

World Space Week 2002 Teacher Activity Guide

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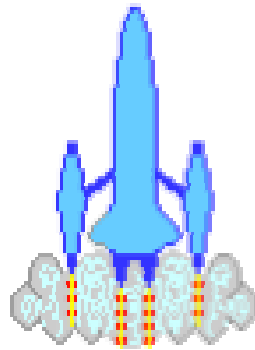


European Space Agency

With a special activity

“Space and daily life... in 45 years – A base on Mars”

For use in grades K-12 during
World Space Week, October 4-10



**Teachers – Get a Cash Grant for
Motivating Students Using Space!**

\$10,000 Available This Year

Apply on line at www.spaceweek.org/application

See page 5 for more information

The **European Space Agency** (ESA) participates in the 2002 World Space Week with the project: “Space and daily life... in 45 years - A base on Mars” presented on page 10. Some other activities have been selected in the full Teacher Activity Guide with the permission of Spaceweek International Association. This reduced guide will be translated in several European languages to help more teachers to use it in the classroom. More information on the ESA projects for the World Space Week and the projects in general can be found on www.esa.int/education.

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Many more activities in the: World Space Week

Teacher Activity Guide published by

**Spaceweek International
Association**

1110 NASA Road One, Suite 100

Houston, TX 77058 USA

Phone: 1.281.333.3627 or (800) 20-SPACE

Fax: 1.281.335.0229

Email: admin@spaceweek.org

Web: www.spaceweek.org

Spaceweek International Association, a non-profit organization, supports the United Nations in the global coordination of World Space Week. Founded in 1981, the Association helps the UN expand World Space Week and serve participants. The Association does not advocate any space programs or policies, but encourages worldwide participation in World Space Week. It is led by volunteer Directors and Officers from around the world and is supported by voluntary contributions. For more information, please see www.spaceweek.org.

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Introduction

\$10,000 to be Awarded to Teachers and Schools for Participating in World Space Week

See details on Page 5

World Space Week: A Tool for Teachers

The United Nations has declared World Space Week as October 4-10 annually. World Space Week is now celebrated in nearly 50 nations. This week is thus the ideal time each year to use space to excite students about learning. Today's youth have so much to benefit from space. Space has changed their world and offers even greater excitement for their future. This guide helps science and math teachers use this natural attraction of youth to space. By participating in World Space Week, not only can you inspire your students, you can win cash grants for yourself or your school.

What is World Space Week?

World Space Week is an international celebration of the contribution that space science and technology makes to the betterment of the human condition. During World Space Week, events and educational programs related to space are held globally. By synchronizing many events, a news story is created that attracts media coverage. This efficiently educates people throughout the world about space and demonstrates widespread public interest in space. For a list of locations and planned events, please see www.spaceweek.org.

When is World Space Week?

The dates of World Space Week, October 4-10 annually, commemorate key milestones in space:

October 4, 1957 was the launch date of Sputnik I, the first human-made Earth satellite. The first international space treaty, the Outer Space Treaty, went into effect on October 10, 1967.

How to Use this Activity Book

To help you use World Space Week in the classroom, enclosed are some stimulating K-12 science and math activities. These activities were designed by teachers to use space to motivate children while teaching essential science and math knowledge and skills. The activities require little or no teacher preparation time and most can be easily tailored for use at all grade levels.

Other Materials in the Teacher Kit

The official World Space Week Teacher Kit, contains many more activities and includes additional helpful materials. The color posters will promote student excitement about World Space Week. The student certificate also enclosed in the kit lets you thank all students who participated in any of the activities. If you or your colleagues wish to order the full Teacher Kit, please visit www.spaceweek.org or call 1.281.333.3627 or 800-20-SPACE (when in the USA). You can also get "European" posters by asking education@esa.int.

2002 Theme: "Space and Daily Life"

The theme of World Space Week 2002 is "Space and Daily Life." Space brings benefits to humanity every day in communications, telemedicine, tele-education, agriculture, environmental protection, or disaster management. How does space help your community? You are encouraged to ask your students to explore, develop, and apply this theme throughout the week.

