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ABSTRACT

This teacher's guide describes seven audiovisual programs developed around the planet Mars. While these programs were developed primarily for use in secondary school science classes, several are appropriate for language arts, drama, art, and photography. Each program starts with the showing of a film or video-tape developed by the National Aeronautics and Space Administration (NASA). Included with each program are the following: program description, lesson purpose and alternatives, objectives, glossary of terms and concepts, suggestions for the presentation of the lesson, follow-up activities, and related sources of information. Topics discussed in these lessons include: the topography and geography of Mars; extraterrestrial life; space probes; and the evolution of Mars. (BT)

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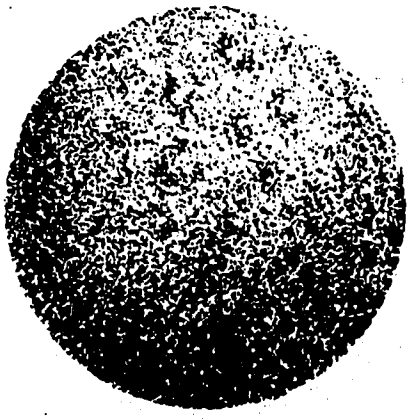
A great volcano on Mars, Olympus Mons, is many times larger than Hawaii. This shows a composite of several Mariner 9 photographs that reveal the summit craters and the cliffs at the base of the huge pile of lava. Below the photograph is an altitude trace across this tremendous mountain.

A TEACHERS' GUIDE

THE MARS ADVENTURE

A TELEVISION SERIES

The University of the State of New York
THE STATE EDUCATION DEPARTMENT
Office of Cultural Education
Albany, New York



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Chief, Bureau of Mass Communications
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FOREWORD

Like all of the guides and the video tape series which are distributed by the New York State Education Department through the offices of the Bureau of Mass Communications, this one, too, represents a cooperative effort of several people, agencies, and materials' sources. The use of this series in New York State is a joint venture of the Bureau of Mass Communications and the Bureau of General Education Curriculum Development of the New York State Education Department, in cooperation with the National Aeronautics and Space Administration.

NASA provided the original programs which we were encouraged to duplicate and distribute for educational purposes. Robert Zimmerman, of the Bureau of General Education Curriculum Development, viewed the programs, and evaluated their applicability to the curriculum needs of the pupils and the science teachers of New York State. He then prepared some of the guide material and combined it with some of the teacher guide material provided by NASA, which he also adapted. All of the material was then carefully edited to fit the curriculum parameters of science teaching in New York State.

What is this series really about? In Robert Zimmerman's words:

"It is relatively easy to describe an orange. It is a citrus fruit - contains an acidy juice - and has a somewhat fleshy outer rind that may range in color from greenish-yellow to reddish-orange.

"Most children have some familiarity with oranges.

"It is not easy to describe the immensity of space and it is difficult for that matter to describe our own planet, the earth. Can children comprehend when they stand on earth that the moon is a sphere constant in size but differing in its illuminated appearance? That the moon is really larger than an orange? Can pupils read about Mars - discuss the size, the topography, the distance from the sun - the distance from the earth - and develop valid and meaningful concepts?

"Films and video tapes make it possible for pupils to 'visit' in space - to develop their own concepts of time, and size, and structure.

"Films and video tapes not only make it possible to supplement the science curriculum but to develop new and exciting curricular adventures - multidisciplinary -

multisensory - with an individualization of personalized concept.

"To visit Mars in films and video tapes is an adventure - to take your students with you can be teaching at its finest."

Bruce Goldfaden, TV Production Supervisor for the Bureau of Mass Communications, coordinated the efforts necessary to make the programs available to schools in New York State at no cost to the users of the video tape library.

The series provides one more important learning experience. The State Education Department is pleased to make it available.

Bernarr Cooper
Chief
Bureau of Mass Communications

Series: MARS

TITLE - MARS-THE SEARCH BEGINS

USEFUL AS AN ADJUNCT TO:

X SCIENCE 7	X BIOLOGY	X SPACE SCIENCE
X SCIENCE 8	CHEMISTRY	X PHYSICS
X SCIENCE 9	X EARTH SCIENCE	X A.P. SCIENCE
X LIFE SCIENCE		

PROGRAM DESCRIPTION - COLOR/SOUND 14:30 minutes

In addition to the numerous experiments designed to gather precise information about the Martian atmosphere and energy fields, Mariner 9's imagery systems revealed a dynamic surface containing huge volcanoes and a Rift Valley of gigantic proportions. Surface features that scientists feel could have been formed only by running water established the basis for the Viking program designed to detect life forms on Mars.

LESSON PURPOSE

This program is designed to acquaint the viewer with the following:

a. Graphic scientific description of the planet Mars and its two satellites, Phobos and Deimos.
b. Comparisons among the outstanding features discovered on Mars and similar natural features that exist on Earth.
c. Possibilities of life on Mars.
d. Life-detection techniques carried aboard the Viking spacecraft that landed on Mars in 1976.

LESSON ALTERNATIVES

a. Discuss the solar system and where life might be found beyond Earth. Include Mars as the most likely place.
b. Discuss the legendary stories of Mars and consider what forms of life, if any, might exist there.
c. Discuss the techniques man might use to enhance his knowledge of Mars.
d. Show projected views of Mars and make comparisons to Earth as to size, number of moons, and other basic characteristics.

OBJECTIVES

After viewing the program, the students will be able to:

a. Identify features of the planet Mars and the planet Earth that are similar.
b. State the reasons why scientists believe that running water once existed on Mars.
c. Identify the two areas in which ice might be found on Mars.
d. Identify at least one technique of life detection used by the Viking spacecraft.
e. Name at least three outstanding unsuspected findings of the Mariner 9 spacecraft.

GLOSSARY OF TERMS AND CONCEPTS

a. extraterrestrial life - any form of existence that is characterized by metabolism, growth and reproduction, as distinguished from inorganic or dead organic materials, and that did not originate on planet Earth

b. Olympus Mons - a volcano on Mars, the largest known volcano in the Solar System, with a diameter of 370 miles and a height of 15 miles

c. permafrost - water that usually lies below the surface of the soil; it is in the form of ice and never changes into a liquid or gas state

d. picture mosaic - a single large picture composed of several smaller pictures to show a vast land area

e. Project Mariner - a series of NASA spacecraft designed to return scientific information about Earth's neighboring planets. Four investigated Mars; the others flew by Venus and Mercury

f. Project Viking - a planetary spacecraft

program designed to place an unmanned landing craft on Mars for gathering atmospheric and surface data, including the detection of any life forms present

g. Valis Marineris - the Great Rift Valley on Mars, extending over 2,000 miles across its surface

PRESENTING THE LESSON

Use leading questions to stimulate student discussion.

Have a student write pertinent student questions on the chalkboard.

Briefly summarize preparatory discussions.

Show the program in its entirety.

Discuss the program. Did it answer the questions?

FOLLOW-UP ACTIVITIES

a. Discuss the main points of the film such as discovery of volcanoes, the existence of water, and life detection.
b. Fabricate a wind tunnel chamber with an observation window. Create a model made from plaster of paris to simulate the Martian surface. Cover the model with a fine grain powder and use a fan as a wind force to erode the powder away from the underlying surface. Take photographs of the simulated surface at frequent intervals and when the dust (powder) is depleted; compare the photographs to those of Mars seen in the program.
c. Discuss the potential value of a manned voyage to Mars.
d. Keeping in mind the physical characteristics of the planet Mars, discuss the design of a spacecraft that could land on the surface of Mars. Also, discuss the equipment necessary for investigating the surface and atmosphere of Mars.
e. Discuss the communications problems of the Viking Project.
f. Prepare a presentation on the Viking mission to Mars.

