution of water and alcohol (surgical spirit or clear methylated spirit)

Management

This activity can be completed in one class period. Be sure to review all safety rules with your students before working with the solutions.

1. Review the background information and discuss the importance and uses of scientific testing of the composition of substances.
2. Demonstrate how to prepare the filter paper and ink marks.
3. Assign students to working groups.

Discussion

1. What happens when the water in the filter paper reaches the ink mark?
2. List the order of colours that you observe on the filter paper from bottom to top (that is, from the ink mark upward).
3. If different coloured ink markers were used, what do you think would happen?
4. If you used hot water instead of cold, how would the results of the experiment be different?
5. Compare the results of the water solvent and the alcohol solvent experiments. Suggest some reasons for the results.

Further Activities

1. Encourage students to research and write a report on how biologists or criminologists use chromatography for identification purposes.
2. Write a mystery note, "left at the scene of a crime". Each suspect has a different marker. Get your partners to work out which pen wrote the note using chromatography.

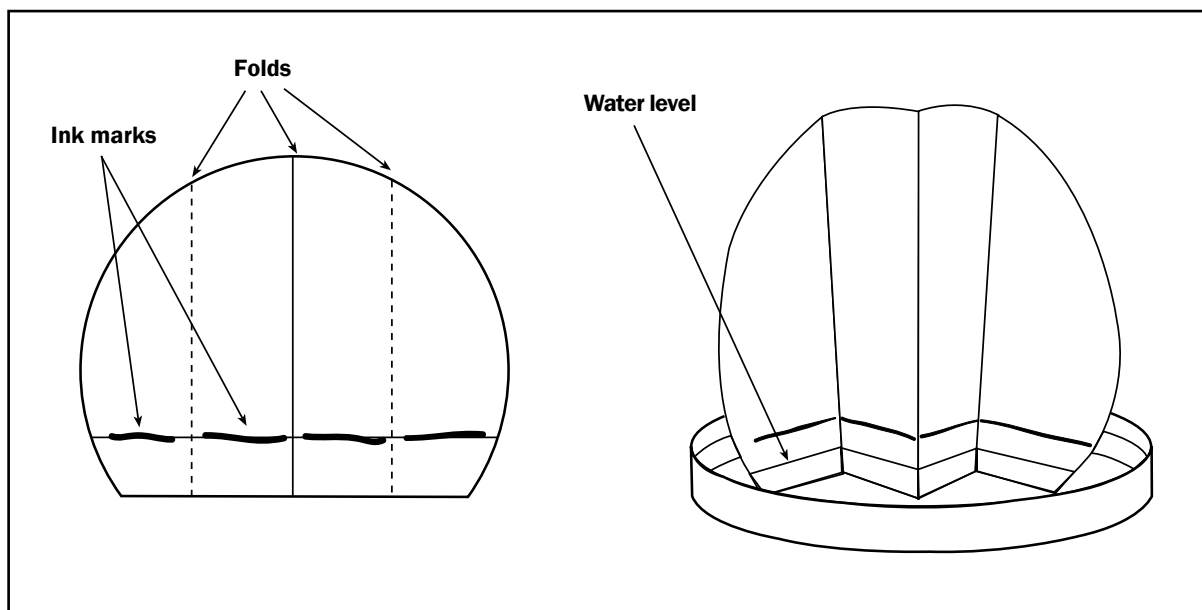
Chromatography

Key Question

What can the process of chromatography reveal about the components in a mixture?

Student Procedures

1. Take a filter paper and fold it in half and then half again to make a "zig-zag".
2. Cut it straight across, 2 cm from one end, to give a straight edge so the zig-zag can stand upright.
3. Flatten the paper and draw a pencil line 1 cm from the cut edge.
4. Make a small mark of each ink on the pencil line, spacing the marks out evenly along the pencil line.
5. Pour a little water into a saucer or petri dish so that it is shallower than the pencil line.
6. Carefully stand the zig-zag in the water and watch as the water soaks up past the ink blobs.
7. Repeat the experiment, using a solution consisting of 50% water and 50% alcohol as the solvent. Observe the change in the pattern of colours on the filter paper.



Questions

1. What happens when the water in the filter paper reaches each ink mark?
2. What does this tell you about the inks you have used?
3. For each ink, list or draw the order of colours that you observe on the filter paper from the ink mark upward.
4. In a set of felt-tip pens, how many different pigments have been mixed to make the colours?
5. If you used hot water instead of cold, do you think the rate of the experiment would change?
6. Compare these results with the experiment using water and alcohol as solvent. Suggest some reasons for these results.

Pulse and Blood Pressure

Mission Requirements

On a Challenger Mission, team members will be expected to:

- use a stethoscope and a blood pressure cuff to monitor vital signs of team-mates
- record and communicate data on vital signs

Background

Vital signs, such as pulse rate and blood pressure, provide important information about a person's health. In the treatment of patients in emergencies, vital signs give indispensable data. Also, vital signs provide important immediate data on the state of fitness of the circulatory system and overall physical health. Many jobs require employees to be physically fit. This is especially true for astronauts because of the stresses of lift-off, re-entry and for working in a low gravity environment.

With each heart beat there is a surge of blood in the arteries of the body and this can be felt as a pulse when you touch an artery which runs close to the skin and pressed against a bone. The two arteries commonly used are one in the side of the neck (carotid artery) or one in the wrist (distal radial artery). The pulse rate is the number of beats per minute that can be felt in the artery. Although the pulse rate itself is a useful indicator of health, the amount that it changes when a person does some exercise and the time it takes to change are also important indicators of fitness.

To measure blood pressure, a sphygmomanometer cuff is placed around the upper arm and inflated with air until it squeezes the arm sufficiently tightly to stop the blood flowing in the artery. A stethoscope is used to listen to the sounds of blood flow in the artery in the angle of the elbow just below the cuff whilst the air in the constricting cuff is gradually released. The pressure in the cuff is recorded (in mm of mercury) when the sounds are first heard and when the sounds can no longer be heard. These two values are, respectively, systolic (when

the heart is pumping) and diastolic (between pumping). Blood pressure readings indicate the pressure of the blood on the inside wall of the vessels, especially the arteries. Knowing these values can be useful for diagnosing shock or illness.

Overview

Students record vital signs of classmates before and after exercise by taking measurements of pulse rate and blood pressure.

Key Question

How can scientists monitor the state of human biological systems?

Key Ideas

- Pulse rate and blood pressure are fundamental vital signs.
- Blood pressure is measured using a stethoscope and a blood pressure cuff.
- Medical data must be collected and recorded carefully.

Materials & Preparation

Each group of students needs:

- Stethoscope
- Sphygmomanometer (blood pressure cuff, valve and meter)
- Sterilising wipes
- Clock with a second hand

Stethoscopes and blood pressure cuffs can often be borrowed from the PE department, a health unit or the school nurse. A nurse might be persuaded to give a demonstration.

Management

This activity will take one class period. Discuss the safety procedures, including proper placement of blood pressure cuff, only leaving the cuff on for less than 3 minutes, and not tapping on the stethoscope. Care must be exercised in using the stethoscope; improper use can cause ear damage. Between each use, the earpieces

of the stethoscopes should be cleaned with sterilising wipes.

Students are best organised into groups of two on a rota basis and it is appropriate to restrict the activity to responsible students who would follow the safety procedures carefully.

Important: Close supervision of students by an adult is essential. Children suffering from asthma or other relevant medical conditions should be excluded from the second part of this activity. In the discussion of results there should be no implication of 'normal' values; the results for each individual should be regarded separately and it should be made clear to pupils that the information is for scientific rather than medical use.

Discussion

1. What happens to your heart rate when you are afraid? Relaxed? Stressed?
2. Could everyone find their partner's distal radial pulse?
3. How reliable is a single reading of pulse rate or blood pressure?
4. How might living in space affect the heart rate?
5. Why do you think that prolonged high blood pressure is dangerous?
6. Can you think of ways a person might try to lower their blood pressure or pulse rate?
7. Can you think of other uses for the

stethoscope?

8. What other human systems need to be monitored in regular health checks?
9. How can technology help scientists accurately monitor these systems?

Further activities

1. Use a pulse rate sensor, data-logger and computer to record a student's pulse rate over a few minutes, before and after some exercise (running on the spot or stepping up and down once per second on a low (15cm) bench or step for two minutes). Continue recording data until the pulse rate recovers near to the starting value.
2. Study the graph of pulse rate versus time and consider the reasons for the difference between the pulse rate before and after exercise.
3. Compare the times taken for the rate to increase during exercise and recover afterwards.
4. A similar investigation could be conducted to observe the effect on the pulse rate of drinking cola, coffee or tea.
5. Students can be shown a graph of pulse rate against time and asked to tell a story of an activity which might produce the graph.

Pulse and Blood Pressure

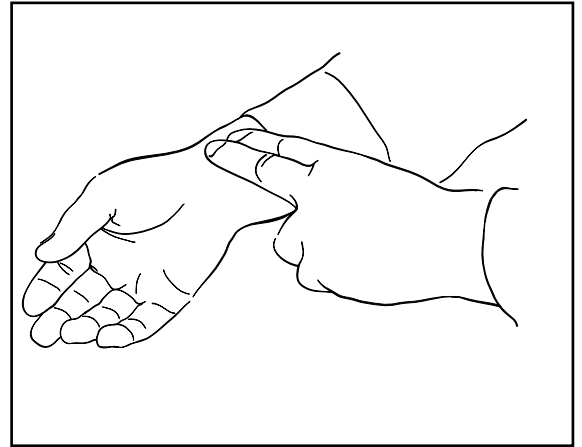
Key Question

How can scientists monitor the state of human biological systems?

