CONTENTS

FROM THE PRESIDENT .................................................. James A. Hooks 1
THE FIRST INTERNATIONAL PLANETARIUM WEEK? ..................... George Reed 2
A RATIONALE FOR THE IMPLEMENTATION OF A MAXIMUM IMPACT SCHOOL PLANETARIUM FACILITY .......................... Mark S. Sonntag 3
THE READABILITY OF ASTRONOMY MATERIALS ...................... Richard J. Reiff 11
P.R. PEOPLE MAKE ME NERVOUS! or (HOW TO ADVERTISE YOUR PLANETARIUM!) ...................................... Philip R. Groceee 14
PUBLIC PROGRAMMING, YOUR AUDIENCE IS YOUR FIRST PRIORITY .................................................. Ruth S. Haag 17
PUT SOME EXCITEMENT IN YOUR PLANETARIUM– WITH ASTRONOMY ................................................. Clarence H. Arnett and Michael K. Boss 19
SMALL GROUP UTILIZATION OF PLANETARIUM WHEN BUDGET CUTS CREATE LARGE GROUPS ......................... Gerald L. Mallon 23
FEATURES:
What's New ................................................................. James Brown 18
Focus on Education ....................................................... Jeanne E. Bishop 25
Creative Corner ("Six Special Effects for Your Overhead Projector" by Roger Grossenbach) .............................. Herb Schwartz 27
Jane's Corner ............................................................... Jane Geohegan 30

Vol. 8 No. 2
Summer, 1979
THE PRESIDENT'S MESSAGE

Before I go into the preliminary results of the survey I conducted in the Spring of '78 to determine the present operating status of the 919 planetariums listed as in existence by the 1977 Planetarium Directory, I would just like to say that I am deeply grateful for all the support, encouragement, and cooperation I have been receiving from you. Together, we are going to put IPS on the map!

Speaking of putting IPS on the map, you might be interested in learning that I have been in touch with officials from NASA, Jet Propulsion Laboratory, and the Columbia Record Company. You, as a member of IPS, should be receiving material from them very shortly.

One last word before presenting the preliminary results of the survey. I would like to take this opportunity to acknowledge the invaluable and untiring efforts of my colleague, Debra Johnson, now a graduate student in museum sciences at Texas Tech University in Lubbock, who spent many hours compiling the information into the form you will read below. All actual documented survey forms are available upon request.

Continued on pages 15 and 16

INFORMATION FOR CONTRIBUTORS

GENERAL INSTRUCTIONS

All materials submitted will be considered. Contributions should relate to one or more of the following: planetarium activities and/or education, astronomy or space sciences.

Articles, reports, planetarium programs, letters, technical comments, guest editorials, items of humor, pictorials (black & white) or selected planetarium facilities and general news relating to the planetarium/astronomy community is published. (This list is not all-inclusive.) The Planetarian will make the final decision as to appropriateness of material submitted.

All material should be submitted directly to the Executive Editor. Contributors will be notified of acceptance, rejection, or need for revision within a reasonable period of time.

The manuscript should be typed free from errors, double-spaced, on 8 1/2 x 11" paper. Strikeovers and other markings are to be avoided. Use the first page to show the title, author's name, complete address, and exactly how the byline is to appear. Begin the text on the second page. Place all legends for figures on a separate sheet at the end of the manuscript, and enumerate in the text where each figure should be located. Place all tables in the manuscript in their appropriate locations.

Photographs must be black and white, on 8 x 10" glossy paper. DO NOT mark or label on photographs. Labels referring to a part of a photograph should be indicated on a separate sheet or onion-skin overlay.

Line drawings, charts, and similar drawings (excluding halftones) should be drawn with dense black (preferably India) ink with a high carbon content. If only printed copies are available they must be equal to the above specifications. Copies duplicated on electro-static type duplicators are not acceptable. DO NOT SUBMIT COLOR WORK of any kind.

REFERENCES should appear in the body of the manuscript by the Author's last name and the date of the publication, e.g.: (Nelson, 1972), with full references listed alphabetically at the conclusion of the manuscript, giving author's name, year, title, publication, volume, number and pages. Example:


Adherence to these instructions will be appreciated.
What do artichokes, secretaries, ripe olives, school lunches, asparagus, pickled peppers, clowns, girl scouts, little league baseball, and people with the surname "Fink" have in common with each other? What do pickles and letter writing have in common with each other but not with the first group of subjects? What do both groups not have in common with the planetarium?

Give up already? The answer is that the first group of subjects has a week set aside for their recognition on a national level while the second group of subjects has a week set aside for their recognition on an international level. The planetarium does not enjoy either of these honors or privileges.