EVALUATION

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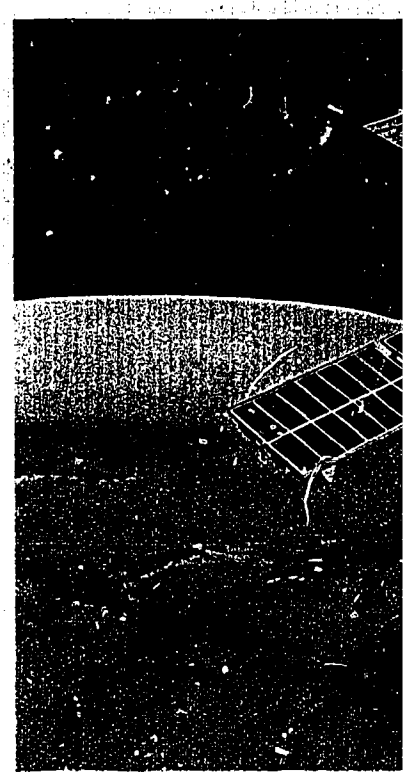

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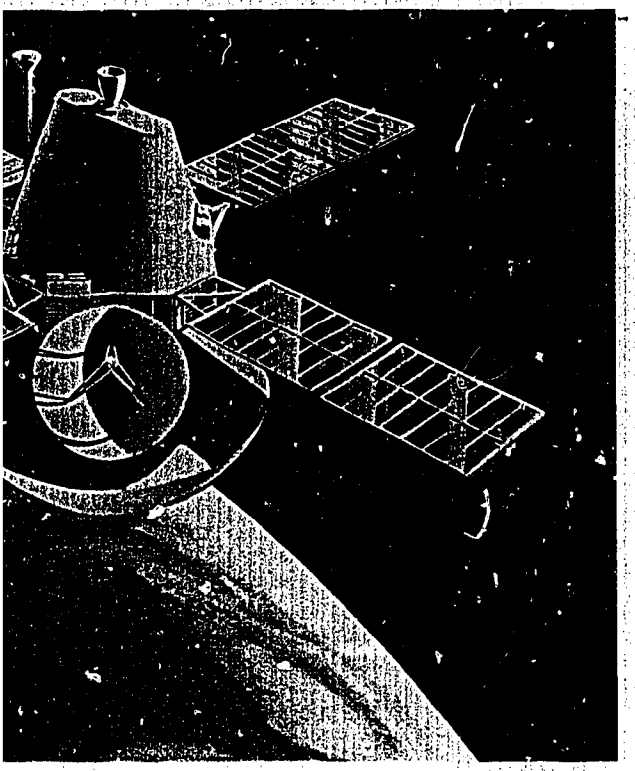


Series: MARS

TITLE - WHO'S OUT THERE?

USEFUL AS AN ADJUNCT TO:

___ SCIENCE 7	_X_ BIOLOGY	_X_ SPACE SCIENCE
___ SCIENCE 8	___ CHEMISTRY	___ PHYSICS
_X_ SCIENCE 9	_X_ EARTH SCIENCE	_X_ A.P. SCIENCE
	___ LIFE SCIENCE	

_X_ LANGUAGE ARTS-DRAMA

PROGRAM DESCRIPTION - COLOR/SOUND

This program utilizes the technique of dramatic narration coupled with film clips of Mars and an enthusiastic scientific symposium to explore the possibilities of life forms in our solar system, within our galaxy, or elsewhere in the universe.

The narration is by Orson Welles whose flair for the dramatic creates interest and excitement in the presentation of the facts, theories, and conjectures that surround the concept of extraterrestrial life.

The investigation of Mars by telescope has now been supplemented by television camera transmission from space probes that have flown past the planet. New information is accumulating, and it has been discovered that in many ways the surface features of Mars are more like those on the earth than those of the earth's moon.

Pictures of the Martian surface show the presence of the polar ice caps which grow and recede each year and the presence of craters, mountains, volcanoes, and sinuous, elongate, depressions which suggest the possibility of a fluid-caused erosion. Is it possible, then, that more water has been present in Mars than we have previously been willing to believe? Is it possible that rains, for thousands or millions of years, have produced some of this striking topography?

The program suggests more questions than answers. Is life present? Has evolution - cosmic, chemical, biological- produced life forms similar to or different from our own? Will life be discovered on Mars or somewhere else within our solar system?

LESSON PURPOSE

This program is designed to:

a. Stimulate the viewer to consider that life forms may be found within our solar system.
b. Acquaint the viewer with the diverse environments in which life systems may thrive.
c. Illustrate the general topography of Mars.
d. Suggest the use of videocartologic methods for Structuring topographic data.

LESSON ALTERNATIVES

- Discuss how scientists gain data from space probes.
- Compare the concepts of the Martian landscape, as they evolved from data gained from telescopic observations, with the data gained from space probe camera transmissions.
- Build models of the Martian surface using paper-mache or plaster.
- Discuss pupil concepts of erosion.
- Compare aerial photographs of the Missouri-Mississippi river system with photographs of the Martian landscape. What similarities and differences are evident?

PREPARATORY ACTIVITIES

a. Discuss the life processes of assimilation, communication, digestion, growth, ingestion, reproduction, response, sensitivity, transport.

b. Compare the "life processes" of a virus with those of a bacterium. How are they similar? How are they unlike?

c. Discuss the steps necessary for man to successfully colonize the moon or mars.

d. Build a scaled model of the sun and the planets Mercury, Venus, Earth, and Mars.

e. Discuss the possibility that man evolved on a planet other than earth. How might he have arrived here? Where might he have originated?

f. Discuss the space probe explorations of the Viking and Mariner projects.

g. Discuss the teamwork efforts needed to produce a successful space probe - the efforts of metallurgists, physicists, astronomers, chemists, biologists, machinists, technicians, administrators, cartographers.

OBJECTIVES

After viewing the program the students will:

a. Be able to list at least four of the following Martian features or conditions: (a) canyons, (b) "dried-up river beds," (c) dust storms, (d) craters, (e) "polar ice caps," (f) volcanoes.

b. Better understand man's ability to hypothesize, theorize, guess at, conjecture, and dream about abstract concepts.

c. Better understand man's ability to gather and interpret data in order to create or to solve problems.

d. Be able to create mental images of the topography of Mars.

e. Realize that individual scientists utilizing identical data may come to divergent conclusions.

GLOSSARY OF TERMS AND CONCEPTS

a. impact craters - surface craters created by the impact of solar system debris

b. life - the state or condition of an energy system which is capable of intraorganismic chemical synthesis and replication.

c. Mars - the fourth planet out from the sun; planet most like Earth in the solar system

d. Martian "duststorms" - winds of 250-300 mph that generally last two to three days on the surface of Mars, moving large amounts of dust.

e. polar caps - polar bodies of water, ice, and frozen carbon dioxide

that vary in size during the Martian year

f. solar system - the aggregates of matter that surround the Earth's nearest star, the sun; most often described as the planetary system of Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, Pluto and such other discrete bodies as moons, planetoids, and fragments

g. space probes - a manned or unmanned vehicle used for penetrating space and capable of receiving and transmitting data

PRESENTING THE LESSON

Use leading questions to simulate student discussion.

Have a student write pertinent student questions on the chalkboard.

Briefly summarize preparatory discussions.

Show program in its entirety.

Discuss the program. Did it answer the questions?