Student Procedures

PULSE

1. Using your index and middle fingertips, find your teammate's distal radial pulse. This will be found on the thumb side of the wrist with the palm facing up. Alternatively, gently find the carotid artery in your partner's neck near the lower jaw.
2. Find the pulse rate by counting how many pulsations you feel in fifteen seconds and multiplying that number by four. Pulse rate is reported as pulses per minute.
3. Fill in pulse rate at rest. Do some running on the spot for 2 minutes, then complete the second set of measurements.



At rest

After running

Student 1 Pulse Rate: _____

Student 2 Pulse Rate: _____

Fill in pulse before running. Run and then complete the second set of measurements.

BLOOD PRESSURE

1. Carefully place the blood pressure cuff around your team-mate's upper arm about two centimetres above the elbow. Make sure the cuff placement indicator is above the bend in the elbow. Tighten the bulb valve. Do not over tighten.

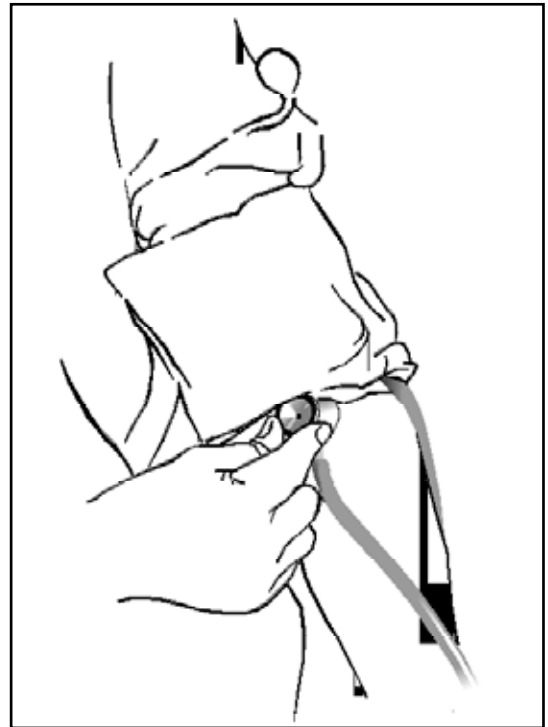
2. Clean the earpieces of the stethoscope with an alcohol swab.

3. Place stethoscope diaphragm on the inside of the arm that has the cuff in the angle of the elbow, then place the earpieces in your ears.

4. Pump the cuff until the sphygmomanometer reads 180 mm of mercury. NOTE: you will not hear pulsation through the stethoscope when the cuff pressure is below the diastolic or above the systolic pressure. (Either the blood is flowing too freely or the blood flow is constricted.) Release the valve slowly and listen carefully for the first pulsating sounds. Note the number indicated by the meter at this point. This is the systolic pressure.

5. Keep slowly releasing the valve and note the number at the point where you no longer hear any sounds. This is the diastolic pressure.

6. Report the blood pressure as the systolic reading over the diastolic reading, for example 110/68. Finish letting out the air from the cuff by completely releasing the valve.



	At rest	After running
Student 1 Blood Pressure:	_____ / _____	_____ / _____
Student 2 Blood Pressure:	_____ / _____	_____ / _____

Electromagnetic Spectrum

Mission Requirements

On a Challenger Mission, team members will be expected to:

- Observe optical spectra
- Record and communicate data
- Interpret data to identify light sources

Background

Galaxies, stars and most of the planets in the Solar System are too far away for humans to visit. So astronomers, engineers and other space scientists have to be clever to learn more about these celestial objects. Scientists have done just this by studying the light, or radiation, that comes from these objects.

Although we cannot observe them, visible light comes in tiny waves, which behave in a similar way to waves on the surface of water with crests and troughs. The distance between two crests is called the wavelength. For visible light the wavelengths are millions of times shorter than for water waves. Not all the wavelengths are the same; some are shorter and some are longer and we see them as different colours. Sunlight may appear to be colourless white light, but really it is a mixture of many colours, each with a different wavelength. You can see some of these colours when a rainbow appears in the sky after rain; as sunlight passes through the raindrops, it is bent, or refracted, by an amount which depends on the wavelength of the light. The effect is to split the sunlight up into its component colours called a spectrum. In the laboratory a diffraction grating can be used to separate light into its component colours. The wavelength of colours in the visible spectrum ranges from long to short in the following order: red, orange, yellow, green, blue and violet, with violet having the shortest wavelength and red the longest.

Waves with wavelengths longer than red cannot be seen at all, but they can be felt as heat. These are called infrared or heat waves. Microwaves and radio waves are further forms

of radiation with even longer wavelengths. At the other extreme, radiation with wavelengths shorter than the visible spectrum includes ultraviolet, X-ray and gamma rays. All of these waves are part of the electromagnetic spectrum; however, only a small portion of the spectrum is visible as light.

When you pass sunlight through a diffraction grating, the resulting spectrum contains so many colours it appears continuous. However, the light emitted from hot gases, such as that from neon or fluorescent lamps, contains a unique selection of colours which makes the spectrum a 'signature' for the particular gas. The gas can be identified by looking at the particular collection of colours. Likewise, the light from galaxies and stars provide signatures which indicate the types of gases and chemical elements present.

Overview

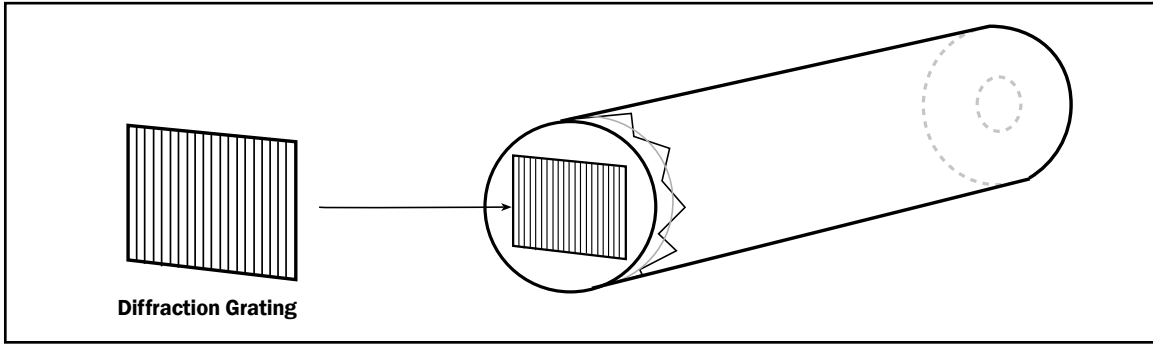
Students use a diffraction grating to separate light into a colour spectrum, then build a pinhole tube with the grating on one end to observe four different light sources. They record their observations and compare and contrast the results to draw conclusions about the light sources.

Key Question

How can light be analysed to obtain information about its source?

Key Ideas

- Sunlight is made up of a spectrum of colours.
- Different types of light have different 'signatures' of spectra, each unique to the source.
- The visible spectrum is only a small part of the electromagnetic spectrum.



Materials & Preparation

Each student needs a diffraction tube made from:

- Diffraction grating (2.5 by 2.5 cm square)
- Cardboard tube from paper towel roll
- Pins (may be shared)
- Small index cards
- Self-adhesive tape

To be shared by the class:

- 4 different light sources including: mains lamp, low energy lamp, fluorescent light, neon light, Light emitting diode (LED), or halogen lamp
- A4 size card for each source

- The diffraction grating may be obtained in sheets from a science equipment supplier and then cut into 2.5 by 2.5 cm squares.
- The light sources may be brought from home, or from hardware shops.

Constructing the diffraction tube:

1. Take the index card and mark a square with sides of 2 cm in the centre of the card. Cut the square out. (To get started it may help to fold the card in half.)
2. Carefully tape the piece of diffraction grating to the card.
3. Hold the card over one end of the cardboard tube, ensuring that the grating is in the middle of the hole. Make radial cuts to the card with scissors then bend the flaps so that they fit around the tube. Tape all the flaps to the tube so that the card is firmly in place.
4. Cover the opposite end of the tube with a similar card containing a small hole in the middle.

Preparing the light sources:

LEDs and neon lights can be viewed directly but the larger lamps will need to have placed in front of them a card with a narrow slit cut out to allow a portion of the light through. The slit should be no more than 2mm wide.

Management

The different light sources should be spread around a darkened room so that three or four students can gather around each to view the light. Students should hold the grating end of the tube to their eye and then point the other end of the tube towards the lamp. The tube helps to exclude extraneous light so that the diffraction images can be seen against a dark background. Students can view each source in turn.

Discussion

1. In what ways do the spectra from different sources differ?
2. How can scientists use spectra to learn about stars and galaxies?

Further activities

1. Experiment with different methods of splitting light into its component colours. For example; try different shapes of hole in the card covering the source; try refracting light with a prism or beaker of water. Compare the results.
2. The Sun emits radiation other than the visible spectrum. Find out about the other types of radiation. Is all radiation safe for humans? How do we experience it? What other parts of the spectrum do astronauts and space engineers use to study the universe?

Electromagnetic Spectrum

Key Question

How can light be analysed to obtain information about its source?