Getting Started

Teacher's Quick Start Guide

To participate in World Space Week, here's what you should do:

Before World Space Week

- Select activities to use during World Space Week (starting on page 9) and collect any materials.
- If you received the full guide as part of the Teacher Kit from Spaceweek International:
 - Post the large color posters in your classroom and or hallway.
 - Make copies of the Student Certificate.

Optional Preparation

- Tell other teachers about World Space Week and make them copies of this Guide.
- Use ePALS or European Schoolnet to collaborate (see "Using ePALS" and "European Schoolnet" on this page)
- Design your own activities – Space can be used to teach virtually any academic subject!
- Plan an event during World Space Week to involve parents or the community (see "Going Beyond the Classroom" on this page).

During World Space Week – October 4-10

- Use space as a theme throughout the week to excite your students about learning.
- Conduct the selected activities
- Document what you do – Take photographs!
- Sign and give a Certificate to all students (sample is provided in the full World Space Week Teacher Kit)

After World Space Week

- By November 1, complete the on-line form at www.spaceweek.org/application or mail the enclosed application to SIA to apply for \$500 grants for Teacher Participation and/or the Best Buy Space Web Page Design Competition. See page 5 for details and pages 6/7 for the form.
- Send a copy to ESA at education@esa.int for all activities within that guide. The best ones will be included in the ESA Education Web site on www.esa.int/education. ESA will make the selection for Spaceweek International for the project "A base on Mars".

Going Beyond the Classroom

If you want to involve parents or your community, consider holding an event during World Space Week. Many teachers have even received media coverage! Here are some ideas:

Competition and/or exhibition of student space projects • Student award event for projects • Concert with space-related music • Oral reading of space stories • Films about space • Guest speakers on space • Model rocket launch • Planetarium or science museum field trip • Space art exhibit • Telescope "Star Party"

For more event ideas, please see www.spaceweek.org

Using ePALS

Here is how to prepare for using ePALS Classroom Exchange™ so your students can collaborate during World Space Week with other classrooms around the world:

- Register your classroom and create a profile including the word "World Space Week" at www.ePALS.com. Search for other profiles using these or other space-related words to access a community of classrooms from around the world that are interested in space and World Space Week.
- Establish an ePALS relationship with a partner classroom to collaborate on projects. Free, monitored e-mail accounts can be created to allow students to communicate with each other. This will encourage students to share information and discover how the same problems are solved in different parts of the world.

European Schoolnet

The European Schoolnet is an international partnership of 23 European Ministries of Education developing learning for schools, teachers and pupils across Europe. You can find partners for your projects on their site.

\$10,000 Educational Awards Program

Notes: All applications must be submitted by 1 November 2002. All application materials become the property of ESA or SIA and will not be returned. Winners will be announced by February 2003. All winners will be recognized at the World Space Week Educational Awards Event in 2003. Travel to the event is the responsibility of the winners and is not required to receive the award.

New! Global Teacher Awards

Sponsored by GEOS

Spaceweek International Association is proud to announce the new World Space Week Global Teacher Awards. These awards in 2002 will be as follows:

- First Place Winner -- **\$2,000** grant
- Second Place Winner -- **\$1,000** grant

These awards will be given to the best winners of lower-level World Space Week competitions, including the two below. For a complete list of eligible competitions around the world and other details, please see www.spaceweek.org.

Teacher Participation Awards

Sponsored by GEOS

Objective: Encourage use of World Space Week in education.

Award: \$500 each awarded to four teachers as follows:

- 1 award – K to 2nd grade level
- 1 award – 3rd to 5th grade level
- 1 award – 6th to 8th grade level
- 1 award – 9th grade and above

How to Qualify: The teacher must use space in the classroom during World Space Week, October 4-10, 2002 to support academic objectives. Teachers do not have to use activities in this guide.