FOLLOW-UP ACTIVITIES

a. Have interested students prepare models of Mars, using clay, paper-mache, or other substances. Compare and contrast the surficial features of Mars to those of the Earth.

b. Have students present position papers on their views of the possibility of life on Mars or elsewhere in the solar system/universe.

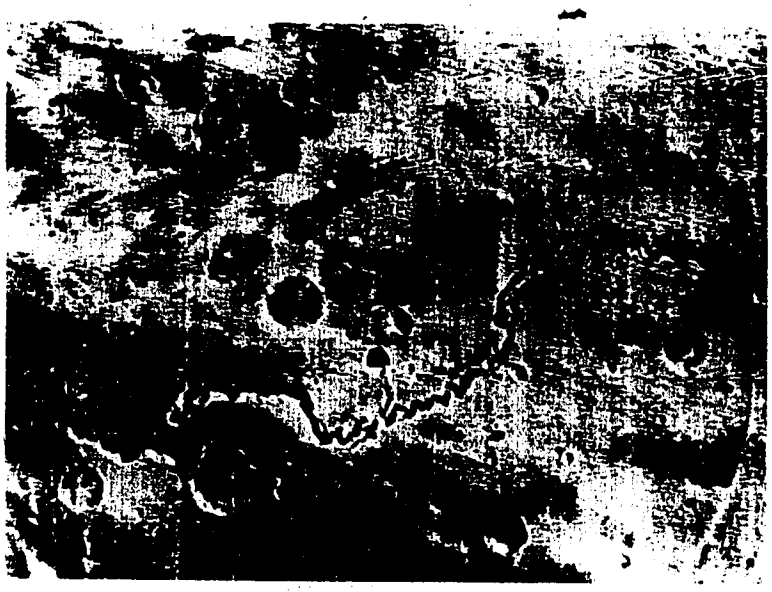
c. Provide opportunity for a formal debate of the positions developed in b. above. Discuss the possible "evolution" of Mars and compare it to the evolution of the Earth.

d. Make a list of Earth organisms that might be able to survive the environmental conditions on Mars. Discuss the types of organisms that might be able to

exist there from a knowledge of the terrain and environmental conditions present.

EVALUATION

Have pupils prepare a brief statement of the concepts that they have gained or modified. Prepare a test to evaluate the objectives and to measure pupil achievement.



Series: MARS

TITLE-MARINER-MARS '69

USEFUL AS AN ADJUNCT TO:

____ SCIENCE 7	____ BIOLOGY	__X__ SPACE SCIENCE
____ SCIENCE 8	__X__ CHEMISTRY	__X__ PHYSICS
__X__ SCIENCE 9	__X__ EARTH SCIENCE	____ A.P. SCIENCE

PROGRAM DESCRIPTION - COLOR/SOUND 21 Minutes

Viewers review the features of Mars that were known or conjectured prior to 1969 and are provided with the opportunity to see film clips of the surface features transmitted to earth by Mariner 5, Mariner 6, and Mariner 7.

Many of the research scientists and their research projects are identified with the methods used to gain new information. Inquiries include surface temperature, kinds of matter present on the surface, topography, presence or absence of water, distribution patterns of craters, possible erosional forces, identification of gases or dusts that are present in the atmosphere, similarities of the Mars surface to that of the earth or of the earth's moon, and the thickness and substance of the polar "ice caps."

Viewers will discover that even well-planned procedures and optimally designed equipment can be prone to failure - that failure leads to alternatives, and that alternatives lead to new knowledge and to success. The knowledge of our total environment and of ourselves is greatly expanded by each new piece of information gained from the investigations of our scientists and technicians whose unique and creative efforts, when harmoniously fused with the work of others, lead to a teamwork amplification of each individual project.

LESSON PURPOSE

This program is designed to:

a. Acquaint the viewer with the use of photography as a tool for increasing man's awareness and knowledge.

b. Review the brief history of rocket probes into space.

c. Explore the successes and failures of Mariner 5, Mariner 6, and Mariner 7.

d. Help viewers to better comprehend the surficial features of Mars in contrast to the surface of the earth.

e. Develop the concept that the "canals" previously thought to exist on Mars were actually illusions produced by craters and plateaus.

f. Help viewers to understand the ways that photographs and film sequences provide the information that enables man to better perceive his interrelationship with the matter and energy of the environment.

LESSON ALTERNATIVES

- Discuss pupil concepts of "space probes."
- Compare the surface of the earth with the surface of the moon - compare the surface of Mars with the surface of the moon.
- Discuss the temperature range on Mars - 63°F at "noon" on the martian equator and 100°F on the night side at "midnight."
- Encourage interested students to build models of the Mars surface.

PREPARATORY ACTIVITIES

a. Discuss the concept of "space probes."

b. Discuss why one picture is worth more than ten thousand words. What do the pictures of Mars reveal?

c. Discuss the knowledge that has been gained from the exploration of the Mariner program.

d. Interested students might build a model of one of the Mariners.

e. Prepare models of the Mars surface - compare the model with a topographic representation of the moon. How are the models alike? How are they different?

OBJECTIVES

After viewing the program, the student will:

a. Understand that in many ways the surficial features of Mars are more like those of the moon than those of the earth.

b. Understand how elements can be identified by the electromagnetic spectrum that their molecules refract.

c. Realize that the martian atmosphere is chemically different from that of the earth.

d. Understand that scientists and technicians work in teams in order to gain new knowledge.

e. Have a better concept of time and distance.

f. Be able to list and compare surface features of the moon with those of the Earth and Mars.

g. Be able to write a brief essay on how man's explanation of Mars has helped him to better understand himself.

GLOSSARY

a. color gradations - a system of film pigments that are combined to indicate the differences in temperature in an air mass or on a land or water surface

b. crater - a bowl-shaped depression in a surface area

c. Fahrenheit - a temperature scale with 180 gradations between the freezing and boiling points of water Water freezes at 32°F.

d. "ice caps" - the highly reflective cyclically contracting and expanding polar areas of a planet

e. solar system - the aggregates of matter that surround the nearest star, the sun; most often described as the planetary system of Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, Pluto, and such other discrete bodies as moons, planetoids, and fragments

f. space probe - a manned or unmanned vehicle used for penetrating space and capable of receiving and transmitting data

PRESENTING THE LESSON

Use leading questions to stimulate discussion:

- What natural resources might be found on Mars?
- How could a colony of "earthlings" be started on Mars? What problems would they face? How could the problems be resolved?
- If an energy source were found on Mars, how could the energy be transferred to Earth?
- How long does it take for a trip to Mars at present? Can this travel time be decreased?

Show the program in its entirety.

Discuss the program.

- Have students developed new concepts of space?
- What new concepts have evolved?
- Why is the teamwork of scientists and technicians imperative?
- What were the "failures" of the mission that had to be compensated for?
- What new information has been gained?

FOLLOW-UP ACTIVITIES

a. Encourage students to discuss how photography has been used to develop a sequential record of space exploration.