Student Procedures

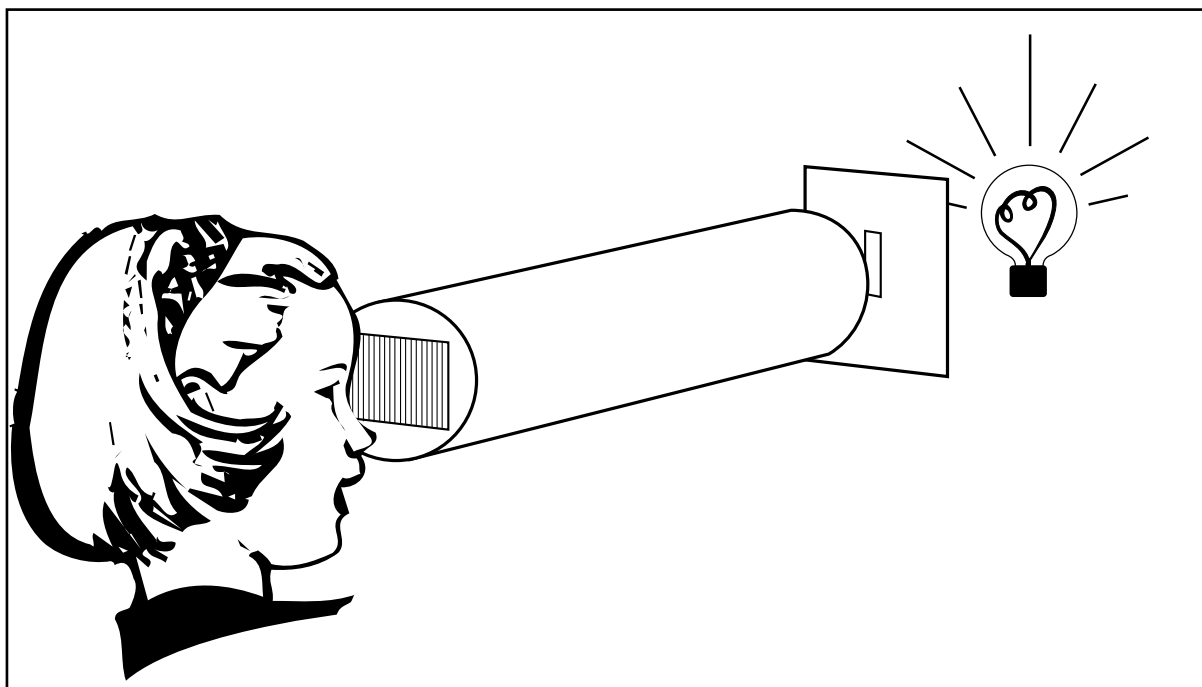
1. You are provided with a tube fitted with a diffraction grating at one end and will use this to examine the spectrum of colours in four light sources. Each light source is shielded by a card but you are able to see the light through a narrow slit in the card.

Do NOT point your tube or look directly at the Sun.

! This can lead to permanent eye damage!

2. Stand about 2 m away from a light source and look through the diffraction grating, pointing the tube towards the slit in the card shield. You need to turn the tube until the spectrum colours appear spread out horizontally in the tube.

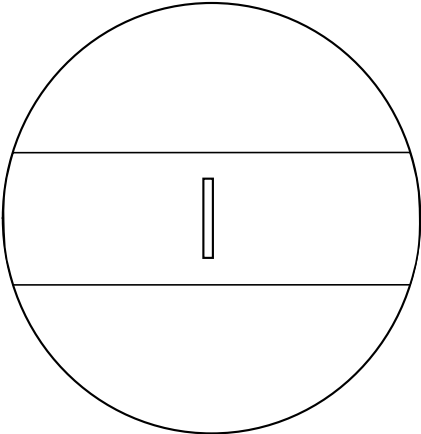
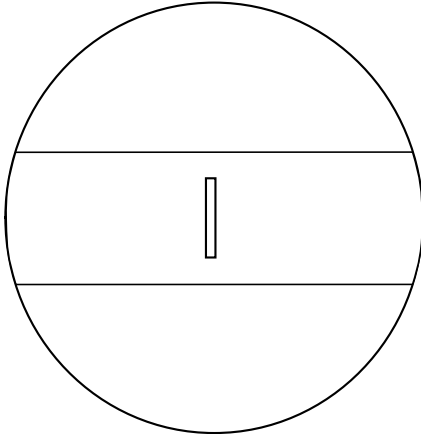
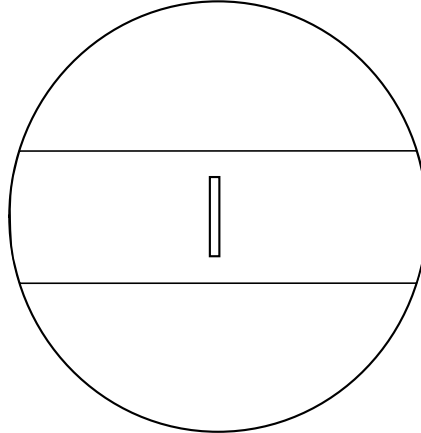
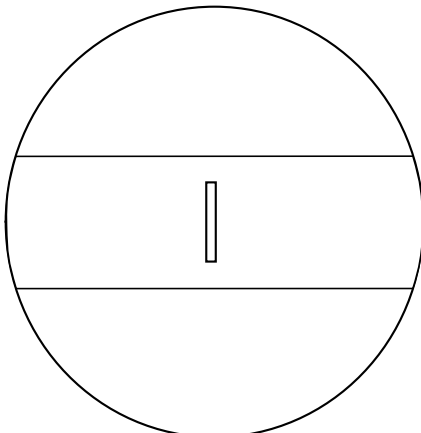
3. As you look through the grating, rotate the tube so that colours appear on the left and



Electromagnetic Spectrum

right of the light source. In the diagrams below, the small slit in the centre represents the light source. Use crayons to draw between the guidelines the colours in the order you see them and add labels to show the main colours visible.

4. Repeat this for three other sources, recording your results on the diagrams.

<p><u>Light Source 1:</u> _____</p> 	<p><u>Light Source 2:</u> _____</p> 
<p><u>Light Source 3:</u> _____</p> 	<p><u>Light Source 4:</u> _____</p> 

5. Describe the main differences between the spectra you have recorded.

6. Suggest how a spectrum might be used to identify which type of light source the light comes from.

Reading Equipment with Scales

Mission Requirements

On a Challenger mission, team members will be expected to:

- Use metric units for measurement
- Read analogue meter dials
- Read graduated scales
- Record measurements
- Calculate the density of rocks

Background

In an effort to gain a deeper understanding of our universe and to better prepare for future missions, scientists examine a wide range of measurements about our Solar System and beyond. For each physical quantity a standard unit of measurement has been agreed so that when scientists exchange information about measurements they can be confident that it can be understood precisely. The International System of Units (SI), based on the metric system, has been adopted throughout the world for expressing scientific data.

The SI includes a series of rules about how units are written when the quantities are very small or very large. The prefixes 'milli-' and 'kilo-' are used to show fractions and multiples:

Lengths and distance:

- millimetre = 1/1000th of a metre
- kilometre = 1000 metres

Mass:

- milligram = 1/1000th gram
- kilogram = 1000 grams

Volume:

- millilitre = 1/1000th litre

Litres and millilitres are the common units for volumes of liquid but the cubic centimetre (cm³) is widely used for solids. 1 cm³ is the same as 1 ml.

Some measurements cannot be obtained directly and have to be calculated from basic measurements. An example is the density of a substance, defined as the mass of unit volume of the substance; the measurement of density requires calculation from two other measurements (mass and volume).

$$\text{density} = \text{mass} / \text{volume}$$

Although measuring instruments increasingly use digital displays these days, many instruments still use analogue meter dials and graduated scales. Common examples are ammeters for electric current and graduated cylinders for volumes of liquids. In both cases the scales need to be read carefully.

Overview

Students practise reading an ammeter dial, a graduated cylinder and a balance. They use measurements of mass and volume to calculate the density of rocks.

Measurement	Unit	Symbol	Instrument
Length, distance	metre, kilometre	m, km	ruler, tape measure
Volume of liquid	litre, millilitre	l, ml	measuring cylinder
Mass	gram, milligram	g, mg	balance
Temperature	Celsius	°C	thermometer
Speed	metre/second	m/s or ms ⁻¹	speedometer
Electrical current	ampere	A	ammeter

Key Question

How are measurements with simple instruments used to assist scientific investigation?

Key Ideas

- Measurement technology is important in scientific investigation.
- Precise reading of measurement instruments is vital for analysis and drawing scientific conclusions.
- Our understanding of many phenomena in the Solar System depends upon the precision and accuracy of measurements.

Materials and Preparation

Each group of students will need:

- Five different rocks to weigh and measure
- Kitchen 'scales' or access to a top-pan balance
- Measuring cylinder (at least 200 ml)
- Calculator

Management

The lesson should take one class period. Discuss the process of using the displaced water to measure the volume of the rock and consider possible sources of error in obtaining accurate readings. (Take care to read from the bottom of the water meniscus in the measuring cylinder.) Students can work in groups of two or three and should organise their measuring and recording tasks cooperatively.

Discussion

1. Describe instruments in everyday life which use analogue scales.
2. Why is it useful to have multiples and fractions of units in the metric system?

Reading Equipment with Scales

Key Question

How are measurements with simple instruments used to assist scientific investigation?