How to Apply: To apply, teachers must either complete the on-line form at www.spaceweek.org/application or complete and mail the paper form on pages 6/7 by November 1, 2002. Photographs, student projects, media clippings, and any other documentation can either be scanned and emailed to admin@spaceweek.org or mailed to the SIA. Clearly label any emails or documents with your name, school, city, country, phone number, and email address. Special rule apply for activity on page 10 (see that activity).

Selection Criteria

1. Quality of documentation (photos are encouraged)
2. Teacher creativity in using space to teach academics during World Space Week
3. Quantity and quality of student impacts
4. Impact on the school, parents, and the community

Space Web Page Design Competition

*Sponsored by Best Buy Co., Inc.
Committed to Kids & Community*



Objectives: Promote mastery of the Internet by students and build their confidence in web technology. Encourage students to explore space-related resources on the web and be inspired by space.

Award: \$500 each awarded to ten schools as follows:

- 2 awards – K to 2nd grade level
- 3 awards – 3rd to 5th grade level
- 3 awards – 6th to 8th grade level
- 2 awards – 9th grade and above

How to Qualify: Teachers must conduct the activity on page 9 during World Space Week, 4-10 October, 2002. As a minimum, each web page must include 1) a link to World Space Week (www.spaceweek.org) and 2) the name and grade or age of the student(s) who designed it. All copyright laws are to be followed.

How to Apply: Upload the completed web pages to the Internet via your school's web site or any other web-hosting service. To apply, teachers must either complete the on-line form at www.spaceweek.org/application or complete and mail the paper form on page 6 by November 1, 2002.

Selection Criteria

1. How well the teacher met academic objectives using this activity.
2. The quality of the web pages designed by the students:
 - Relevance to the theme "Space and Daily Life" and the teacher's assigned topic(s).
 - Depth of the subject matter and academic quality appropriate for the grade level.
 - Clarity of expression and proper grammar, spelling, etc. appropriate for grade level.
 - Appearance and effectiveness of the design. Does the site engage the visitor? If multiple pages, can visitors navigate easily?
3. For grades 6 and higher, the technologies used in creating the page.
4. For grades 9 and higher, technical performance of the web page (e.g. how quickly the page loads and how well it performs with different web browsers).

World Space Week Award Application

To compete for \$10,000 in awards, simply tell us what you did during World Space Week! You can do so easily on-line at www.spaceweek.org/application or mail/fax this form to SIA, 1110 NASA Road One, Suite 100, Houston, TX 77058, USA; fax 1-281-335-0229. In either case, send your entry by November 1, 2002.

We will appreciate your application and your feedback! Thank you.

1) Teacher Information

Your Name:	School:
Grade: Subjects:	Address:
Telephone:	City:
Fax:	State or Province:
E-mail:	Zip/Postal Code: Country:

2) How did you receive the Activity Guide? Please check one.

Downloaded Received from another teacher Ordered a Teacher Kit Received free Kit in mail
 Received from ESA

3) Please list what you did for World Space Week and the approximate amount of class time spent on each:

4) If you did the Web Page Design Activity, please complete the following:

Address (URL) of the students' web site (write neatly)

Assigned topic: _____ How did this meet academic objectives?

What web-authoring software did the students use?

5) How many students participated? _____ Date started: _____ Date ended: _____

6) Did you "go beyond the classroom" by organizing an event? If so briefly describe:

About how many people attended? _____ Please show attendance breakdown below:

Students Parents Teachers Other (describe) _____

List media coverage received, if any (please enclose clippings if available)

7) Did you participate in ePALS? Yes No If so, please describe what you did and the results:

8) Did you participate in European Schoolnet? ___Yes ___No If so, please describe what you did and the results:

8) Are photos or documentation enclosed (or being emailed to admin@spaceweek.org and/or education@esa.int)? ___Yes ___No

9) What was most successful about your participation in World Space Week?

10) How could it be improved next year? Any suggestions to improve this Guide?

Additional Resources

Spaceweek International Association

SIA is a partner of the United Nations in the global coordination of World Space Week. The Association provides the Teacher's Kit, Poster, press materials, and other services to participants.