Why should planetariums receive less recognition than "nature's most humorous vegetable," the pickle? The answer is simple. We never asked for a recognition week. We never asked for a recognition week. The process of obtaining a week of national or international celebration and recognition is fairly easy. It basically consists of asserting that certain dates represent the week of honor. Unbelievable as it may seem, there are no forms to fill out!

The week can receive some semblance of official dignity and free publicity by being listed in the Chase Calendar of Annual Events. All that this requires is a request letter on official stationary.

Now that we know how to get a week set aside to create an awareness of the contributions of the planetarium to the educational and cultural climates of the schools and community in which it serves, the next question is what week would best serve as an International Planetarium Week? The best week for such a celebration would most likely be the week that includes the date of October 21. It was on this date in 1923 that the first public, projection planetarium program was given. The event took place using the Zeiss Optical Company instrument designed by Dr. Walter Bauersfeld at the Munich Deutsches Museum in Germany.

An October date commemorating this event would seem to be a good choice for an International Planetarium Week. It would avoid any problems between a "major" and "small" planetarium celebration, a "public" and "educational" planetarium celebration, and a "United States" and "International" planetarium celebration. We can all identify with the beginning of our profession.

How do you celebrate an International Planetarium Week? The answer is any way you want. Each planetarium could decide how it was to celebrate its week. This could be done by special programs, special events, and "behind the scenes" open houses. The week could be promoted by bumper stickers or buttons produced by IPS or affiliate organizations, but the local planetarium would be autonomous in its programming.

I have suggested the creation of an International Planetarium Week Committee to IPS President, Jim Hooks.

I will consider it at a future IPS Executive Council Meeting. The main purpose of the committee would be to promote the idea and observance of the week among planetariums throughout the world. The IPS committee would consist of an international chairman and the chairmen of the committees of the affiliate organizations. The international chairman would be selected by the IPS president and the affiliate chairman by the presidents of the affiliate organizations.

Who know, by 1980 we may have the same status as nature's most humorous vegetable—the pickle.
A RATIONALE FOR THE IMPLEMENTATION OF A MAXIMUM IMPACT SCHOOL PLANETARIUM FACILITY

Mark S. Sonntag
Educational Programs Specialist
Fiske Planetarium
University of Colorado
Boulder, Colorado 80309

INTRODUCTION

According to Pitluga, in a report issued by the Great Lakes Planetarium Association, the “maximum impact planetarium”: implies that every elementary child visits the planetarium three times a year (on the average) during his/her elementary school career for presentations related to the science taught in his/her classroom. The high school students, as part of the instruction in their earth science, mathematics, physics, English, or perhaps biology classes, will make one visit (on the average) each year to the planetarium. (Pitluga, 1969)

However, I suggest that another requirement be considered for a “maximum impact planetarium” facility. In addition, the planetarium lessons must be integrated effectively into the existing school curriculum, or a new planetarium curriculum needs to be written, which can reflect the goals and objectives of the local school system.

As part of this curriculum, the planetarium instructor needs to prepare both pre- and post-visit activities for each lesson. By approaching the planetarium curriculum in this way, the students are brought to the planetarium because of a need generated in the classroom, the planetarium lesson being a natural extension of learning begun elsewhere. The planetarium lesson, when designed with the student’s total learning environment considered (both in and out of the classroom), becomes an extension of classroom learning, and, I believe that it needs to be perceived in this manner by both teachers and students in order to achieve maximum impact on learning outcomes. By using this approach in planetarium curriculum design, the planetarium visit is elevated above the role of an isolated extra-curricular activity to a legitimate part of the school curriculum.

But is there any justification for the use of a planetarium in a school curriculum? Can the planetarium help students learn concepts that are not easily learned in other ways? I believe that the answer to both of these questions is a resounding YES! My conclusion is based on three separate lines of evidence: 1. the research into cognitive development by Jean Piaget and the more recent confirmation of much of his work by researchers, 2. the need for the laboratory approach in science instruction to strengthen the learning of science processes, and 3. the effort to strive toward an interdisciplinary approach to science instruction which emphasizes the science/society interaction and the humanistic nature of science.