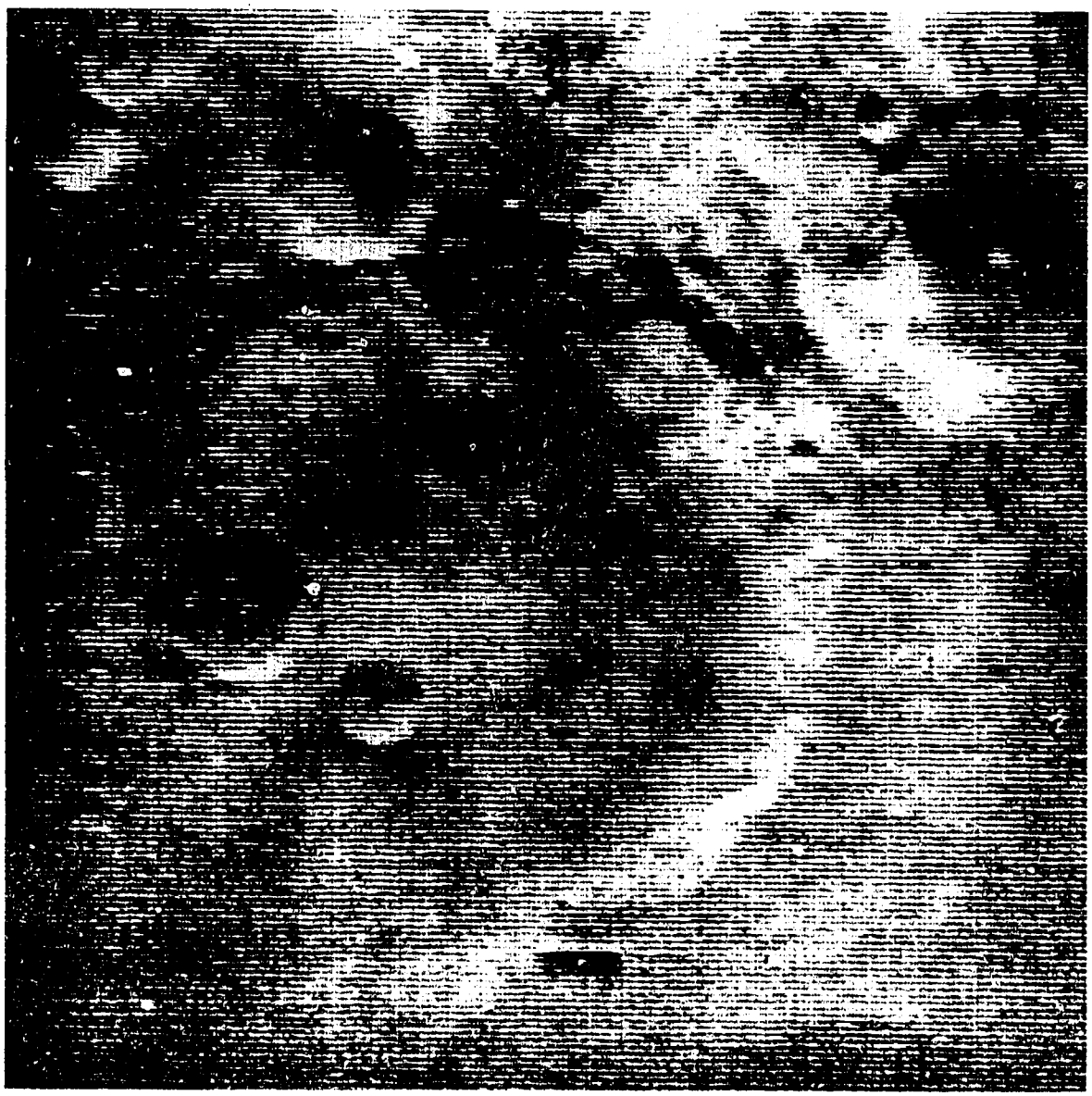
b. Discuss student concepts of space - how has this film modified student concepts?

c. Discuss some of the technologies that have made space exploration possible -

metallurgy
computer science
chemistry
physics
petrochemicals
photography
basic engineering
physiology

EVALUATION

Have pupils prepare a brief statement of the concepts that they have gained or modified. Prepare a test to evaluate the objectives and to measure pupil achievement.



The first spacecraft (Mariner 4) to arrive at Mars showed large craters but also hinted at volcanic activity by the presence of a lineament cutting diagonally across the bottom right-hand corner of the picture.

Series: MARS

TITLE - THE MARTIAN INVESTIGATORS

USEFUL AS AN ADJUNCT TO:

____SCIENCE 7	____BIOLOGY	____SPACE SCIENCE
____SCIENCE 8	____CHEMISTRY	____PHYSICS
____SCIENCE 9	____EARTH SCIENCE	____A.P. SCIENCE

PROGRAM DESCRIPTION - COLOR/SOUND 14:30 Minutes

This program attempts to show the human side of scientific investigators. Scientists, like other human beings, have diverse personalities that respond uniquely to the challenges, the successes, the failures, the accomplishments, the frustrations, the anxieties, the preconceptions, and the personal ego drives of the life process and the human spirit.

The program shows the personal interactions of the scientists who were a part of the Mariner 6 and Mariner 7 fly-bys of Mars.

LESSON PURPOSE

The program can help pupils understand that scientists have the same human traits as other human beings and that the conflicts of personality and personal interest common to each of us can often be resolved by spirited discussion and eventual compromise.

LESSON ALTERNATIVES

- Discuss how scientists might determine the presence or absence of chemical substances such as methane or carbon dioxide on Mars.
- Discuss the possible differences in appearance of volcanic craters and impact craters.
- Compare the surficial features of Mars with those of the earth and the earth's moon. What commonalities and differences exist?

PREPARATORY ACTIVITIES

a. Discuss the kinds of education and training that Martian investigators might have in common.

b. Discuss the specialized training that might be unique for each investigator.

c. Discuss the similarities in appearance of solid carbon dioxide and water ice. How can one be distinguished from the other?

d. Encourage pupils to identify unknown substances by spectographic analysis. Discuss the use of infrared spectroscopy as a method for determining the presence or absence of chemical compounds.

PRESENTING THE LESSON

Use leading questions to stimulate student discussion.

Have a student write pertinent student questions on the chalkboard.

Briefly summarize preparatory discussions.

Show program in its entirety.

Discuss the program. Did it answer the questions?

FOLLOW-UP ACTIVITIES

- Discuss the environmental conditions needed for "life" as we know it.
- Discuss what scientists might learn from an analysis of crater shapes, sizes, and locations.
- Discuss the personality attributes that might help a person develop into a successful scientific investigator.

EVALUATION

Have pupils prepare a brief statement of the concepts that they have gained or modified. Prepare a test to evaluate the objectives and to measure pupil achievement.

Series: MARS

TITLE - NEW VIEW OF SPACE

USEFUL AS AN ADJUNCT TO

X SCIENCE 7	X BIOLOGY	X SPACE SCIENCE	X ART
X SCIENCE 8	CHEMISTRY	X PHYSICS	X PHOTOGRAPHY
X SCIENCE 9	X EARTH SCIENCE	X A.P. SCIENCE	
X LIFE SCIENCE			

PROGRAM DESCRIPTION - COLOR/SOUND 14:30 minutes

Students are given the opportunity to absorb the essence of 20.000 separate film images which reiterates the old Chinese proverb that one picture is worth more than ten thousand words.

New View of Space is a photographic essay of man's accomplishments and failures on earth, and in space, with an emphasis on how the explorations of space have increased man's understanding of his environment and of himself.

The skilled use of photography provides the viewer with an exceptional opportunity to better understand man's continual probing of the unknown.

LESSON PURPOSE

This Program is designed to:

a. Acquaint the viewer with the use of photography as a tool for increasing man's awareness and knowledge.

b. Review the brief history of rocket probes into space.

c. Explore the vastness of space with a photographic record of information gained by Ranger, Lunar Orbiter, and Mariner.

d. Help viewers realize the spin-off impacts of the space program in weather forcasting, topographic studies of the earth, pollution studies, and environmental studies.

e. Help viewers to understand the ways that photographs and film sequences provide the information that enables man to better perceive his interrelationship with the matter and energy of the environment.