Web: www.spaceweek.org
Email: admin@spaceweek.org
Phone: 800-20-SPACE or 1-281-333-3627
Fax: 1-281-335-0229
Mail: 1110 NASA Road One, Suite 100
Houston, TX 77058 USA

Other Space Organizations

Aerospace States Association
<http://www.aerostates.org/>

Astronomical Society of the Pacific
<http://www.astrosociety.org/>

Canadian Space Agency
<http://www.space.gc.ca/>

Centre National d'Études Spatiales
<http://www.cnes.fr/>

Challenger Center
<http://www.challenger.org/>

China National Space Administration
<http://www.cnsa.gov.cn/>

DLR
<http://www.dlr.de/DLR-Homepage>

European Space Agency
<http://www.esa.int/>

International Astronautical Federation
<http://www.iafastro.com/>

Mars Society
<http://www.marssociety.org/>

NASA
<http://www.nasa.gov/>

National Science Teachers Association
<http://www.nsta.org/>

National Space Development Agency of Japan
<http://www.nasda.go.jp/>

National Space Society
<http://www.nss.org/>

Planetary Society
<http://www.planetary.org/>

Russian Aviation and Space Agency
<http://www.rosaviakosmos.ru/>

Space Camp
<http://www.spacecamp.com/>

Space Link
<http://spacelink.nasa.gov/index.html>

Space Foundation
<http://www.ussf.org/>

Space Frontier Foundation
<http://www.space-frontier.org/>

Students for Exploration & Development of Space
<http://www.seds.org/>

United Nations Office for Outer Space Affairs
<http://www.oosa.unvienna.org/index.html>

Young Astronauts
<http://www.yac.org/yac/>

Space Topics & News

International Space Station and Space Shuttle
<http://spaceflight.nasa.gov/>

Lunar & Planetary Science
http://cass.jsc.nasa.gov/CASS_home.html

Space Science
<http://cse.ssl.berkeley.edu/SegwayEd/index.html>

Online Collaboration Resources

ePALS Classroom Exchange™
<http://www.epals.com>

European Schoolnet
<http://www.eun.org>

GLOBE Program
<http://www.globe.gov>

Local Resources

For local assistance with World Space Week, you might also try to contact any of the following in your area:

- Science museums
- Planetariums
- Astronomy clubs
- Model rocket clubs
- Observatories
- Government space centers
- Aerospace companies
- Astronomy departments at universities

Student Activities

SPACE WEB PAGE DESIGN

*Sponsored by Best Buy Co., Inc.
Committed to Kids & Community*



Win a \$500 grant for your school! See page 5.

Objectives

The objectives of the Space Web Page Design Competition are to:

- Promote mastery of the Internet by students and build their confidence in web technology
- Encourage students to explore space-related resources on the web and be inspired by space

Overview

This is a fun, exciting activity that can be done by any grade level with access to computers and the Internet.

During World Space Week, students create web pages about space that relate to an academic area selected by the teacher. This uses space to excite students about learning.

Students can work individually, in teams, or as a class. Software such as Word or PowerPoint can be used to create basic web pages. Students are encouraged to incorporate modern web technology into their pages to learn how the Internet works.

Content Guidelines

Teachers should pick a specific class topic that is exciting and reinforces academic objectives. For example, a class topic could include:

- Grades K-5 – The planets, space art, space movies, the future in space, etc.
- Grades 6-8 – Celestial navigation, what satellites tell us about Earth, secrets revealed

by the Hubble Telescope, space as the next frontier, international cooperation in space, etc.

- Grades 9-12 – New materials made in space, impacts of astronomy on religion, space in modern cinema, science fiction and science fact, the space race and the Cold War, etc.

The activity should start with a class discussion of the selected topic. Teachers should then describe the Web Page Design Competition, briefly discuss how to build a web page, and review the available resources (computers, software, books, etc.).

See “How to Qualify” on page 5, 2nd column, to win the cash grant.

How to Build a Web Page

Teachers, if you have never built a web page, ask your students! Today’s technology-savvy youth know much about computers and are fast learners.