The research findings of Jean Piaget have indicated that all children go through a series of stages during cognitive development. According to his data and confirming data of other researchers (Good, 1977), Piaget’s theory of cognitive development suggests that all students must pass through a stage in which they need concrete experiences during learning activities in order for the learning to be meaningful to them. Most children pass through this stage during their elementary school years. The important implications for the planetarium curriculum are that the planetarium lessons should heavily favor concrete experiences in the form of non- telescope observational astronomy for elementary school students, and perhaps more importantly, since the planetarium is able to provide concrete experiences in observational astronomy, it can be used effectively to help concrete operational students learn concepts which were previously only presented to them in abstract terms through the use of textbooks (Bishop, 1976). Concepts, which were only learned superficially and rote from non-concrete sources such as textbooks, can have much more meaning for students who are dependent upon concrete experiences, when presented in the planetarium. Because the planetarium can manipulate the sky in both space and time, some of the problems presented by observational astronomy that are mere mental abstractions in the “real world” become concrete visualizations in the planetarium. Here are a few of the “impossibles” that can become standard procedure during a series of planetarium lessons (Bonney, 1976):

★Sunrise and sunset can occur whenever you wish.
★A day or night can be compressed into minutes.
★The stars can stand still.
★Constellation figures can be projected against their starry background.
★Winter constellations can be seen at any season, and the same is true for any other seasonal stars.
★Planets can speed up their apparent wandering among the stars.
★The moon can go through its month of phases in just minutes.
★The sky can be observed from around the world without ever leaving home.
★The circumpolar constellations can be shown and explained.
★A year of sunrises, sunsets, and midday suns can be observed showing their seasonal changes and the changing lengths of night and day.
★The “land of the midnight sun” can become real.
★Constellations of the southern hemisphere can be identified.
The effect that changing latitude has upon apparent star motions can be demonstrated.

By using the coordinates and geocentric projectors, time belts can be shown, making it easier to understand our system of time.

Coordinate systems can actually be projected onto the sky.

Precession of the earth's rotation axis can be shown.

It is also important to note the Piaget's original research suggested that this concrete operations stage extends only from about age seven to eleven, but more recent research in the United States seems to indicate that many high school and even college students are concrete thinkers (Schatz, 1976), and thus the implications of planetarium education go beyond just the elementary school science curriculum when just this factor alone is considered. As will be discussed later, there are additional factors that justify the use of the planetarium in the secondary schools, but the implications of Piagetian theory seems obvious: if planetarium curricula emphasize observational astronomy, concept learning beyond merely the rote level will be enhanced. Previously abstract concepts such as the earth's rotation, the celestial sphere, the earth's orbital motion and the reasons for the seasons, planetary and lunar motions, the cause of night and day, etc. are rendered concrete through the use of the planetarium, and therefore are more easily understandable by the vast majority of students in the schools.

The planetarium is a science laboratory—a laboratory for observational astronomy. Laboratory work is central to the teaching of science, because it provides a means for students to relate science concepts to the processes of science. Processes such as observing, using numbers, classifying, measuring, predicting, inferring and interpreting data have been identified by the National Assessment of Educational Progress as important, and these processes can and should be emphasized in any maximum impact school planetarium curriculum. Following planetarium laboratory activities, the students should be encouraged to make continuing observations in the real sky. The planetarium lessons at all levels should actively involve students in the various processes of science.

The fact that the planetarium is in its broadest definition a multimedia theater suggests that in this regard its use is limited only by the creativeness of the people who operate it. It is this property that makes the planetarium an excellent facility for use in an integrative approach to the traditional school disciplines. There has recently been a desire expressed for an interdisciplinary approach to curriculum development. Paul DeHart Hurd, Professor Emeritus, Stanford University points out that discipline centered science courses are too restricted, fragmented, and hierarchial to focus on the science-based social problems with which students must deal as citizens. . . We have little hope of resolving population, food, wealth, water pollution, and many other problems of human concern unless we can relate disciplines and teach them in an integrative mode. (Hurd, 1975)

Thus interdisciplinary planetarium programs should be student-centered science activities in the planetarium environment, integrated with natural and social sciences. The planetarium can serve well in promoting a holistic approach to social problems, and this type of educational approach may well help to avert technological/social disasters in the future. Natural sciences can be integrated across common processes used in scientific research or by the study of the history of science. This historical approach provides an extremely interesting way of showing the human interaction necessary for the practice of science. The whole area of science-related values and ethics has been much neglected in past science curricula, but can be exploited nicely in a well-written planetarium curriculum.

In summary, the maximum impact planetarium facility can be justified when the planetarium environment is used as a sky simulator for the study of observational astronomy on a concrete level, a science laboratory which helps teach the processes of science, and a multimedia theater emphasizing an interdisciplinary approach to science education where the social and technological implications of scientific research are presented.

In addition to the school curriculum, which should be its major thrust, the maximum impact school planetarium facility should involve the entire community in its operation. Public programs and observing nights, adult classes in astronomy, and special programs for community service organizations and children's organizations should be offered. The school planetarium offers a way for the citizens of a community to use a school facility and get involved in school-related activities. Most school systems today welcome the opportunity to serve their supporting community, and the planetarium provides one such opportunity.