Student Procedures

- The diagrams show the results of an experiment similar to what you will do. Some water was put into the measuring cylinder shown in diagram A. Then, a rock was dropped in and the water level went up as shown in diagram B.

Look carefully at the scales in the diagrams and record the volumes indicated.

Volume shown in diagram A _____ ml

Volume shown in diagram B _____ ml

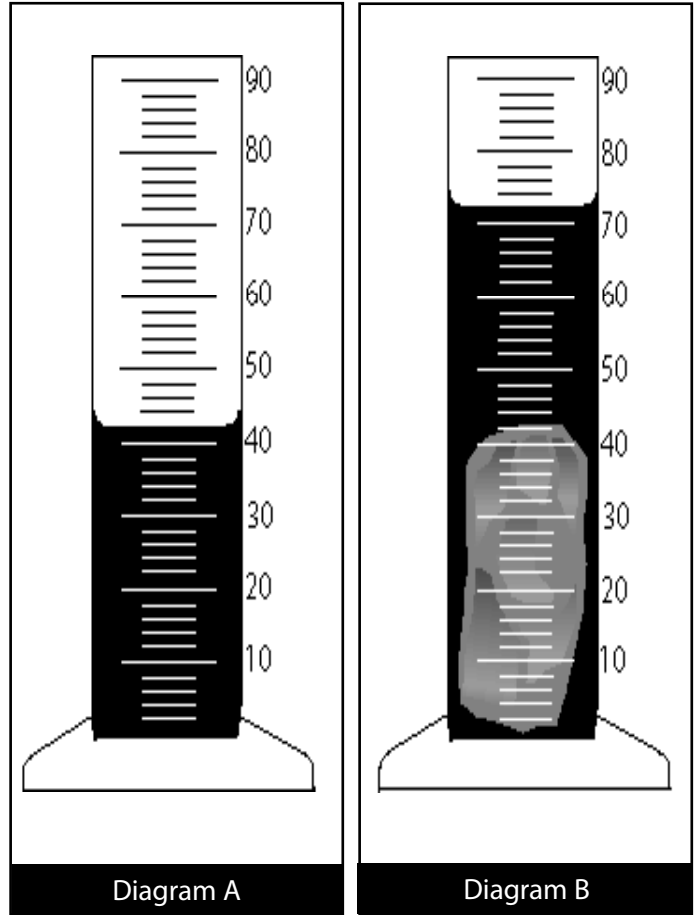
Subtract the above values: _____ ml

The subtraction gives the volume of the rock which was immersed in the cylinder.

The mass of the rock is 120 g.

The density of the rock is found by working out the mass of just 1 ml (the same as 1 cm³) of the rock. Use a calculator to find the density of the rock in the formula:

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$



- Now find the mass volume and density for the rocks provided.

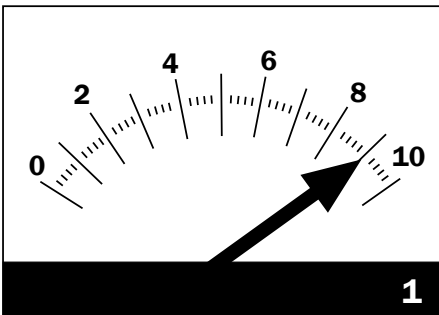
In each case:

- Place the rock on the balance and record its mass in grams.
- Half fill the cylinder with water and record the volume in ml.
- Carefully immerse the rock in the water and record the new volume.

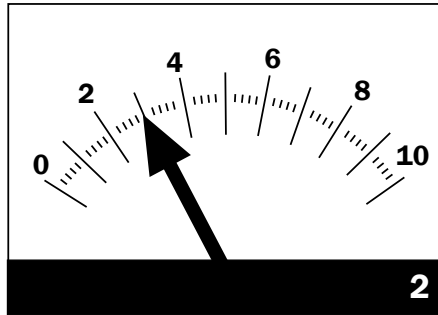
3. Calculate the volume of each rock by subtracting the volume of water from the volume of water with the rock. (Remember 1 ml is the same as 1 cm³.)
4. Calculate the density of each rock by dividing the mass by the volume of rock.

	Mass of rock (g)	Volume of water (ml)	Volume of water & rock (ml)	Volume of rock (ml)	Density of rock (g/cm ³)
Rock A					
Rock B					
Rock C					
Rock D					

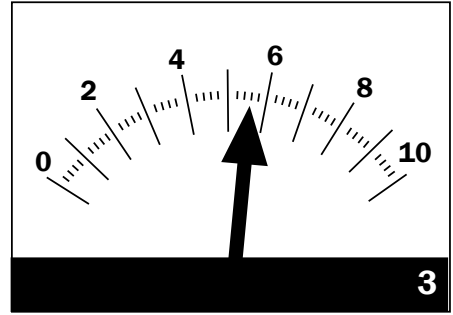
5. Look at the ammeter dials illustrated below and write under each the reading shown by the pointer.



Current = A _____

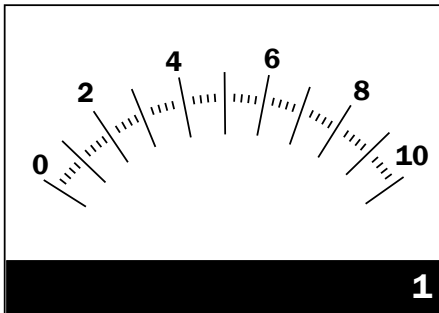


Current = A _____

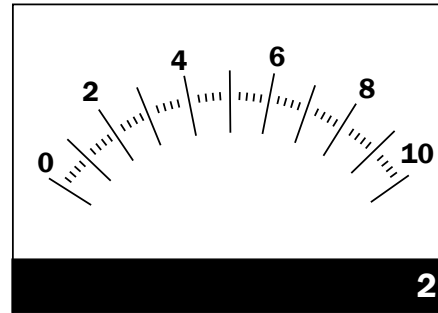


Current = A _____

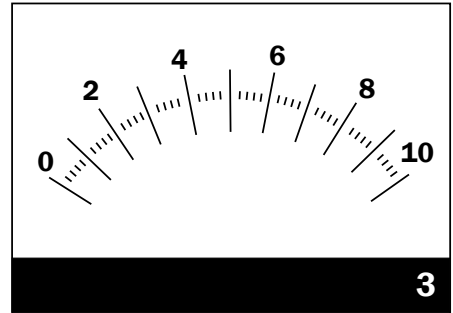
6. Add a pointer to the ammeter dials below to indicate the currents shown.



Current = 2.8 A



Current = 7.0 A



Current = 4.4 A

Average Temperature

Mission Requirements

On a Challenger Mission, team members will be expected to:

- Take temperature readings
- Calculate average values
- Plot a graph
- Control variables and conduct fair tests

Background

The Earth orbits the Sun in an elliptical path that is very nearly a circle. During the month of January each year, the Earth is nearest to the Sun; in July it is furthest from the Sun.

Earth experiences changes of average surface temperature between the seasons because its axis of rotation is tilted with respect to its orbital plane. The tilt of Earth's axis makes the Sun rise to a different height in the sky according to the season. In the northern hemisphere during the summer, the Sun takes a very high path across the sky which makes the rays of sunlight strike the Earth at a high angle of elevation. It also appears for a longer period of time making days longer. In winter, the Sun travels in a low path across the southern sky, making the angle of incident sunlight striking the northern hemisphere lower. The low angle of sunlight is less efficient at heating the Earth's surface because the energy is spread out over a larger area. Also, the combination of this with shorter days causes average winter temperatures to be colder.

Temperatures also differ during night and day. In general, the temperature in daytime is higher than at night because the Sun's energy warms the Earth and its atmosphere during the day. Other causes for varying temperatures include the amount of cloud cover and the occurrence of atmospheric weather fronts.

Overview

Students study variations in the microclimate inside a box fitted with a low voltage lamp and two temperature probes. One probe is shaded from direct rays from the lamp. As the lamp is switched on and off at regular intervals the temperatures are recorded every minute using a data-logger and computer. The results are presented on a 'Temperature vs. Time' graph and average temperatures are calculated for each probe.

Key Question

How can scientists use temperature data to describe the climate of a particular location?

Key Ideas

- Data collection
- Analysing data sets
- Conducting scientific investigations
- How scientists use technology to help them in their research

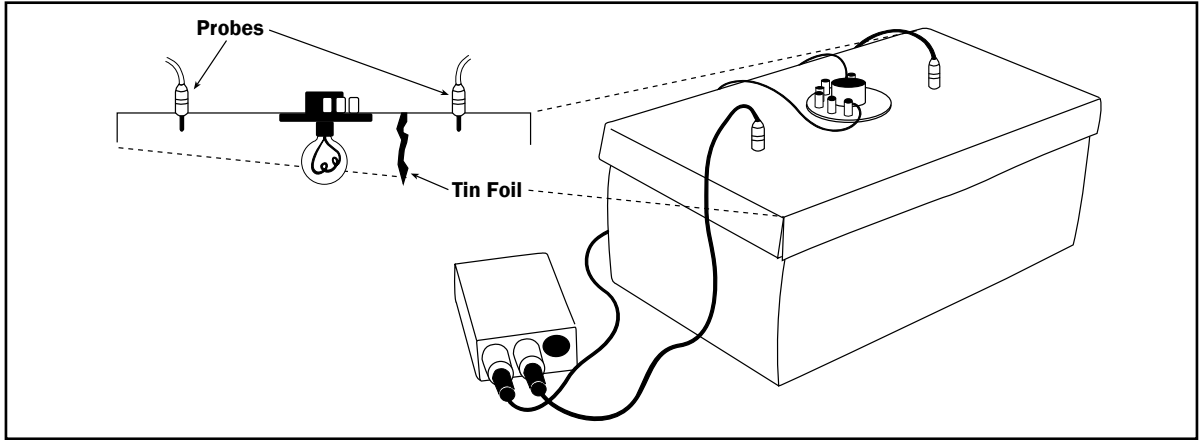
Materials & Preparation

Each group of students will need:

- Box fitted with 12 volt bulb (car brake bulb 21W)
- 12 volt power supply (e.g. from model racing cars kit)
- Computer, data-logger and temperature probes

Alternatively:

- Thermometers (2)
- Data collection sheet
- Graph paper
- Pencil
- Clock



Preparing the microclimate box:

A shoe box is most suitable, with a bulb holder fitted in the centre of the lid with the bulb inside the box. Pierce the lid with two small holes equidistant (10 cm) on each side of the bulb. Insert a temperature probe in each hole with their bulbs just inside the box. Attach a piece of aluminium foil to the inside of the lid so that one of the probes is shielded from the direct light from the electric bulb. The bulb should be connected to a 12 volt power supply, preferably with a switch in series.