The simplest way is to use a word processor that can save a document in web format. Students can use a program like Microsoft Word to design a page with a title, pictures, text, and links. To save as a web page using Word, click File, Save As, and select “Web Page” in the “Save as Type” field.

Students can also try simple web-authoring software, some of which can be downloaded for free (for more information, see www.knopfler.com/pc or www.cnet.com). Students should be encouraged to try these tools and learn how easy and fun designing a web page can be.

Space Resources on the Web

To explore space resources on the web, students should start with the links on page 8, 10 and 11 (also on the links page at www.spaceweek.org). Many of these sites then link to other exciting places to explore. Web sites with space-inspired music, art, and poetry, etc. include:

- www.spacestory.com – By Astronaut Story Musgrave
- www.novaspace.com – Novaspace Galleries

Sites with space images include:

- <http://opposite.stsci.edu/pubinfo> – Hubble Telescope
- images.jsc.nasa.gov – Human Space Flight

Students can incorporate photos, other multimedia elements, and interaction to communicate and tell a story. They could even have a quiz, puzzle, game, or slide show to make their page fun.

SPACE AND DAILY LIFE ... IN 45 YEARS - A BASE ON MARS

Proposed by **European Space Agency** and **Parsec**.



Mars....

The year is 2047! 90 years after Sputnik 1! And journeys to Mars are now common. You, Earthling engineers, have to design and build **the first ever permanent base** to enable around twenty explorers to live and work on the planet Mars for one Martian year. The scientific objective of the mission is the detailed exploration of Mount Olympus. Each (terrestrial) week, the crew based on Mars has to report its latest research findings to the terrestrial "Institute of Areophysicists" base, located in Greenland.

You will find the chief features of the Red Planet set out in the Annex.

For **World Space Week (4 to 10 October 2002)**, which is focusing on the theme of "Space and Daily Life", you are asked to produce a model of your base and photograph it, providing details of its various component parts and explaining precisely the solutions adopted, the tasks performed and the proposed living arrangements. This model is to be made from used materials (packaging, paper, card, etc.) and painted.

Strategy proposed:

- I. Analyse living conditions on Earth (physiological, physical, energy)
- II. Compare the terrestrial and Martian environments
- III. Analyse the resources on Mars (gas, liquid, surface rock, etc)
- IV. Define the requirements (qualitative for the under 15s, qualitative/quantitative and technical solutions for 15+)
- V. Design the science programme (exploration, analysis, data transmission)
- VI. Define the team membership (numbers, tasks)
- VII. List the base's various component parts and their interaction

VIII. Build and photograph the base

IX. Write the explanatory project file, maximum 20 000 characters and 10 illustrations (photos, drawings, diagrams) – in one of the 11 languages of the ESA Member States (English, French, German, Italian, Dutch, Spanish, Portuguese, Danish, Norwegian, Swedish, Finnish)

Disciplines concerned: physics, chemistry, geology, biology, geography, written/oral expression, visual arts, economics, languages. The project can therefore be done on an interdisciplinary, even multinational basis (like the cross-disciplinary projects and supervised individual projects set in France, twinning).

Electronic files (PDF format) must reach education@esa.int (Subject: WSW) by **31 October 2002**. They must include the name/age of the entrants, the coordinates/disciplines of the teachers or the coordinates of the supervisors. An individual file from a minor will require accompanying parental authorisation.

Entries will be judged according to pupil age categories. The winners will have their projects featured on the ESA website. These may also be entered for the World Space Week competition (www.spaceweek.org).