LESSON ALTERNATIVES

- Discuss pupil concepts of "camera," "film," "photographic record" and "photo essay."
- Discuss pupil concepts of "space probes."
- Develop a "time-line" of the probes and satellites that have been used to explore, and provide information about, the surfaces of the earth, the moon, and Mars.
- Discuss the concepts of "success" and "failure." How might each contribute to the other?

PREPARATORY ACTIVITIES

a. Have students discuss how they would develop a photographic essay of a trip to New York City's Central Park.

   - What kinds of cameras would they use?
   - What kinds of film?
   - How many pictures or sequences would be needed to develop a truly representative essay?
   - What kinds of "camera platforms" might be used by the photographer - park benches, rock ledges, trees, auto roofs, hovercraft, airships, helicopters?
   - How would they "sequence" their essay? What would be considered the climax?

b. Discuss the concept of "space probes."

c. Discuss why one picture is worth more than ten thousand words. What do pictures reveal? Do they reveal anything at all to the untrained mind?

d. Interested students might create cardboard models of rockets and/or satellites.

e. What effect has space exploration had upon man's concept of himself?

OBJECTIVES

After viewing the program, the students will:

a. Understand how information gained from photographic lunar exploration was used as part of the information base for the manned landings.

b. Understand how TIROS reports are used in weather forecasting.

c. Understand how film color can be used to indicate surface temperatures.

d. Have a better concept of time and distance.

e. Be able to list and compare surface features of the moon with those of the Earth and Mars.

f. Be able to write a brief essay on how man's exploration of the solar system has helped him to better understand himself.

GLOSSARY OF TERMS AND CONCEPTS

a.	TIROS	- an orbiting satellite that transmits weather information
b.	color gradations	- a system of film pigments that are combined to indicate the differences in temperature in an air mass or on a land or water surface
c.	cyclone	- a low pressure center surrounded by rotating winds
d.	photo essay	- a method of transmitting concepts or ideas by skilled use of photographs or photographic sequences
e.	solar system	- the aggregates of matter that surround the nearest star, the sun; most often described as the planetary system of Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, Pluto, and such other discrete bodies as moons, planetoids, and fragments
f.	space probe	- a manned or unmanned vehicle used for penetrating space and capable of receiving and transmitting data

g. ERTS - the Earth Resources Technology Satellite used for obtaining and transmitting information about the Earth to the Earth, operating at an approximate altitude of 500 miles above the earth

PRESENTING THE LESSON

Use leading questions to stimulate student discussion.

Have students discuss the program title, "New View of Space."

- What are some of the "old views of space"?
- How has man's view of space been expanded?
- What does "view" mean?

Show the program in its entirety.

Discuss the program. Did it create new questions?

FOLLOW-UP ACTIVITIES

a. Encourage students to discuss how photography has been used to develop a sequential record of space exploration.

b. Discuss student concepts of space. How has this film modified student concepts?

c. Discuss some of the technologies that have made space exploration possible.

metallurgy
computer science
chemistry
physics
petro-chemicals
photography
basic engineering
physiology

EVALUATION

Have pupils prepare a brief statement of the concepts that they have gained or modified. Prepare a test to evaluate the objectives and to measure pupil achievement.

Series: MARS

TITLE - LIFE?

USEFUL AS AN ADJUNCT TO:

X SCIENCE 7	X BIOLOGY	X SPACE SCIENCE
X SCIENCE 8	CHEMISTRY	PHYSICS
X SCIENCE 9	X EARTH SCIENCE	A.P. SCIENCE
X LIFE SCIENCE		

PROGRAM DESCRIPTION - COLOR/SOUND 14:30 minutes

The program discusses the concept of life as we know it. General characteristics of life are first described with non-life similarities noted. A number of adaptations are included to show how life has adapted to earth conditions, and how certain individuals can withstand environmental insults. In conclusion, the habitat of Mars is described with the question raised as to the possibility of life existing there.

LESSON PURPOSE

This program is designed to:

a. Acquaint the viewer with the general characteristics of life as we know it.
b. Demonstrate the diversity of adaptations of life to environmental hardships on Earth.
c. Illustrate the general environmental conditions on Mars.
d. Acquaint the viewer with the Viking Mission to search for life on Mars.

LESSON ALTERNATIVES

- Discuss definitions of "life."
- Have pupils develop their concepts of "life."
- Discuss "life characteristics."
- Prepare charts of life processes.
- Have pupils prepare a summary of the major concepts developed in the program.

PREPARATORY ACTIVITIES

a. Have students prepare reports on viruses: How is a virus like a "living chemical?" Why is it considered life? Why is it considered non-life?

b. Discuss the characteristics that living things share. Discuss the concept of a "partial definition" of life when considering life from only one or two characteristics. Conclude by having students compile their own definition of a living organism in as few words as possible. Discuss their definitions.

OBJECTIVES

After viewing the program, the students will:

a. Be able to list at least five characteristics of life, from the following: (a) cellular organization, (b) organic composition, (c) locomotion (movement), (d) constant energy requirement, (e) growth, (f) reproduction, (g) life span (death), (h) response, (i) adaptations to the environment and/or the biological society.

b. Select the accurate statements from a mixed list of choices that concern water and life: (a) water is a general necessity for life on earth, (b) some organisms can survive periodically without water, (c) no organism can survive when its body water is removed, (d) some organisms can survive losses of 95-100% of their internal body fluids. (a,b,d)

c. List a minimum of four types of organisms that can survive harsh environmental conditions: (a) rotifers, (b) roundworms, (c) water bears, (d) bacteria.

d. Select the accurate statements from a mixed list of choices which are valuable reasons to search for life on Mars: (a) because Mars is very similar to the Earth, but not polluted, (b) because we might be able to still better understand life, and ourselves, (c) because we might be able to extend our knowledge into the unknown. (b, c)

e. List some of the characteristics of Mars: (a) water in form of frost in the evenings, (b) intense ultraviolet radiation from the sun, (c) thin atmosphere, (d) surface winds 250-300 mph.

f. Recognize that the Viking Mission marks man's search for life on the planets of the solar system.

GLOSSARY OF TERMS AND CONCEPTS

a. virus - noncellular structures that can reproduce in the presence of living tissue

b. organic - refers to compounds containing carbon

c. adaptation - adjustment to environmental conditions

d. habitat - place and conditions in which an organism lives

e. water bear - common name for Tardigrade, an organism with four pairs of legs having retractable claws; it commonly lives on the surface of mosses

f. rotifer - member of phylum Trochelminthes or Rotifera; "wheel animals" with rows of cilia around the mouth, an apparatus to grind food, and a forked grasping foot.

g. bacteria - members of phylum Schizomycophyta Kingdom, Protista; cells lack an organized nucleus; they reproduce by fission or endospores

h. stentor - trumpet-shaped protist in phylum Ciliophora, a ciliate

i. ameba - a protist in phylum Sarcodina; locomotion by change of state from sol to gel

j. roundworms - members of Nematoda phylum; slender, elongated, and unsegmented worms

k. hydra - a freshwater coelenterate; possesses stinging cells (nematocysts) that can paralyze organisms up to the size of small fishes

l. tentacles - elongate appendages of hydra which contain nematocysts stinging cells

m. Viking Mission - NASA mission designed to place an unmanned landing craft on the surface of Mars to search for evidence of life and to record surface and near-surface data

PRESENTING THE LESSON

Use leading questions to stimulate student discussion.

Have a student write pertinent student questions on the chalkboard.

Briefly summarize preparatory discussions.

Show program in its entirety.

Discuss the program - Did it answer the questions?