As an alternative, the whole experiment may be conducted using thermometers, a clock and graph paper.

Management

Discuss concepts presented in the Background section, then present the experiment as an investigation of a microclimate inside a box.

Students should be organised into groups of 3 or 4 and assigned to co-operative roles (operating the software and controlling the lamp). When students have assembled the apparatus and are ready for readings, the activity will take 30 minutes. While data-logging is in progress, students should be encouraged to discuss the results as the graph appears on the computer screen and then use the software tools to analyse the data. The experiment and analysis of results can be accomplished in one class period. If thermometers and graph paper are used, it is likely that another class period may be needed for students to complete the line graph and discuss the results.

Discussion

1. What factors contributed to the different average temperatures recorded for the two temperature probes?
2. What are the implications of sunlight and shadow on astronauts in space? How do conditions in the experiment differ from those in space? Consider the extremes of temperature which are likely to be recorded.
3. Consider the similarities and differences between the experiment and the climate on the Earth during night and day.
4. Consider how information about the local climate is important to people in these occupations: farmer, city planner, fire fighter or headteacher.

Further Activities

Investigate the effects of convection and radiation by repeating the experiment with the box placed on its side or by lining the inside of the box with aluminium foil.

Collect data to find average temperatures for the classroom. Take temperatures at several locations within the room and calculate the average.

Collect data from the school weather station over several days and include measurements of pressure, humidity, and rainfall.

Collect local weather data (using local newspaper or TV weather reports) and data from other regions of the world (using websites e.g. Meteorological Office). Compare your results.

Average Temperature

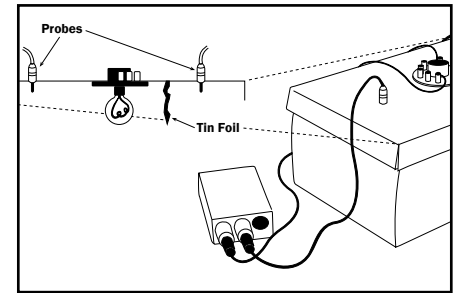
Key Question

How can scientists use temperature data to describe the climate of a particular location?

Student Procedures

USING A COMPUTER AND DATA-LOGGER

1. Insert the two temperature probes into the holes provided in the lid of the box and connect them to the data-logger linked to the computer.
2. Connect the lamp and switch to the low voltage power supply.
3. Switch on the lamp and set the software to record temperatures for 30 minutes.
4. After 5 minutes switch off the lamp. Switch it back on after a further 5 minutes. Repeat this so that the lamp is on and off alternately at 5 minute intervals.



USING GLASS THERMOMETERS

1. Insert the two thermometers into the holes provided so that the temperature scales can be read from outside the box.
2. Connect the lamp and switch to the low voltage power supply.
3. Organise your team so that two students can read the thermometers and another can record the results in a table.
4. Record the temperatures at one minute intervals for 30 minutes. When you start the clock switch on the lamp also.
5. After the first 5 minutes switch off the lamp. Switch it back on after a further 5 minutes. Repeat this so that the lamp is on and off alternately at 5 minute intervals.

Discussion of results

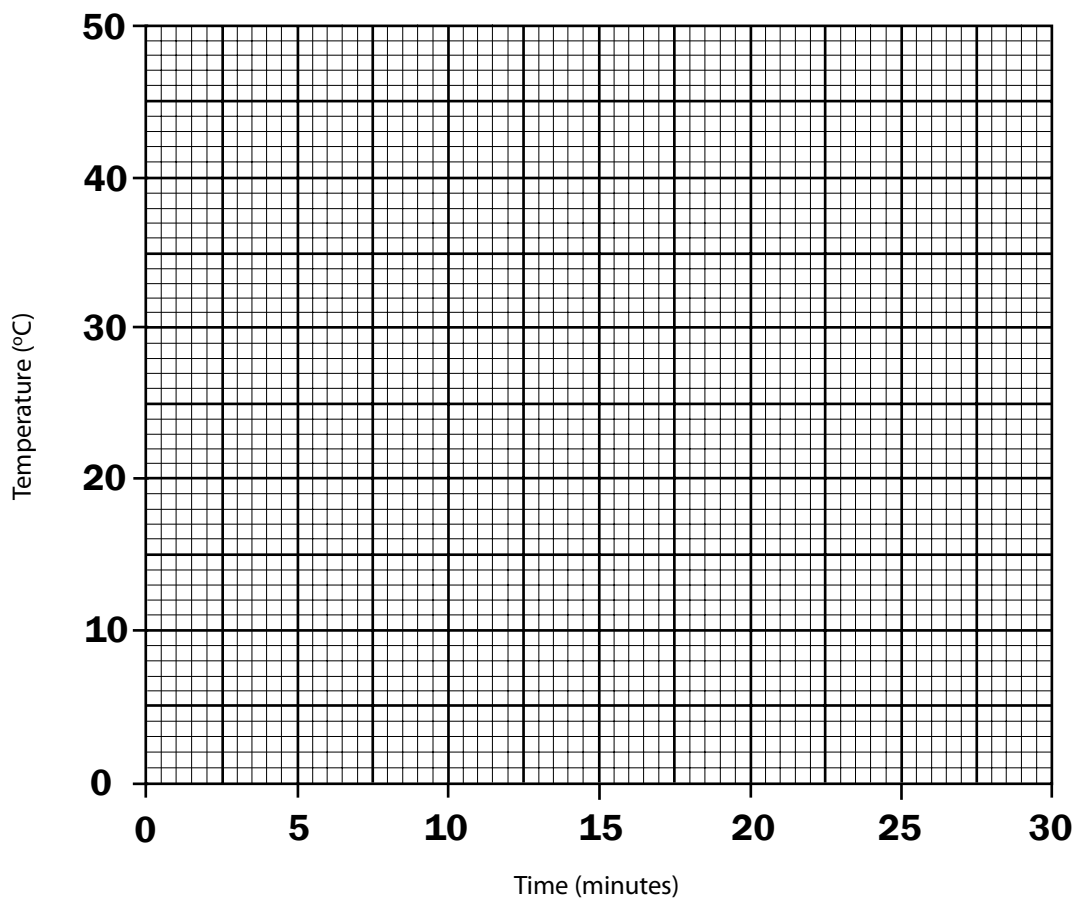
1. Use the table of results or the graph to find the average temperatures for each probe during the whole experiment.

Av. Temperature for Probe A: _____ Av. Temperature for Probe B: _____

2. Why is the average temperature for one probe different from that for the other probe?

3. Explain why the temperature inside the box varies during the experiment.

Time (minutes)	Temp. A (°C)	Temp. B (°C)	Time (minutes)	Temp. A (°C)	Temp. B (°C)	Time (minutes)	Temp. A (°C)	Temp. B (°C)
1			11			21		
2			12			22		
3			13			23		
4			14			24		
5			15			25		
6			16			26		
7			17			27		
8			18			28		
9			19			29		
10			20			30		



Mission Badge

Mission requirements

On a Challenger Mission, team members will be expected to:

- Communicate and discuss ideas
- Arrive at a team consensus

Background

While in training, the crew of every Space Transport System (STS) designs a badge that identifies its unique mission. Since the first mission in April 1981, more than 300 astronauts have participated in more than eighty missions. Most Shuttle crews consist of the commander, a pilot, mission specialists, and payload specialists. Each member of the crew contributes to the badge design. The team uses colour, shape, images, and text to represent different aspects of their mission. Here are two examples.

STS 51- L CREW INSIGNIA - This mission badge symbolises the mission of shuttle flight 51-L, to fly and to teach. The shuttle, being launched from the United States of America, encircles the planet to signify its U.S. presence in space to explore new frontiers. The shuttle in flight with open cargo doors represents the 51-L mission to launch a communication satellite (TDRSS), to collect data from Comet Halley and to conduct scientific experiments. The apple next to the teacher's name signifies the educational mission of the crew to touch the future through the lessons taught in space. The scene is encircled by the surnames of the crew members. They were astronauts Francis R. (Dick) Scobee, commander; Michael J. Smith, pilot; Ron McNair, Ellison Onizuka, and Judy Resnik, all mission specialists; Greg Jarvis, payload specialist; and Christa McAuliffe, teacher.