Annex

For further information and examples of projects and achievements to date, see the following sites (and many others too!):

www.esa.int/education: European Space Agency (ESA) and Education – multilingual

www.astrorama.net: Parsec and Astrorama – French

www.spaceweek.org: World Space Week official site

www.esa.int/education/worldspaceweek: Mars 2047 project – multilingual

www.sci.esa.int: ESA Science Directorate - English

www.esa.int/export/esaHS/future.html: the future of manned spaceflight at ESA - English

<http://www.nasa.gov/kids.html>: NASA's site for kids - English

www.cnes.fr: Centre National d'Etudes Spatiales – French/English

www.dlr.de: Deutsches Zentrum für Luft- und Raumfahrt – German/part English

www.bnsc.gov.uk/: British National Space Centre – English

www.asi.it: Agenzia Spaziale Italiana – Italian/English

<http://www.seds.org/billa/tnp/>: The nine planets - English

www.marssociety.org: Mars Society, expeditions simulating future Mars missions - English

Mars features

Equatorial diameter	6794 km
Oblateness	0.0034
Distance from Sun to aphelion	249.23 million km
Distance from Sun to perihelion	206.65 million km
Mean distance from Sun	227.94 million km
Mass	6.419×10^{23} kg
Period of rotation	24h 37min 22.6 s
Period of revolution	686.98 days
Mean orbital speed	24.13 km/s
Inclination of equator	25°12'
Inclination of orbit	1°51''
Eccentricity	0.0934
Density	3.94
Gravity	3.72 m/s^2
Escape velocity	5.02 km/s
Composition of atmosphere	carbon gas (95.3%), nitrogen (2.7%), argon (1.6%), oxygen (0.13%), water vapour (0.03%)
Mean atmospheric pressure	7 millibar
Temperature	-133°C to +27°C
Mean temperature	-55°C
Climate	violent winds
Satellites	Phobos, Deimos

Info: education@esa.int, parsec@astrorama.net

EGGNAUT ... OR ... HOUSTON WE MAY HAVE AN OMELET!

Grade Level: Primary and Middle School

The Problem: Your mission, should you choose to accept it, is to design and build a vehicle that will protect your Egnaut from the perils of reentry. The objective is to have your Egnaut survive the fall without a crack.

Grades K-5	Grades 6-8	Materials
4	2	8.5" x 11" sheets of standard copy or typing paper
25	20	Drinking straws of any size with at least a 5" length
25	20	Popsicle or craft sticks/wood splints/tongue depressors
150 cm	100 cm	String of any size
150 cm	100 cm	Masking tape of any size
5	5	Rubber bands any size
1	1	RAW grade A egg
1	1	Pair of scissors

The Rules:

- 1) The reentry system must fit inside
Primary - a space of 30 cm x 30 cm x 30 cm
Middle - a space of 20 cm x 20 cm x 20 cm
- 2) Parachutes or helicopters are allowed.
- 3) A plumb line can be used to target the reentry vehicle onto the recovery zone.
- 4) All parts of the reentry system must be above the reentry orbital height of
Primary - 2 to 3 meters
Middle - 3 to 5 meters
- 5) The reentry system's mass must not exceed
Primary - 400 grams
Middle - 300 grams
- 6) It must land as close as possible to the center of the reentry zone.
- 7) You do not have to use all of the materials listed.

Questions to Consider:

- 1) How can I design my reentry system (capsule) to protect the egnaut?
- 2) What can I design into my reentry system to make sure it lands in the center of the target area?

- 3) How am I going to slow it down?
- 4) Which of Newton's Laws of Motion are at work on the capsule and eggnaught?
- 5) Draw a plan of your system and explain how it is going to work and why?
- 6) Report your test results and

Primary - why they happened and how you would fix them.

Middle - why you think they occurred and what you could do to improve your design.

Grade Level: High School

The Problem: Your design team is to design and build a scale landing pad to be used in case of an emergency extraction from the new eggnaught orbital system. The landing pad must prevent a raw eggnaught from breaking after it has accelerated under the force of gravity for a distance of one meter or more.