IMPLEMENTING THE PLANETARIUM CURRICULUM

Regardless of objectives and the good intentions, any curriculum change will not be effective if certain prerequisites are not met. Victor (Victor, 1975) cites in some detail the necessary prerequisites for an effective elementary science program. From his list I have drawn a few examples which seem especially appropriate for the successful implementation of a planetarium curriculum.

Planning. A good planetarium curriculum should be planned and structured. A planned curriculum not only provides a steady progression of astronomy in all grades, it also gives the teacher a definite background and framework of basic astronomy information with which to work in the classroom. Teacher education as well as student education must be provided for.

A Coordinated Part of a K-12 Science Curriculum. Astronomy in the elementary school should be planned and coordinated so that it is part of an overall K-12 astronomy curriculum. A steady progression of learning should take place at each grade level, building upon knowledge from previous grades and leading to further knowledge in the following grades. Goals and objectives can help to structure the curriculum to meet this prerequisite.
Correlation With Other Parts of the School Curriculum. The planetarium curriculum should show the relationship of astronomy to other disciplines whenever possible. A holistic approach to learning should be the goal of the maximum impact school planetarium, and as mentioned previously, the emphasis of science processes or a historical approach can help to accomplish this goal.

Scope and Sequence. Scope refers to the content in the curriculum and sequence refers to the grade level or levels where the content is taught. As stated above, I feel that the use of the planetarium as an observational astronomy laboratory along with interdisciplinary programs will have the greatest impact on the school curriculum. The content then is astronomy and especially, it relates to other disciplines and society. The sequence should allow for a spiral pattern which allows further development and refinement of a few basic astronomical concepts. Such topics are repeated at later grade levels in more detail.

Emphasis of a Few Major Concepts. The planetarium curriculum should be concerned with more than technological achievements such as manned space flight, although that should be part of the curriculum. Major concepts should be derived from astronomical content, science processes, and the science/society interaction. Observational astronomy should be emphasized through junior high school, with the interdisciplinary use of the planetarium gaining in importance in the high school years.

Emphasis on the Processes of Science. The planetarium curriculum should make students aware that science is a way of life—an exciting process of inquiry and discovery that astronomers use to explore, discuss, and explain the natural celestial phenomena and the universe as a whole. Whenever possible, the planetarium should be used to help students gain proficiency in the use of the processes of science. Psycho-motor skills needed to use astronomical instruments such as a telescope, sextant, compass, star map, sun dial, or quadrant should not be overlooked.

Help and Encouragement for the Teachers. Giving all teachers as much help as possible on both a formal and an informal basis is an important facet of any successful planetarium curriculum. Teachers will generally need a good deal of help in the content area of astronomy as well as help in implementing pre- and post-visit classroom activities in conjunction with the planetarium lesson.

Continuous Evaluation. To be effective the planetarium curriculum needs to be evaluated continuously, with everyone involved in the curriculum participating in the evaluation. Subjective evaluations as well as cognitive domain measures of learning accomplished by the students should be a part of the evaluation program. Teachers should be allowed to continuously critique the curriculum, and input from all levels should be encouraged. The curriculum should not be static. It should be made dynamic by the continuous evaluation process with improvement being the primary goal.

THE MAXIMUM IMPACT SCHOOL PLANETARIUM FACILITY

Accepting the goals of a maximum impact school planetarium facility and implementing a plan as described below, a school system with a student population of 10,000 can expect to have an annual attendance of about 35,000 students. Comparing this figure with attendance figures from other school facilities, it is not difficult to conclude that the planetarium can have a large impact on the school curriculum, especially when one considers that the planetarium curriculum includes grades K through 12.

Described below is specifically how a maximum impact planetarium could be implemented in a school system of about 10,000 students.

Teacher Education. As stated before, the maximum impact planetarium curriculum should be perceived by both teachers and students as an extension of classroom activities. Therefore, if the planetarium is to become an effective teaching facility, the classroom teacher must have a certain degree of competence and confidence in dealing with the subject matter of the planetarium curriculum, namely, observational astronomy. The planetarium itself can provide this needed training of teachers through an in-service program. Teachers need to get general training in observational astronomy and specific information about what to expect when they bring their students to the planetarium. Another subtle but extremely important function of the planetarium in-service training sessions should be to form a bond of common purpose between the planetarium instructor and the classroom teachers. This is of course necessary for a smoothly-run and efficient operation of the planetarium curriculum. In short, it is highly desirable for maximum effectiveness to have a team of competent classroom teachers and not just one expert located at the planetarium.