STS-81 CREW INSIGNIA - The mission badge for STS-81, the fifth Shuttle-Mir docking mission, is shaped to represent the Roman numeral V. The Space Shuttle Atlantis, OV-104, is launching toward a rendezvous with Russia's Mir Space

Station silhouetted in the background. Atlantis and the STS-81 crew spent several days docked to Mir during which time astronaut Jerry M. Linenger (NASA-Mir 4) replaced astronaut John E. Blaha (NASA-Mir 3) as the United States crew member on board Mir. Scientific experiments and logistics were also transferred between Atlantis and Mir. The United States and Russian flags are depicted along with the names of the Shuttle crew members: Michael A. Baker, commander; Brent W. Jett, pilot; Peter J. K. (Jeff) Wisoff, mission specialist 1; John W. Grunsfeld, mission specialist 2; Marsha S. Ivins, mission specialist 3; Linenger mission specialist 4; and Blaha, mission specialist 5.

Overview

Students work in teams of four. They read the two mission badge descriptions and analyse the badges. Using shape, colour, images and text, they then design their own crew badge.

Key Question

How can a graphic design represent all of the members of a team and their mission?

Key Ideas

Shape, colour, images and text can be used to create a graphic representation of a mission.

Materials & Preparation

Each team will need:

- Mission Badge Descriptions
- Drawing materials
- Graphics computer programs (if available)
- Mission goals (See Mission Activity Guide)

Management

1. This activity can be completed in one class period.
2. Divide students into groups of four.

3. Begin by discussing the example Mission Badge Descriptions to establish the ideas behind a badge design. This could be done with the whole class or in student groups.
4. In groups, encourage students to brainstorm ideas for representing the goals of their mission and the team members as images for their mission badge.
5. Once students have developed some ideas, they need to come to a consensus on how to design the badge. Note: Because this is a team-building activity, it is important to require students to come to a consensus rather than to vote on the design.
6. Once consensus has been reached, students will produce a written description and begin designing their badge.
7. When students have completed their badge design, assemble a gallery of designs.
8. Provide time for students to evaluate each badge in turn, writing down their interpretation of each design.
9. Students can then compare their interpretations of each design with the original design description.

Discussion

1. If you will all be flying the same mission, why are each of the badges different?
2. What was difficult about reaching a

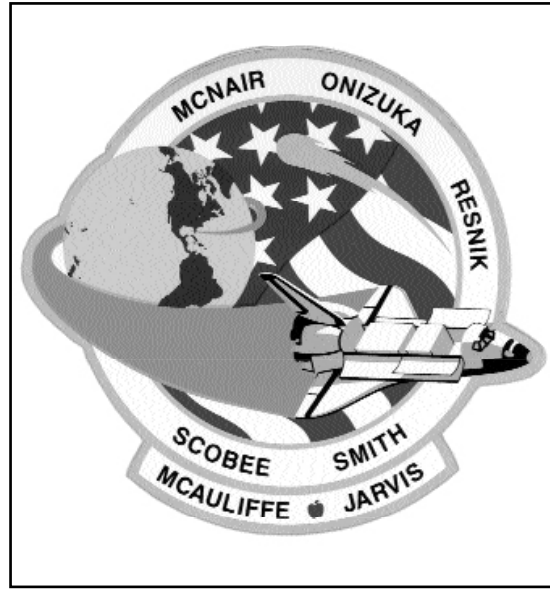
consensus?

3. What kinds of consideration went into planning your class badge?
4. How can visual images inspire teamwork and group missions?

Further Activities

1. Find out from the NASA Website about forthcoming shuttle missions and each mission badge (or "Mission Patch"). (http://www.hq.nasa.gov/office/pao/History/shuttle_patches.html) Create a display of Mission Patches for shuttle missions throughout the school year.
2. Scouts and Guides get badges for skills they acquire. How do these badges represent the organisations and the skills?
3. Create a mission badge for other activities students may be involved in. (Scouts, Guides, Band, Sports, Community Service)

Mission Badge Description



51-L Mission Badge

This badge symbolises the mission of shuttle flight 51-L, to fly and to teach.

- The shuttle, being launched from the United States of America, encircles the planet to signify its U.S. presence in space to explore new frontiers.
- The shuttle in flight with open cargo doors represents the 51-L mission to launch a communication satellite (TDRSS), to collect data from Comet Halley, and to conduct scientific experiments.
- The apple next to the teacher's name signifies the educational mission of the crew to touch the future through the lessons taught in space.
- The scene is encircled by the surnames of the crew members: Francis R. (Dick) Scobee (commander); Michael J. Smith (pilot); Ron McNair, Ellison Onizuka and Judy Resnik (mission specialists); Greg Jarvis (payload specialist); and Christa McAuliffe (teacher).

Mission Badge Description



STS-81 Mission Badge

The crew badge for STS-81, the fifth Shuttle-Mir docking mission, is shaped to represent the Roman numeral V.

- The Space Shuttle Atlantis, OV-104, is launching toward a rendezvous with Russia's Mir Space Station silhouetted in the background.
- Atlantis and the STS-81 crew spent several days docked to Mir during which time astronaut Jerry M. Linenger (NASA-Mir 4) replaced astronaut John E. Blaha (NASA-Mir 3) as the United States crew member on board Mir.
- Scientific experiments and logistics were also transferred between Atlantis and Mir.
- The United States and Russian flags are depicted along with the names of the Shuttle crew members: Michael A. Baker (commander); Brent W. Jett (pilot); Peter J.K. (Jeff) Wisoff, John W. Grunsfeld, Marsha S. Ivins, Linenger and Blaha (mission specialists).

Press Conference

Skills Requirements

For this post-mission activity, students will be expected to:

- Use writing to inform
- Speak in public
- Reflect on personal experience

Background

NASA holds a press conference after every mission. Each press conference lasts approximately one hour and covers general information and specific mission data that is presented by the crew and Mission Control staff. Information about press conferences is available at the NASA Spacelink on the Internet (<http://spacelink.nasa.gov>).

Post-visit activities are vitally important to the success of the overall Challenger mission. They provide an opportunity for the students to reflect on their activities at the Challenger Learning Centre. Also, the teacher can use this time to assess the students' knowledge of key concepts and relate them to other curriculum materials.

On the day after your Challenger mission, conduct a debriefing session. Each team should describe its activities while at the Challenger Learning Centre and explain how these activities were essential to the success of the entire mission.

Overview

After a Challenger mission, students conduct a debriefing session. In teams, students prepare reports in the form of a press conference that reflect their activities while at the Challenger Learning Centre and they describe how their activities were essential to the success of the entire mission.

Key Questions

- What actually happened at the Challenger Learning Centre?

- What part of the Learning Centre mission were you responsible for? How successful was it?
- How can you express personal ideas and experiences to others?

Key Ideas

The use of a range of visual, written and verbal techniques enhances effective communication of ideas.

Materials & Preparation

The class will need:

- Video camera and monitor
- 2 long tables
- Decorations, costumes, props

Management

This activity will take several class periods to prepare and complete depending on the level of sophistication. Students first work in the crew teams from the original mission to plan the information they will present at the press conference.

1. Give each crew team some sample questions that might be asked. They must come to a consensus about how to answer these questions.
2. Get each crew team to elect a note keeper to record the crew's responses to the questions.
3. Set each crew team the task of writing a prepared statement about their mission. This will be reported before the questions to the panel begin. Information for this statement may be taken from the DATA LOGS.
4. Organise students into the following groups:
 - Panel of Crew Representatives: 8 students (Assign one student from each crew team.)
 - Panel of Reporters: 6-8 students or parents and staff
 - Camera Crew: 2-4 students

5. Give each Reporter a set of sample questions for posing to the Crew Representatives.
6. Ask reporters to write at least one additional question, which is not included in any of the samples. Review these before the press conference.
7. Ask each reporter to be prepared to clarify his/her questions during the conference.

Be sure students speak facing the camera. Discuss with the group other techniques for effective public speaking.

Press Day

1. Assign the Camera Crew the task of setting up the tables and chairs and reviewing good filming techniques.
2. Arrange the monitor so that the students in the audience can see it.
3. Start the press conference by introducing the crew members.
4. Invite each crew representative to give their prepared report.
5. Give each reporter the chance to choose and ask one of their prepared questions in turn. Encourage them to address the person to whom the question is directed and ensure that representative of the crew responds before another question is asked. Make clear your duty as Moderator to clarify a question or an answer.
6. Invite the students in the audience to agree or disagree or clarify their representative's response.

Discussion

1. List some ways in which knowing how to use science, maths, technology and communication helps the mission.
2. List some ways in which the simulated mission was like real life.
3. What did you learn from the mission:
 - about yourself?
 - about teamwork?
 - about problem-solving?
 - about science?
4. Did the mission give you any help in deciding a career or job for the future?
5. How did you reach consensus on making decisions?
6. Was the mission successful? In what ways?
7. What happened at the Learning Centre?
8. What were your roles and responsibilities?
9. How did your team contribute to the success of the mission?

Further activities

1. Prepare this press conference and submit it to a local TV station or newspaper.
2. Invite other classes, parents and the headteacher to hear about your experience.
3. Prepare the press conference like a news story for television or as a newspaper special feature.
4. Create a multimedia press conference for your school assembly, class assignments, family events, etc.

Press Conference

Student Procedures

1. Fill in the blanks with your specific team's information. Write this statement in your own words and use it during the Press Conference. Give this form to your teacher to file. Add any other information you think is important.