FOLLOW-UP ACTIVITIES

a. Have a small group of students take a field trip into a nearby wooded habitat and collect mosses from the base of trees, along trails, etc. (If a field trip is impossible, have individual students bring in as many moss samples as possible, at least fifteen samples, favoring tree mosses.) Carefully wash the dirt from the base of the plants and turn them upside down into containers of water. Allow 24-48 hours minimum for the organisms to settle into the water. Gently wring out the leaflets and examine the water for the presence of roundworms, rotifers, and water bears. Isolate these organisms and slowly allow their water to evaporate over several days. Experiment on their resistant states; variables can include temperature, salt, light, etc. Also study the cryptobiotic state in which these creatures can survive in a near death-like condition. Add water at the conclusion of the experimentation; give up to 48 hours for the organisms to become active. Attempt to make conclusions quantitatively as to percentages of variables these organisms can withstand. Relate the value of such resistant states when living in the film of water that covers moss leaflets.

b. Obtain brine shrimp eggs (sometimes called "sea monkeys") from a local aquarium shop. Hatch in an ocean water mix. Observe development of the brine shrimp within different salinities. Compare to their working ability to survive in a habitat that would destroy most organisms.

c. Obtain cactus plants and examine their root systems. How have desert plants adapted to an existence on small amounts of moisture? Diagram their root systems, stems, and leaves.

d. Discuss various adaptations of desert creatures to survive in a habitat lacking moisture. Consider desert mice, spiders, camels, burros, lizards, prarie dogs, snakes, plants, etc.

e. Have students report on bacteria that exist in hot springs, within arctic temperatures, and in extremely saline conditions. How could these examples relate to the possibility of life elsewhere in our solar system?

f. Have students prepare repo
characteristics of Mars.
kinds of life that might e

EVALUATION

Have pupils prepare a brief st
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achievement.

Series: MARS

TITLE - MARS - IS THERE LIFE?

USEFUL AS AN ADJUNCT TO:

X SCIENCE 7	X BIOLOGY	X SPACE SCIENCE
X SCIENCE 8	CHEMISTRY	PHYSICS
X SCIENCE 9	X EARTH SCIENCE	A.P. SCIENCE
X LIFE SCIENCE		

PROGRAM DESCRIPTION

Students are introduced to the possible past history of Mars as well as its present surface topography--volcanoes, ice caps, stream beds, impact craters, canyons and wind-eroded surfaces. The Viking Lander and its biology experiments are discussed in relation to the search for life on Mars. In conclusion, students are asked to consider life forms that might be able to survive on Mars, and the potential significance of their discovery.

LESSON PURPOSE

This program is designed to:

a. Acquaint the viewer with the general surface features of Mars.
b. Emphasize the biology experiments aboard the Viking Lander.
c. Explore the past history of Mars.
d. Assist the student in better understanding the Viking Mission's search for life on Mars.

LESSON ALTERNATIVES

- Discuss pupil concepts of "topography."
- Discuss pupil concepts of "erosion."
- Interested pupils might prepare 3-dimensional models of volcanoes, river valleys, canyons or block-faulted mountains using cardboard or paper-mache.
- Discuss the environmental extremes on earth which contain diverse forms of living things.
- Prepare charts or maps of a variety of surfaces.
- Have pupils prepare a summary of the major concepts developed by the program.

PREPARATORY ACTIVITIES

a. Have students research Mars from early knowledge to recent discoveries. How have man's views changed through time, in regard to what we presently believe exists on Mars?

b. Have students discuss how they would search for life on Mars. The only limitations are that they cannot physically be present to conduct their search.

c. In describing the biology experiments aboard the Lander, describe five of the following experiments:

1. Utilization of carbon 14 to trace materials through life processes,
2. Provision of food (or sunlight) for possible organisms,
3. Introduction of an atmosphere of carbon dioxide,
4. Introduction of small to large amounts of water,
5. Introduction of gases being given off by the organisms present,
6. Introduction of photosynthetic or metabolic processes,
7. Utilization of chemical detectors to determine the presence of life.

d. Select the most accurate answer in regard to the kinds of organisms the Viking biology experiments seek to detect: (a) only extremely large organisms, (b) only plants, (c) only animals, (d) microscopic animals and plants, (e) only larger animals. (d)

OBJECTIVES

After viewing the program, the students will:

a. Be able to list at least four of the following Martian features or conditions: (a) canyons, (b) "dried-up river beds," (c) "dust storms," (d) impact craters, (e) "polar ice caps," (f) volcanoes.

b. Be able to select the most accurate statement concerning Martian volcanoes from this list: (a) all Martian volcanoes are small compared to the size of Earth volcanoes, (b) the largest known volcano is on Mars, (c) the smallest known volcano is on Mars, (d) most Martian volcanoes are still active. (b)

c. Be able to select the most accurate statement concerning "Martian Water" from this list: (a) water is presently in two large lakes, (b) there is (absolutely) an absence of water on Mars, (c) at times there has been flowing water, but today the water is largely ice or frost, (d) water has always been in the form of ice on Mars, (e) water has never been in the form of ice on Mars. (c)

d. Be able to select the most accurate statement concerning the canyons of Mars from this list: (a) canyons do not exist on Mars, (b) Martian canyons are only a few miles wide, (c) Martian canyons may extend for 200 miles, up to 500 miles only, (d) Martian canyons are small compared to canyons on Earth, (e) Martian canyons are much larger than any canyons on Earth. (e)

GLOSSARY OF TERMS AND CONCEPTS

a. carbon 14 - radioactive isotope used to trace carbon through metabolic or photosynthetic processes

b. chemical detectors - equipment aboard the Lander that is specifically designed to identify chemicals

c. impact craters - surface craters created by the impact of solar system debris attracted by a heavenly body

d. Mars - the fourth planet from the sun; planet most like Earth in the solar system

e. Martian "dust storms" - winds of 250-300 mph that generally last two to three days on the surface of Mars, moving large amounts of dust

f. polar caps - polar bodies of water, ice and frozen carbon dioxide that vary in size during the Martian year

g. Viking Lander - the landing craft of the Viking Mission to Mars; while on the surface of Mars, the Lander conducted life detection experiments, also determined meteorological and geological data

PRESENTING THE LESSON

Use leading questions to stimulate student discussion.

Have a student write pertinent student questions on the chalkboard.

Briefly summarize preparatory discussions.

Show the program in its entirety.

Discuss the program. Did it answer the questions?

FOLLOW-UP ACTIVITIES

a. Compare student suggestions for ways to search for life on Mars to NASA's biology experiments. Discuss the strengths and weaknesses of NASA's biology experiments.

b. Have interested students prepare models of Mars, using clay, paper-mache , or other substances. Compare and contrast the surficial features of Mars with those of the earth.

c. Have students present position papers on their views of the possibility of life on Mars or elsewhere in the solar system/universe.

d. Provide opportunity for a formal debate of the positions developed in c above. Discuss the possible "evolution" of Mars and compare it to the evolution of the Earth.

e. Make a list of Earth organisms that might be able to survive the environmental conditions on Mars. Discuss the types of organisms that might be able to exist there from a knowledge of the terrain and environmental conditions present.

f. Diagram each of the three biology experiments. Compare and contrast the experiments.

EVALUATION

Have pupils prepare a brief statement of the concepts that they have gained or modified. Prepare a test to evaluate the objectives and to measure pupil achievement.