The maximum impact planetarium can serve teachers in another way. It can serve as a resource center for astronomy and related topics, providing a mini-library and study center, display materials for classroom use, and equipment such as telescopes for classroom use. For example, books suggesting student activities or enrichment exercises, telescopes, models, and/or displays could be made available to teachers on a “check-out” basis. The resource aspects of the planetarium should also be made available to advanced students wishing to do work in astronomy and related subject areas.

This aspect of the use of the planetarium, although providing a necessary service and vital to the overall effectiveness of the planetarium curriculum, would account for a relatively small percentage of the total planetarium usage, probably accounting for no more than 2% of attendance figures.

Elementary School Curriculum. The elementary schools provide the basis for the most comprehensive usage of the planetarium in the school curriculum. This aspect should account for about 45% of the expected attendance. The reason for its wide range of usage in the elementary schools is that the emphasis of the planetarium curriculum should be observational.
astronomy, and these concepts can be taught concretely to elementary school students using the planetarium.

To make the elementary school planetarium curriculum continuous and sequential, the major conceptual theme of motions in the heavens can be used, and individual concepts such as the earth's diurnal motion, the earth's orbital motion, the motion of the planets, and the motion of the moon can be presented in a spiral curriculum arrangement. In this manner, concepts taught in succeeding years, can be expanded and made more abstract. It would also be highly desirable to build into the curriculum another conceptual theme—one that can be used to integrate astronomy into other disciplines, including the social sciences. A most appropriate and timely theme would be “energy: the earth-sun system as an energy system.” This latter theme would be emphasized increasingly with higher grade levels, reaching its culmination in the junior high school planetarium curriculum.

The following outlines a suggested plan for an elementary school planetarium curriculum, assuming an elementary school population of 5,400 students and using the principles stated above.

KINDERGARTEN
Concepts:
1. The stars, planets, and moon can be seen in the night sky.
2. The sky appears to have the shape of a bowl.
3. Using one's imagination, one can populate the sky with star pictures.
4. The sky changes.
5. The planetarium is a projection device.
1 Program: “The Night Sky”

GRADE 1
Concepts:
1. As the earth rotates, the sun illuminates different parts of the earth, which causes night and day to occur.
2. The apparent daily motion of the sun and stars across the sky is a result of the earth's rotation.
3. Knowing the four cardinal directions makes it easier to locate the stars, planets, and sun.
4. The sun rises toward the east, is due south at midday, and sets toward the west.
2 Programs: “The Day and Night Sky”
“What Causes Night and Day?”

GRADE 2
Concepts:
1. The earth has two major motions.
2. The earth revolves around the sun, and it takes one year for the earth to complete one revolution about the sun.
3. When the earth is at different parts of its orbit, we have different seasons.
4. The different seasons affect life on the earth.
5. The sun's energy makes the earth warm.
2 Programs: “The Earth Moves Around the Sun”
“The Four Seasons”

GRADE 3
Concepts:
1. The apparent size of an object is determined by its actual size and its distance from the observer.
2. The moon changes its place in the sky day after day.
3. We can see the moon because it reflects light from the sun.
4. The moon orbits the earth, and it takes one month to complete one orbit.
5. As the moon orbits the earth, its shape as seen from the earth appears to change, and this change repeats in a monthly cycle.
2 Programs: “The Moon and Stars”
“Moonbeams”

GRADE 4
Concepts:
1. The apparent diurnal motion of the stars is a result of the earth's diurnal rotation.
2. The latitude of the observer affects the pattern of the star movement that one sees in the sky.
3. The North Star, Polaris, is the star around which the stars seem to circle, is near a point directly above the earth's North Pole.
4. The equatorial coordinate system provides a means of defining with fixed values the locations of objects on the celestial sphere.
5. All spherical coordinate systems have the same basic framework.
6. The celestial sphere and constellations are map concepts.
7. The concept of latitude and longitude can be extended to the imaginary celestial sphere.
8. The sun's position and apparent diurnal motion can be estimated by observing its compass direction and altitude above the horizon.
9. The size and shape of constellations have not changed for thousands of years and will remain the same for thousands of years to come.

The positions of the constellations above the horizon vary with the seasons as well as during the night.
4 Programs: “The View from Earth: The Celestial Sphere”
“From Day to Day”
“The Earth's Rotation from Around the World”
“A Visit to the Zodiac”

GRADE 5
Concepts
1. Because of the revolution of the earth around the sun, the sun appears to move annually through the background path of constellations called the zodiac.
2. The earth's equator and orbital plane are not in the same plane, the difference being about 23½°.
3. Both the inclination of the earth's axis and the revolution of the earth about the sun combine to cause the seasons; neither could bring about the seasons alone.
4. The annual revolution of the earth around the sun and the inclination of the earth's equator to the plane of its orbit are responsible for: a) changes in the position of the sun at sunrise, midday, and sunset, and b) changes in the night sky during the year.
5. We have not always had our present model of the solar system. We did not always think the earth moved.
6. The energy of the sun is needed for life on the earth.