Materials:

10, 8.5" x 11" sheets of notebook or copy paper

30 cm of masking tape

A RAW eggnaught (grade A large egg)

Plumb line for aiming (meter stick)

Modeling clay (50 to 60 g. lump as a practice egg; dents = cracks)

Triple beam balance

Specifications:

- 1) You may use only the materials listed; you do not have to use all of them.
- 2) Egg landing pads must stand by themselves. They cannot be taped to anything or held by anyone.
- 3) A cracked egg is a broken egg. If the egg bounces off the landing pad or the landing pad falls over allowing the egg to touch the floor, the egg is considered broken.
- 4) No parachutes or wings are allowed.
- 5) Use any technique that you may have learned in any science or mathematics class that will aid you in constructing the pad.
- 6) When you have completed the task, you will hand in a report that will have a drawing with a written description of your design with a prediction of how it will function. Repeat the results of the tests. Make suggestions on how to improve your design and explain exactly how these changes will function. You will also calculate the speed at which the egg is hitting the landing pad and the force of the impact of the

egg on the landing pad. Show your work and include the formulas.

- 7) Your design will be scored on how successful you are in the egg drop and your report.

Working Collaboratively

If you would like to work collaboratively on this project, use ePALS Classroom Exchange™ as an online resource to find other classrooms that are working on this project. Create a classroom profile or update your profile on ePALS to include the words "World Space Week" and "Eggnaught". Working together with another classroom will enable students in different parts of the world to compare how they solved the same problem. It would also let them see whether the same raw materials are available the world over or whether adaptations need to be made. Students could submit their solutions to each other electronically with a 2-minute video, or by still pictures with written descriptions.

You can also use European Schoolnet if you are in Europe.

T I M E L I N E

Using the Internet and/or other resources, students will explore information from the earliest records on astronomy and develop a timeline that is current through today. Use pictorial or artwork when appropriate to enhance the timeline.

Working Collaboratively

If you would like to work collaboratively on this project, use ePALS Classroom Exchange™ as an online resource to find other classrooms that are working on this project. Create a classroom profile or update your profile on ePALS to include the words "World Space Week" and "Timeline". Working together with another classroom will enable students in different parts of the world to contribute and enhance their own knowledge of astronomy, scientific events and achievements. Students can create an electronic version of this timeline together, by emailing their information to each other and creating a final collaborative list about the information they have found. This shows students how events and scientists in different parts of the world have all contributed to general knowledge about space and astronomy, and that collaboration has played a large role in scientific endeavors.

You can also use European Schoolnet if you are in Europe.

GREAT SCIENTISTS

Objective: To provide a framework in which students can develop an understanding, appreciation, and application of the history of science that has influenced space programs and our daily lives.

Task: Research key figures such as Galileo, Newton, Kepler, Einstein, Tsiolkovsky, Goddard, Von Braun, etc. relative to period in which they lived, what they discovered, how it is applied to space exploration.

Working Collaboratively

If you would like to work collaboratively on this project, use ePALS Classroom Exchange™ as an online resource to find other classrooms that are working on this project. Create a classroom profile or update your profile on ePALS to include the words “World Space Week” and “Great Scientists”. Working together with another classroom will enable students in different parts of the world to contribute and enhance their own knowledge of these key figures, and their achievements. The profiles of each great scientist could be split up into sections with small groups in both classrooms sharing the work of researching that particular scientist. Students could also research scientists, and in particular their achievements and contributions in their own country and share this information with their epals. In order to use the private chat room available on ePALS, both classrooms could set up a real-time interview, where one classroom prepares the questions of the “great scientist” and the other classroom prepares the responses.

You can also use European Schoolnet if you are in Europe.

Elementary

Dress in costume and demonstrate basic knowledge of their character. Could be done on the final day to culminate World Space Week activities. Students would present something about the person and their significance in space exploration. For example:

- Galileo: Could be done at a star party in honor of the telescope
- Newton: Could demonstrate the effect of gravity in the classic setting of the tree.

- Goddard: Could demonstrate rocketry by launching model rockets

Middle School

Students could write and perform a play where the characters above were brought to future. As an alternative, they could write for the school newspaper “interviews” with their characters, or broadcast a live “interview” across the school. They should emphasize the difference between now and then (how far we have come).

High School

Students would work in teams to develop an in-depth profile of the above characters and then present synthesis in the following possible formats.