RELATED SOURCES OF INFORMATION

NASA Films

a. Life? (HQ-261)
b. Mars: The Search Begins (HQ-236)
c. Who's Out There? (HQ-226)
d. Mariner-Mars '69 (HQ-208)
e. Martian Investigators (HQ-195)
f. Mission for Mariner (HQ-A-192)

From the U.S. Government Printing Office
Washington, DC 20402

a. SP-334 The Viking Mission to Mars $1.20
b. SP-337 The New Mars $8.75
c. EP-50 Space Resources for Teachers: Biology $2.50
d. EP-82 Planetary Exploration $.75
e. EP-90 Two Over Mars $.90
f. NF-76 Viking Mission to Mars $.50

Series: MARS

TITLE - MARS AND BEYOND

USEFUL AS AN ADJUNCT TO:

X SCIENCE 7	X BIOLOGY	X SPACE SCIENCE
X SCIENCE 8	X CHEMISTRY	X PHYSICS
X SCIENCE 9	X EARTH SCIENCE	X A.P. SCIENCE
X LIFE SCIENCE		

PROGRAM DESCRIPTION - COLOR/SOUND 14:30 minutes

Students are introduced to the possibilities of life in the solar system, from Mercury to Pluto. Major emphasis is on Mars and the Viking Mission to investigate life there. The organic analysis instrument is specifically discussed - how it functions, and the implications of its findings.

LESSON PURPOSE

This program is designed to acquaint the viewer with:

a. The planets in the solar system
b. The purpose and function of the organic analysis instrument
c. The possibility of life within and beyond the solar system
d. The Viking Mission to search for life on Mars.

LESSON ALTERNATIVES

a. Discuss the characteristics of the planets of the solar system.
b. Discuss what an "organic analysis instrument" might be like, and how it might work.
c. Discuss the properties of organic compounds.

OBJECTIVES

After viewing the program, the students will be able to:

a. Select the planet most likely to possess life as we know it: (a) Mercury, (b) Pluto, (c) Mars, (d) Venus. (Mars)

b. List the planets that more than likely do not possess life as we know it: Mercury, Venus, Jupiter, Saturn, Uranus, Neptune, Pluto.

c. Describe the function of the organic analysis instrument aboard the Viking lander, including the following: (a) soil is vaporized, (b) vapor passes through the column, (c) molecules and atoms of vapor are accelerated, (d) accelerated particles fall into collection plates, (e) the substances present are identified.

d. Select the major biochemical components of life as we know it: oxygen, potassium, hydrogen, helium, argon, copper, carbon, nitrogen, silicon, aluminium. (carbon, hydrogen, oxygen, nitrogen)

e. Conceptualize that the energy for life in the solar system as we know it originates from the sun.

f. Describe the Viking Mission to Mars as the initial step for searching for life elsewhere in the solar system.

GLOSSARY OF TERMS AND CONCEPTS

a. asteroids - group of minute planets that are primarily situated between Mars and Jupiter

b. atom - the smallest unit of an element that retains the characteristics of the element

c. carbohydrate - an organic substance composed of carbon, oxygen, hydrogen; produced by plant life on earth

d. lipid - a fat or oil; an organic compound found in earth life

e. molecule - the smallest combination of atoms in a substance that retains the properties of the substance

f. organic analysis instrument - a gas chromatograph - mass spectrometer (GCMS) that separates gases of a substance and is able to identify the components; a major life detecting instrument of the

Viking lander

g. organism - a complete (or entire) living thing

h. protein - a complex carbon-based substance that is found in the nuclear materials of life as we know it; composed of carbon, hydrogen, oxygen, nitrogen, also sulfur and phosphorus

i. spores - sexual reproductive cells of less advanced forms of life (as we know it); often extremely resistant to environmental extremes

j. Viking Mission - the NASA project that is investigating the possibilities of life on Mars

PREPARATORY ACTIVITIES

a. Have students list the foods they consume in a particular day. Compile a list of foods on the blackboard and have students organize the foods into similar groups; eventually identify three major groups: carbohydrates, proteins, and lipids (fats and oils). Discuss the characteristics of each substance and its relationship to life as we know it.

b. Use molecular models to demonstrate similarities and differences of sugars, starches, amino acids, and lipids.

PRESENTING THE LESSON

Use leading questions to stimulate student discussion.

Have a student write pertinent student questions on the chalkboard.

Briefly summarize preparatory discussions.

Show the program in its entirety.

Discuss the program. Did it answer the questions?

FOLLOW-UP ACTIVITIES

a. Diagram the two components of the organic analysis

instrument, the gas chromatograph, and mass spectrometer. Discuss their purpose and function. (The gas chromatograph can be compared to a sorted deposit of sands and gravels in a delta. Each deposited substance travels only as far as the energy available will transport its mass.

b. Develop a class panel discussion on the kinds of life that may have existed on Mars in the past, that may exist there today, or possibly exist there in the future.

FOR CHEMISTRY TEACHERS

c. Consider the environmental conditions which prevail upon the planet Mars. The night time temperatures are approximately -123°C in some localities. The atmospheric pressures are low, but may be as much as 4.7 torr in some of the lower lying regions. If indeed life, as we know it, does exist, then what substances might be found? Consider the following list of substances which are biochemically related to living systems or their by-products:

1. acetic acid
2. adenine
3. adenosine triphosphate
4. alanine
5. ammonia
6. amylose
7. carbon dioxide
8. cellulose
9. cetyl palmitate
10. chlorophyll
11. cholesterol
12. cysteine
13. cytosine
14. glucose
15. guanine
16. hexacosanyl palmitate
17. hexanol
18. hippuric acid
19. hystidine
20. lactic acid
21. maltose
22. methane
23. stearic acid
24. threonine
25. thriolein
26. tristearin
27. uracil
28. water

This list is merely a sampling of biochemically related substances. Using some convenient reference work such as the Handbook of Chemistry and Physics or the Handbook of Chemistry, try to classify these substances according to the following categories:

1. Substance which would not be found in solid samples taken from the Martian surface unless they were trapped within the surface or were formed as a decomposition product during pyrolysis (strong heating).

2. Substances which might be found in the solid

Martian samples. This category may be further divided into the following categories:

- Substances which would decompose when heated to 200°C in the gas chromatographic column;
- Substances which would be found (detected) unchanged when the gas chromatographic column were heated to 200°C;
- Substances which would either vaporize or decompose when the column were heated from 200°C to 482°C.

d. Classify these substances into their general biochemical classification. An organic or biochemistry reference book will be of help.

1. Lipids
2. Carbohydrates
3. Amino Acids (as well as polypeptides and proteins)
4. Nucleic Acids and Nucleotides
5. Porphyrins
6. Alcohols
7. Fatty Acids
8. Biochemically Related (although not necessarily organic)

e. Because most biochemically active substances are decomposed by heating (pyrolysis), determine the typical decomposition products for some of the examples which have been categorized.

For example, if glucose were in the sample, what would be some of the decomposition products?