4 Programs: “Copernicus: The Man Who Moved the Earth”
“The Changing Sky”
“Orbiting the Sun”
“The Seasons from Around the World”

GRADE 6

Concepts
1. The sun, moon, and planets are seen to move in relation to the fixed background stars.
2. The moon orbits the earth once a month, moving eastward through the constellations of the zodiac.
3. Most of the time the planets move eastward through the constellations of the zodiac, however, periodically this motion is seen to reverse.
4. The sun, moon, and planets move along the same narrow pathway in the sky—the zodiac.
5. Although models of the solar system have not always been the same, our present heliocentric model explains the planetary motions quite adequately.
6. The relative change of positions of the earth, moon, and sun causes the phases of the moon.
7. As seen from the earth, inferior planets always appear close to the sun.
8. The apparent motions of the planets result from the motion of the earth as well as the planet.

4 Programs: “Models of Our Solar System”
“Journey Through the Solar System”
“Tracking the Planets”
“The Motions and Phases of the Moon”

Junior High School Curriculum. The two major goals of the junior high planetarium curriculum are: 1) to summarize and generalize the concepts of observational astronomy which were developed during elementary school, gradually working on a more abstract level; and 2) to further develop the conceptual theme of the earth-sun energy system and generalize to the stellar and galactic systems. Fortunately, there is a commercially available astronomy curriculum which fulfills both of these objectives. The University of Illinois Astronomy Program (available through Harper & Row, Publishers) is a student-centered, activity oriented series of six short-texts that introduce junior high school students in a unique way.

Two subsidiary elements are reflected in this program's approach to the teaching of astronomy. First, there is a strong flavor of history throughout the books. Not only are fundamental concepts presented, but students also learn the way in which these concepts were uncovered by astronomers down through the centuries. The human interaction in science discovery is definitely not overlooked. Secondly, the interdisciplinary nature of astronomy is repeatedly emphasized. Principles from the physical sciences are applied, and mathematics is used as a tool of science. These aspects of this program are certainly in keeping with the two major conceptual themes that are developed by the planetarium curriculum in the elementary school and with the holistic approach of the school planetarium. This text series would serve as a transition between the elementary and high school curricula and would contribute to about 20% of the total planetarium attendance.

Grade 7

Main Topics
1. A study of daily motions of the sun, the moon, and the stars.
2. The motions of the planets.
3. Moving models of the solar system.
5. The motions of stars, star-pairs, and galaxies.

3 Programs: “Time and Motion”
“Kepler's Laws of Planetary Motion”
“Lunar Motion: Tides and Eclipses”

Grade 8

Main Topics
1. The physical properties of the sun.
2. Models of the solar interior using known physical laws as a guide.
3. The source of solar energy.
4. Properties of other stars—their luminosities, temperatures, and masses.
5. Stellar Models and the evolution of stars.
6. The birth and death of stars.

3 Programs: “Star of Life”
“A Star Is Born”
“Stardust”
Grade 9  
Main Topics  
1. The home galaxy—its contents, its architecture, and the motion of the stars within it.  
2. Other types of galaxies.  
3. The arrangement of galaxies in the universe.  
4. Motions of galaxies.  
5. Cosmology—the expanding universe.  
3 Programs: "The Milky Way"  
   "The Milky Way Galaxy"  
   "Journey Through the Universe"  

The High School Curriculum  
The high school planetarium curriculum is extremely varied in its content and approach, ranging from actual astronomy classes and clubs meeting in the planetarium to music appreciation classes utilizing the multimedia aspect of the planetarium theater. The interdisciplinary use of the planetarium is emphasized with high school classes. Science is a discipline with many dimensions: aesthetic, empirical, futuristic, historical, philosophical, and technological. Each student's interest orientation will match at least one of these perspectives. Thus, every student can be placed in an astronomy/science learning situation which matches his or her interest orientation and, consequently, he or she will learn more astronomy or science. The rationale behind this holistic approach to the high school planetarium curriculum now seems quite simple and justified. (Andersen, 1978)  
The high school planetarium curriculum is the most difficult part of the entire school planetarium curriculum to estimate an expected attendance, because for the most part, the programs are completely optional. Hopefully, enough interest can be generated to expect that each high school student will visit the planetarium on the average once per year. This is a rather conservative estimate and would involve about 24% of planetarium attendance.  
Astronomy Class  
3 Courses  
Fall—Introductory Astronomy  
Spring—Stellar Astronomy  
Summer—Observational Astronomy  
Astronomy Club—meets once a month  
Interdisciplinary Planetarium Programs  
Physics  
planetary motion  
Kepler's laws  
celestial mechanics  
Copernican Revolution  
gravitation  
cosmic dimensions  
astrophysical topics  
Doppler effect—astrophysical applications  
stellar energy sources  
radio astronomy  
Chemistry  
stellar energy processes  