- Conduct a debate on issues of science that the group as a whole would not have experienced. Teams will choose debater for their historical character. This would be most applicable in a large student body presentation.
- Develop and write a play which would bring the characters together in some type of setting with the purpose of exposing their thoughts and theories.
- Students could structure a special edition of the school newspaper framed around space and its benefits to society, and the roles of great scientists and engineers.

ASTRONOMY AND SOCCER

Soccer is one of the most loved sports in the world. A 100-yard soccer field could serve as a venue to compare distances in our Solar System. Hopefully, this exercise will add perspective to the vastness of our part of the Universe and to the learning of astronomy.

The first step in this exercise is to scale a soccer field (100 yards or meters) onto an 11” x 14” sheet of paper, e.g. let 2.50 cm equal to every 10 yards or meters. Before plotting on your 11” x 14” soccer field, make two copies for future use. Next, locate the Sun on one goal line and Pluto on the other goal line. You can represent each planet as a small circle. The planet size does not have to be to scale, however feel free to use relative sizes to represent each planet, e.g. the circle for Jupiter will obviously be larger than the one for Mars. If you choose to represent the planets with relative size, plot the

center of the planet at your calculated values. You may choose to color or highlight each planet with its individual characteristics, e.g. red for Mars, definitive rings for Saturn, and the belts and zones of Jupiter. Using the information and equation below, calculate the average distance of each planet from the Sun scaled to the soccer field on your 11" x 14" paper. Plot each calculation as accurately as possible. Show all your calculations for each planet on a separate sheet of paper. You will be solving for x in the equation.

$$\frac{\text{Distance of Pluto from Sun (in A.U.)}}{100 \text{ yards or meters}} = \frac{\text{Distance of each planet from the Sun (in A.U.)}}{x}$$

Planet	Average Distance (AU)
Mercury	0.39
Venus	0.72
Earth	1.00
Mars	1.52
Jupiter	5.20
Saturn	9.54
Uranus	19.18
Neptune	30.06
Pluto	39.44

Extending Your Knowledge

- If a hypothetical planet were located halfway between Uranus and Neptune, where would it be located on your scaled soccer field? Show your calculations.
- How much farther is Neptune from the Sun than Uranus? Express your answer as a percentage.
- The closest stars to Earth, besides the Sun, are Alpha, Beta and Proxima Centauri. They are 4.3 light years away. (a) How many miles away from Earth are these stars? Express your answer in scientific notation. (b) If this star system were a planet orbiting the Sun, what would be its period? For (b) use Kepler's Third Law, $P^2 = R^3$ where P is the orbital period expressed in years and R is the semi-major axis expressed in astronomical units (AU). Your answer in (a) is the semi-major axis. It needs to be converted to AU.
- The Titus-Bode Law is an empirical formulation used by early modern astronomers to approximate a planet's distance from the Sun even if the planet was undiscovered. The empirical formulation works as follows: consider the sequence (0, 0.30, 0.60, 1.20,....).

Add to each number in the geometrical sequence the number 0.40 A.U. to get the planet's distance from the Sun. For Mercury, add 0.40 A.U. to 0, i.e. $0 + 0.40 \text{ A.U.} = 0.40 \text{ A.U.}$ This is the distance of Mercury from the Sun rounded off. For Venus add 0.30 to 0.40 A.U. to get 0.70 A.U., the rounded off distance of Venus from the Sun.

- Using the Titus-Bode Law predict where you would find the nine planets in our Solar System by completing the geometrical sequence and the addition.
- Using the two extra copies of your scaled soccer field, cut and tape them together so that the goal lines overlap. Plot on this two soccer field paper the calculations from the Titus-Bode formulation of the planet distances from the Sun. You will have to convert these values to yards or meters before plotting. Again, feel free to use color and relative sizes on this plot. Lay this plot alongside your first plot. Comment on any similarities and differences. Can you see how early modern astronomers used this empirical tool to hunt for new planets?
- Where would you expect to find the tenth planet using the Titus-Bode formulation?

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