RELATED SOURCES OF INFORMATION

NASA Films:

a. Life? (HQ-261)
b. Mars: The Search Begins (HQ-236)
c. Who's Out There? (HQ-226)
d. Mariner-Mars '69 (HQ-208)
e. Martian Investigators (HQ-195)
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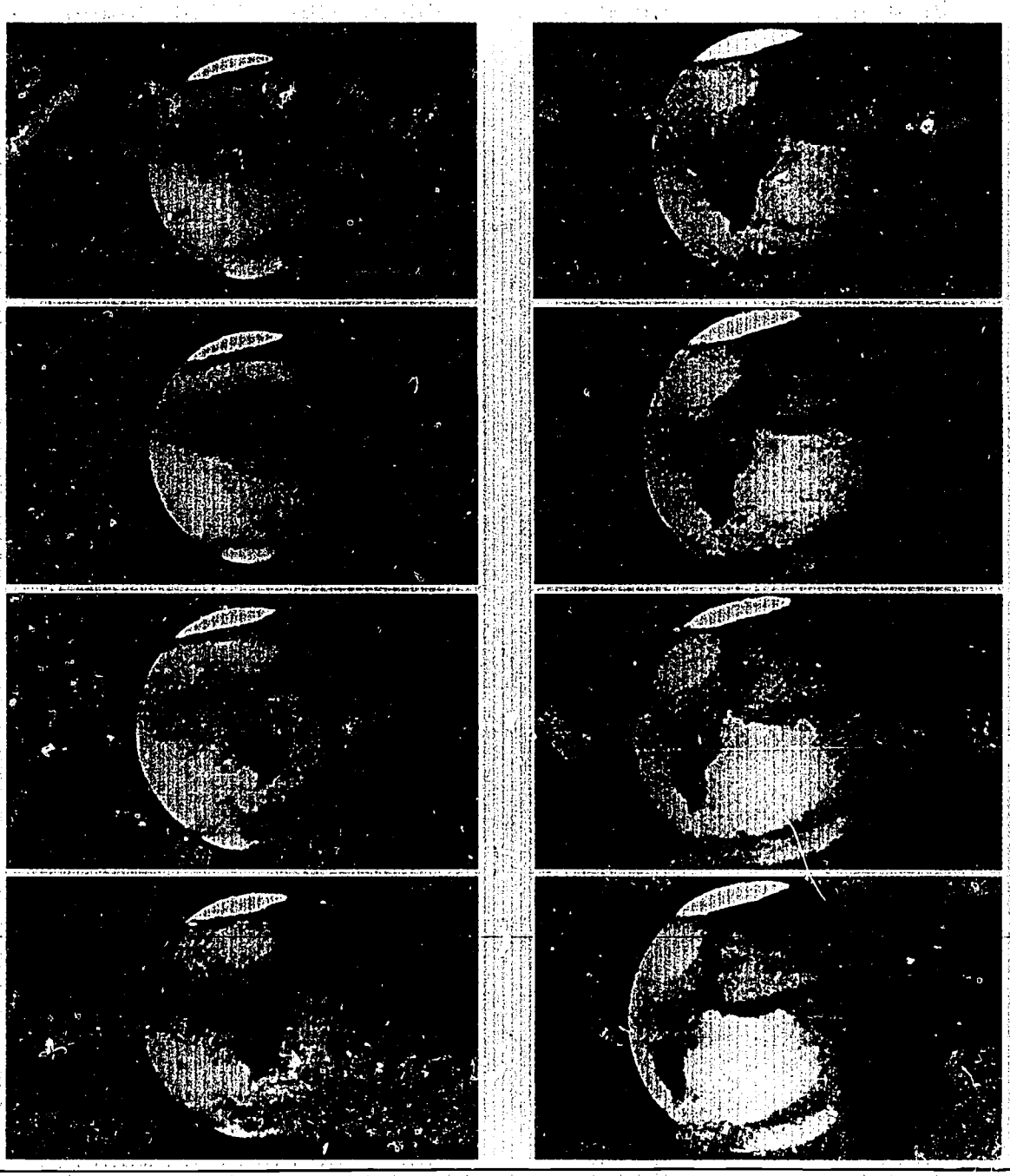
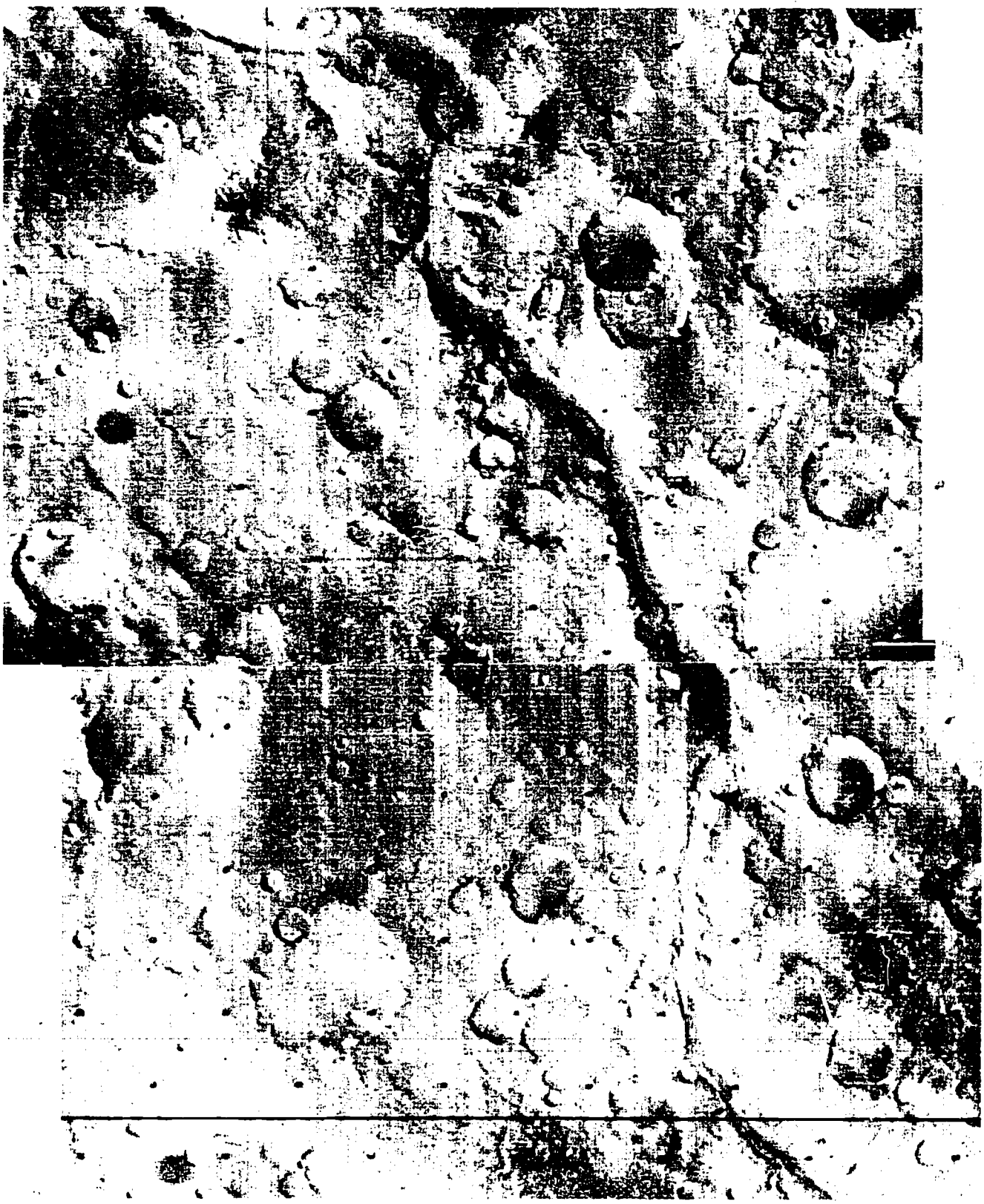
e. EP-90 Two Over Mars $.90
f. NF-76 Viking Mission to Mars $.50
g. EP-87 Space Resources for Teachers: Chemistry $2.50



Mars as seen from Earth through a telescope shows dark markings and polar caps. These vary with the seasons on Mars. This series of Mariner 7 pictures shows rotation of Mars at about the same resolution.



From the highland areas of Mars to the lowlands there are many channels that have the appearance of being dried-up channels, the beds of once mighty rivers rivalling the rivers of Earth. Much material appears to have been carried down these channels and deposited in the Martian equivalent of ocean basins.