atomic structure  
origin of spectra  
origin of chemical elements  
spectroscopy—application to astronomy  
nuclear reactions  
chemistry of the stars  
interstellar molecules  
chemical abundances in the universe  

Biology  
origin of life  
extraterrestrial life  
external relationships and their effects on the biosphere  
exobiology  
climatic change and its possible relation to the solar cycle  

Geology/Geography  
geology of the moon and planets  
astroblem  
mineralogy of meteorites  
the reasons for the seasons  
navigation  
coordinate systems of a sphere  
climatic change and its possible relation to the solar cycle  
lunar and solar tides  

Mathematics  
geometry of the sphere  
applications of spherical trigonometry  
navigation  
estimation techniques  
the measurement of time  
celestial mechanics  
non-Euclidean geometry  

English Greek sky mythology  
Greek sky mythology  
American Indian sky mythology  
African sky mythology  
science fiction stories dramatized in the planetarium  
astronomy and the stars in literature  

Fine Arts  
music of the spheres  
concerts under the stars  
space art  

History  
astro-archeology  
history of astronomy  
the Copernican Revolution  
history of space flight  
primitive sky mythologies  

Language  
general programs in a foreign language  

Adult Education Programs  
To complete the maximum impact planetarium concept, we leave the realm of the school curriculum proper and extend the planetarium to the community as a whole. Involving the public in general with planetarium usage is an important way to strengthen ties between the community and the school system. Public programs, adult
evening classes (possibly for high school or college credit), programs for adult service clubs, programs for children's groups, and possibly an amateur astronomy club would all have the effect of community involvement. This aspect of planetarium programming would involve about 9% of total attendance.

### SUMMARY OF PROJECTED PLANETARIUM ATTENDANCE
**BASED UPON A SCHOOL POPULATION OF 10,000**

#### Elementary School (K–6)
*based on 3,400 students & 900/grade & 2 classes/program*

<table>
<thead>
<tr>
<th>Grade</th>
<th>programs/grade</th>
<th>planetarium-hours</th>
<th>student-hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>K</td>
<td>1</td>
<td>15</td>
<td>900</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>30</td>
<td>1,800</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>30</td>
<td>1,800</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>30</td>
<td>1,800</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>60</td>
<td>3,600</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
<td>60</td>
<td>3,600</td>
</tr>
<tr>
<td>6</td>
<td>4</td>
<td>60</td>
<td>3,600</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>19</strong></td>
<td><strong>285</strong></td>
<td><strong>17,100</strong></td>
</tr>
</tbody>
</table>

#### Jr. High School (7–9)
*based on 2,400 students & 800/grade & 6 teachers/grade*

<table>
<thead>
<tr>
<th>Grade</th>
<th>programs/grade</th>
<th>planetarium-hours</th>
<th>student-hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>3</td>
<td>36</td>
<td>2,400</td>
</tr>
<tr>
<td>8</td>
<td>3</td>
<td>36</td>
<td>2,400</td>
</tr>
<tr>
<td>9</td>
<td>3</td>
<td>36</td>
<td>2,400</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>9</strong></td>
<td><strong>108</strong></td>
<td><strong>7,200</strong></td>
</tr>
</tbody>
</table>

#### High School (10–12)
*based on 2,000 students & 733/grade*

<table>
<thead>
<tr>
<th>Class</th>
<th>planetarium-hours</th>
<th>student-hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Astronomy class (30 students)</td>
<td>180</td>
<td>5,400</td>
</tr>
<tr>
<td>Interdisciplinary programs</td>
<td>50</td>
<td>2,200</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>230</strong></td>
<td><strong>7,600</strong></td>
</tr>
<tr>
<td><strong>SUBTOTALS—SCHOOLS</strong></td>
<td><strong>623</strong></td>
<td><strong>31,900</strong></td>
</tr>
</tbody>
</table>

#### Adult education programs

<table>
<thead>
<tr>
<th>Program</th>
<th>planetarium-hours</th>
<th>student-hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public programs (1 program/week)</td>
<td>50</td>
<td>2,000</td>
</tr>
<tr>
<td>Adult evening class</td>
<td>60</td>
<td>1,200</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>110</strong></td>
<td><strong>3,200</strong></td>
</tr>
</tbody>
</table>