As members of the _____ team, our purpose was to _____
_____. Our responsibilities included _____
_____.

(Names) _____ and _____ began as Mission
Controllers, and _____ and _____ began at the Spacecraft.
Spacecraft personnel followed task cards to carry out important activities. Mission
controllers supervised and recorded data from all activity in the Spacecraft.

We were able to complete (some, most, all) _____ of our tasks. Our most important
accomplishment was _____.

The data generated on our mission will be analysed for potential close encounters or
for future needs by the spacecraft. This data is also important because it adds to our
knowledge about space travel and

_____.

General Questions

1. What have you learned from this mission that will help us make important decisions about our own planet ?
2. What would you suggest be added to the next mission as an important improvement ?
3. What was the most exciting part of your mission ?

Communication

Mission Requirements:

On a Challenger Mission, team members will be expected to:

- give clear and concise instructions
- follow clear instructions precisely

Background

At the Challenger Learning Centre, teams accomplish their goals by following instructions on task cards. Each team has two sets of task cards, one for use at Mission Control and one for use in the Spacecraft. The role of team members at Mission Control is to monitor the success of the mission and health/well-being of the crew. They must also assist the Spacecraft team when needed and when emergencies occur, to ensure that the Spacecraft team is able to complete the activity. Mission Control team members must always be aware of where the Spacecraft team is in the task cards so they can relay vital information needed to complete the task. The spacecraft team must follow the instructions on the task card step by step to accomplish their task. It is important to read and follow the instructions in order to complete a task before going on to the next task card.

Overview

In teams of two, students each design a simple object using Lego bricks. They then create a set of instructions for making their object. They take turns to give verbal instructions to their partner for the construction of their object. During the construction, students are in constant one-to-one verbal contact with their partner, just as the Challenger Learning Centre mission will require. They then review the effectiveness of their instructions.

Key Question

How can we create clear and effective instructions to complete a task?

Key Concepts

- Clear spoken and written language is essential to accomplish tasks.
- Reading and following instructions are skills essential for success.

Materials & Preparation

Each student needs:

- 10 Lego bricks of a variety of shapes (and colours)

- 2 treasury tags
- Instruction template sheets

For the teacher: Hole punch

Management

This activity is prepared individually and completed in pairs and will take one class period.

1. Working individually, students make a 'module' from the Lego blocks and write down the stages for its construction.
2. As students complete their instructions, they cut them into cards and make the set of cards into a 'manual' using treasury tags.
3. They find a team-mate and sit so they can hear each other well but not see one another's work.
4. In turn they 'transmit' the instructions they have written for constructing their Lego module to their partner.

The emphasis on clear unambiguous communication is important to the Mission. In order to match the task to students' capability, you can vary the complexity of the shape of the Lego module: a 2-dimensional shape with simple bricks for some students through to a complex 3-dimensional shape with a wider variety of bricks for others. To give students a start, you may find it helpful to discuss what to call the various blocks and to use the example set of instructions. Selecting a distinctive colour for each type of block gives a powerful additional cue for less-able students.

Discussion

1. How clear were your instructions?
2. How well could your partner carry out your instructions?
3. How do you make sure your instructions can be understood?
4. What sorts of things go wrong if communication is unclear?

Further Activity

Design a space probe with building blocks, then write instructions for making the space probe. Sit back to back with a partner and transmit the instructions to your partner. Can your partner build the space probe correctly to your instructions? How could you improve the instructions?

Communication

Mission Control Task Cards

○ ○

Getting Started

- Your job in Mission Control is to transmit instructions for constructing the Lego module you have designed.
- You will have one-to-one contact with your team-mate in the Space Station.
- Your team-mate will begin to build your Lego module by following your instructions step by step.
- When you 'send' a message to your team-mate, please use the proper procedures. Say only what is given in this manual. Clear communication is vital to the success of your mission.

When your team-mate informs you that he/she is ready to begin, turn to the next card.

MISSION CONTROL
TASK CARDS

○ ○

Test Run: Instructions for building the Example Lego Module

- When you 'send' a message to your team-mate, please use the proper procedures. Say only what is given in this manual.
- Send a verbal message to your team-mate. You should say:
 Space Station, this is Mission Control:
 Do you have the Lego blocks as follows?
 4 blocks each with 2 rows of 4 buttons '2x4 blocks'.
 4 blocks with 2 rows of 2 buttons '2x2 blocks'.
 Are you ready to begin? OVER.
- When your team-mate informs you that he/she is ready to begin, turn to the next card.

MISSION CONTROL
TASK CARDS

○
○

- 'Send' the following message to your team-mate. You should say:
 Space Station, this is Mission Control:
 We will now construct the first section of the Lego module.
 Place a 2x2 block, a 2x4 block and another 2x2 block to make a line.
 OVER.
- You may be asked to repeat instructions. Do so quickly. Wait until your team- mate tells you that he/she is ready to proceed before moving to the next card.

MISSION CONTROL
TASK CARDS

○
○

- When your team-mate is ready to proceed, send this message.
 You should say:
 Space Station, this is Mission Control:
 Place two 2 x 4 blocks exactly on top to lock the bottom row together.
 OVER.
- Turn to the next card.

MISSION CONTROL
TASK CARDS



- When your team-mate is ready to proceed, send this message.
You should say:
Space Station, this is Mission Control:
Now add a 2x2 block, a 2x4 block and another 2x2 block to form the top row and complete the module.
OVER.
- Turn to the next card.

MISSION CONTROL
TASK CARDS



- When your team-mate is ready to proceed, send this message.
You should say:
Space Station, this is Mission Control:
The assembled module should be a rectangle three blocks high and eight studs long.
Is this correct?
OVER
- Repeat previous instructions as necessary.

MISSION CONTROL
TASK CARDS

○ ○

Construction of the Lego module by _____

- Send a start-up message to your team-mate. You should say:
Space Station, this is Mission Control.
Do you have the Lego bricks as follows:

OVER.

- When your team-mate replies that he/she is ready, turn to the next card.

**MISSION CONTROL
TASK CARDS**

○ ○

Construction of the Lego module by _____

- Send a message to your team-mate. You should say:
Space Station, this is Mission Control.

OVER.

- When your team-mate replies that he/she is ready, turn to the next card.

**MISSION CONTROL
TASK CARDS**



Construction of the Lego module by _____

- Send a message to your team-mate. You should say:

Space Station, this is Mission Control.

OVER.

- When your team-mate replies that he/she is ready, turn to the next card.

MISSION CONTROL
TASK CARDS



Construction of the Lego module by _____

- Send a message to your team-mate. You should say:

Space Station, this is Mission Control.

OVER.

- When your team-mate replies that he/she is ready, turn to the next card.

MISSION CONTROL
TASK CARDS

Communication

Space Station Task Cards

<p style="text-align: center;">○ ○</p> <p>Taking instructions from Mission Control</p> <ul style="list-style-type: none"> • Your job in the Space Station is to construct a Lego module with guidance from Mission Control. You have all of the materials necessary to build the Lego module and your team-mate in Mission Control has all the necessary instructions. • You will have one-to-one contact with your team-mate in Mission Control. • You will need to follow the step-by-step instructions transmitted by your team-mate and construct the Lego module according to those instructions. • When you send a message to your team-mate, please use the proper procedures. Say only what is in this manual. • Make sure you have all the necessary materials. You will need the correct Lego bricks. 	SPACE STATION TASK CARDS
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<p style="text-align: center;">○ ○</p> <p>Communication protocols:</p> <p>READY:</p> <ul style="list-style-type: none"> • When your team-mate asks if you are ready to begin, 'send' your reply. You should say: Mission Control, this is Space Station: I am ready to begin. OVER. <p>HELP:</p> <ul style="list-style-type: none"> • Follow the instructions carefully. If you need the instructions repeated, send a message to your partner. You should say: Mission Control, this is Space Station: Repeat that instruction. OVER. <p>PROCEED:</p> <ul style="list-style-type: none"> • When you have completed an instruction, send the following message. You should say: Mission Control, this is Space Station: I have completed those instructions. Proceed. OVER. 	SPACE STATION TASK CARDS
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Mission Survival

Skills Requirements

On a Challenger Mission, team members will be expected to:

- Communicate and discuss ideas
- Arrive at a team consensus
- Solve problems

Background

For us to survive in a hostile environment, basic human needs have to be met. On Earth, basic human needs include food and water, shelter and clothing. The body can go without food for longer than it can go without water. We need shelter from the elements, such as extreme temperatures and inclement weather. Appropriate clothing allows humans to live and function in comfort. Usually, in the Western world, these needs are easily met. Also, the Earth's atmosphere provides the air we need to breathe, the pressure that the human body requires to function and protection from much of the harmful radiation from the Sun.

However, in extreme situations, humans have to prioritise how they meet their needs in order to survive. Tools, resources and skills may be necessary to obtain food and water or to construct proper shelter and clothing. Communication can be a key to survival as well. In a hostile environment, successful teamwork may be all that stands between the life and death of individuals.

Overview

This activity is a classic way to generate discussion, problem solving and consensus building around issues of survival in a hazardous environment following a hypothetical emergency situation. Students are asked what they would do if they were stranded in Antarctica, several days walking distance from base camp. The class must make a plan and prioritise the items needed for a survival kit.

Students will:

- Establish criteria for selecting the contents of a survival kit to meet specified objectives.
- Identify hostile aspects of the environment to be overcome in Antarctica.
- Use problem solving skills to decide, formulate and evaluate a course of action.
- Discuss and reach a consensus on items to pack in a survival kit for emergencies.
- Compare the hostile environment of Antarctica with other places on Earth or in the Solar System.

Key Question

Why is reaching a consensus and prioritising issues essential to making team decisions?

Key Ideas

- Good communication skills are necessary for successful teamwork.
- Consensus-building and prioritising are important skills for successful teamwork.

Management

This activity should take one class period to complete. You can break the class into small groups of six students and plan for each group to share their solutions with the class, or do the activity as an entire class.

Students will plan what they would do in the circumstances of the scenario. Each group must reach a consensus (i.e. complete agreement) on whether they should stay near the plane or head for the base camp. Students then put a star next to the essential items for their survival kit and answer the questions on the student worksheet as a class or in groups of six.

The teacher should focus less on 'the answer' than on promoting critical thinking and consensus-building skills. Pay attention to the leadership that will emerge in the group work. It may provide some surprising insight into your students skills and influence how you assign them to roles for the Learning Centre mission.

Discussion

1. What do humans need for survival in a hostile environment?
2. What items are 'nice to have', but not essential?
3. Why is it important to have emergency plans in place?
4. What kind of emergency plans are there in case of a fire, earthquake, or power failure?
5. What kind of emergency measures are available in aeroplanes, cars or homes?
6. What was difficult about reaching a consensus? What would make it easier next time?

7. Contrast survival in Antarctica with planning to live on the Moon, Mars or on a long duration space mission.

Further Activities

1. Plan and produce a first aid kit for home use.
2. Find out the skills needed for wilderness survival training for which a person spends several days alone, living off the land.
3. What emergency plans are in place on Mir, the Space Shuttle, the International Space Station or for a spacesuit? Information about current missions is available at the NASA Spacelink on the Internet (<http://spacelink.nasa.gov>).
4. What can your class do to help those that survive a natural disaster?

Mission Survival

Key Question

Why is reaching a consensus and prioritising issues essential to making team decisions?

Problem

Life in a hostile environment requires careful thinking and planning to meet human survival requirements. In many respects, Antarctica is an excellent training ground for a long duration, human mission on Mars. Like Mars, Antarctica is barren and typically very cold. Unlike Mars, Antarctica has air, atmospheric conditions fit for humankind and access to water.

You are part of six-person crew on its way to Antarctica to collect meteorites, which are easily found in the white snow. Just short of base camp, the plane develops electrical problems and crashes. Miraculously nobody is seriously injured, but all radio communication has been permanently damaged.

The pilot estimates that the team is approximately a five-day walk from base camp. Another plane with a second crew will be flying out to camp in two weeks.

1. As a class or in groups of six, answer the questions below. You will need to come to a team consensus on your answers (i.e. complete agreement).

Based on the scenario above, plan what you would do. Should you stay put near the plane or head for the base camp? List the advantages and disadvantages of each plan of action. Your group must reach a consensus.

2. The items below survived the crash. If you decide to head for base camp, you can only take what you can carry with you to survive until you can get help or be rescued. What items are essential for your survival kits?

Put a star next to the essential items for your survival kit.

- | | |
|---|--|
| <input type="checkbox"/> Parachutes (2) | <input type="checkbox"/> Campstove |
| <input type="checkbox"/> Matches (1 book) | <input type="checkbox"/> Dehydrated food (100 packs) |
| <input type="checkbox"/> Sleeping bags (2) | <input type="checkbox"/> Scissors |
| <input type="checkbox"/> Long underwear | <input type="checkbox"/> String |
| <input type="checkbox"/> Water (50 litres) | <input type="checkbox"/> Tinned meat (100 tins) |
| <input type="checkbox"/> Pick axe | <input type="checkbox"/> Mess kits (6) |
| <input type="checkbox"/> Torch | <input type="checkbox"/> Make-up compact with mirror |
| <input type="checkbox"/> Chocolates (1 box of 24) | <input type="checkbox"/> Flare gun |
| <input type="checkbox"/> Fruit (1 crate of bananas) | <input type="checkbox"/> Portable radio |

- | | |
|--|---|
| <input type="checkbox"/> Thermal boots | <input type="checkbox"/> Pocket video games |
| <input type="checkbox"/> Hammer | <input type="checkbox"/> Diary |
| <input type="checkbox"/> Screwdriver | <input type="checkbox"/> Shovel |
| <input type="checkbox"/> Nails & screws | <input type="checkbox"/> Pen |
| <input type="checkbox"/> Duct tape | <input type="checkbox"/> Pocket knife |
| <input type="checkbox"/> Plastic bin liners | <input type="checkbox"/> Compass |
| <input type="checkbox"/> Plastic shopping bags | <input type="checkbox"/> Thermal jackets |
| <input type="checkbox"/> Canteens | <input type="checkbox"/> Thermal gloves |
| <input type="checkbox"/> Soap | <input type="checkbox"/> Thermal hats |
| <input type="checkbox"/> Washing flannel | <input type="checkbox"/> Map |
| <input type="checkbox"/> Batteries | <input type="checkbox"/> Gun |
| <input type="checkbox"/> Can opener | <input type="checkbox"/> Ammunition |
| <input type="checkbox"/> Toothbrush and toothpaste | <input type="checkbox"/> Tents (two 2-person tents) |
| <input type="checkbox"/> Rucksack | <input type="checkbox"/> Toilet paper (2 rolls) |
| <input type="checkbox"/> Petrol (5 litres) | <input type="checkbox"/> Jewellery |
| <input type="checkbox"/> First aid kit | <input type="checkbox"/> Magnifying glass |
| <input type="checkbox"/> Wool blankets | <input type="checkbox"/> Paper plates |
| <input type="checkbox"/> Sunglasses (6) | <input type="checkbox"/> Napkins |
| <input type="checkbox"/> Lip salve | <input type="checkbox"/> Cooler |
| <input type="checkbox"/> Sunscreen | <input type="checkbox"/> Soft drinks (1 case) |
| <input type="checkbox"/> Cassette tapes | |

Discussion

1. What items are essential? (items marked with a star)
2. What items will you leave behind?
3. What items don't belong in the survival kit, but you would be willing to carry on a five-day walk to the base camp?
4. Compare and contrast surviving in a hostile environment like Antarctica to surviving in other places on Earth or in the Solar System, such as the Moon, Mars, on a space station or on an extended mission (2 year, round-trip) to Mars.
5. What was difficult about reaching a consensus? What would make it easier next time?
6. Using a list at first, then a Venn diagram compare and contrast survival in Antarctica to surviving on the Moon, Mars, or a long duration space mission.



Glossary

Acid In chemistry, a substance that can react with an alkali (or base) to make a salt and which makes blue litmus paper turn red.

Alkali chemical compound which will neutralise acids and dissolves in water to make a solution which turns red litmus paper blue.

Ammeter A device used to measure electrical current, measured in ampères (A, or amps).

Axis An imaginary line through the centre of a planet or satellite around which it rotates.

Base A substance that can neutralise an acid to form a salt and produce water. (Bases which can dissolve in water are called alkalis.)

Blood Pressure The pressure of blood on the inner walls of blood vessels.

Chromatography A method of separating a mixture of compounds which makes use of the fact that some compounds dissolve easily while others tend to cling to a porous substance like filter paper.

Compound A substance made by combining two or more types of atoms (elements). Water is a chemical compound made from the elements hydrogen and oxygen.

Co-ordinate System A grid system used to identify locations on a graph or a globe. Latitude/Longitude is an example of a co-ordinate system.

Dehydrated The state a substance is in when moisture has been removed from it. A human body is also said to be dehydrated if it loses too much moisture by sweating or excretion.

Diastolic A measurement of the amount of pressure on the walls of blood vessels when the heart is resting.

Diffraction The spreading of light as it passes through a narrow slit; a diffraction grating has thousands of slits per centimetre and spreads white light to produce a spectrum of colours.

Meteorite A solid planetary fragment that has passed through the Earth's atmosphere and landed intact on the surface.

Latitude Lines on a map or globe that represent an angular distance north or south of the Earth's equator.

Longitude Lines on a map or globe that represent an angular distance east or west of the Prime Meridian (located in Greenwich, England).

Parallel Two lines running side by side at a constant distance apart e.g. railway tracks.

pH A scale from 1-14 that indicates how acidic or alkaline a substance is.

Pigment A chemical which gives colour to an object or substance. Black ink is often a mixture of pigments of several different colours.

Propulsion The act of moving an object and maintaining its motion against opposing forces.

Pulse rate The number of times a person's heart beats per minute.

Respiration rate The number of breaths a person takes per minute.

Spectroscope A device used for separating light into its component colours for analysis.

Sphygmomanometer A pressure cuff and pressure gauge used with a stethoscope, to measure a person's blood pressure.

Stethoscope A device used to listen to internal functions of the body, such as breathing and heart beats.

Systolic A measurement of the amount of pressure on the walls of blood vessels when the heart is pumping.

Transceiver A radio that uses many of the same components both to transmit and to receive signals.



Acknowledgments

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National Space Centre is a Millennium Project supported by funds from the National Lottery.

Special Thanks

Challenger Centre For Space Science Education extends many thanks to the following
education consultants for their contributions to this activity guide:

Donna Matthews, M.S. Space Studies

Barbara Tolbert, Performance Based Instructional Specialist

Renita Spriggs, M. Ed. Special Education

Carlton Carter, M. Ed. Administration & Supervision

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