#### Teacher Education

<table>
<thead>
<tr>
<th>Group</th>
<th>planetarium-hours</th>
<th>student-hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elementary teachers (180)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>K–3 (90)</td>
<td>3</td>
<td>270</td>
</tr>
<tr>
<td>4–6 (90)</td>
<td>3</td>
<td>270</td>
</tr>
<tr>
<td>Jr. High science teachers (18)</td>
<td>3</td>
<td>48</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>(198 teachers)</strong></td>
<td><strong>588</strong></td>
</tr>
</tbody>
</table>

**GRAND TOTALS**

733 | 35,100

Assuming 180 school days, this attendance figure shows that on the average there will be about four (4) programs given per day and an average daily attendance of almost 200.
SUMMARY

The figures listed above (and summarized below) are not meant to be exact. They suggest only an estimation of the possibilities. Neither are the suggested programs that comprise this curriculum the only possible ones. I think that this curriculum would work well in the proposed school system, but certainly other programs could be substituted. However, my suggestions do give some clue as to what type of program should be given at each grade level, if one follows suggestions from Piaget. What this information does supply is a rationale for considering the implementation of a maximum impact planetarium facility and a meterstick of evaluating what can be achieved with a planetarium in a school system of approximately 10,000 students.

Each of the aspects of learning which the properly prepared planetarium lesson can elucidate should lead to an increase in breadth of understanding. With the maximum impact planetarium facility, the only limit is the edge of the universe.

Assuming 180 school days, this attendance figure shows that on the average there will be about four programs given per day and an average daily attendance of almost 200.

REPERTITION AND SEQUENCING OF MAJOR CONCEPTUAL THEMES--GRADES K THROUGH 9

<table>
<thead>
<tr>
<th>Theme</th>
<th>K</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diurnal motion</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual motion</td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lunar motion</td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planetary motion</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Celestial sphere</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stars &amp; constellations</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Earth-sun energy system</td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Indicates that concepts are emphasized at that grade level

REFERENCES


THE READABILITY OF ASTRONOMY MATERIALS

Richard J. Reiff
Hefferan Planetarium
Career Enrichment Center
807 Mountain Rd. NE
Albuquerque, NM 87102

Very often, as planetarians, we are in a position to recommend or evaluate texts for astronomy courses or to choose a text for an adult education course offered through the planetarium. While there are many astronomy texts on the market, most are intended to be used for college-level introductory courses. Judging the appropriateness of texts for high school level students or the general public requires the consideration of factors that reach beyond the examination of just the content of the texts. In addition, the large number of texts available makes examining them all a monumental task. Tabulations of text characteristics may serve to narrow the range of texts being considered.

One factor that might indicate the suitability of a given text for use in an astronomy course is the readability, or reading level, of the text. Readability is simply a measure of the difficulty of the material to be read. Readability is often indicated by the grade level at which a student’s reading ability should be well enough developed to handle the printed material.

While many methods have been developed to determine readability, most consider two factors: the number of words in each sentence, and the difficulty of the words themselves. In general, readability measures do not consider either inherent difficulty in conceptualizing the content of the written material or the interest level of the reader.

One readability formula which is widely used is that developed by Edward Fry (1968). This method uses a count of syllables to determine word difficulty, and is thus a relatively quick and simple method compared to others. To use Fry’s method, three passages of one hundred words each are selected from a book or article. The number of sentences and the number of syllables are determined for each passage, then averaged. The grade level of the material is then read from the graph shown in Figure 1. The readability graph shown here has been extended to provide greater reading level definition in the upper grade levels. The graph indicates that relatively short sentences with short words make reading less difficult; such material would be more readable at a lower grade level. Specific instructions for using the Fry graph can be found in many references including Forgan and Mangrum (1976) and Kennedy (1979).

Other readability measures in common use for grades four through sixteen include those developed by Dale and Chall (1948) and Flesch (1948). The Dale-Chall method uses sentence length and word difficulty as indicators of readability. Word difficulty is judged by comparing words in a passage with a list of “familiar” words. While generally considered accurate, the Dale-Chall method tends to be time-consuming. The Flesch formula, like the Fry method, uses sentence and syllable counts. The numbers are inserted into an equation that results in a readability score. The various methods have been correlated by comparing the relative ranking of materials evaluated by the different methods. Such rank-order correlations between these methods are high. The correlation between the Fry and Dale-Chall formulas is 0.94, and between the Fry and Flesch formulas the correlation is 0.96 (Fry, 1968).

In 1978 Fraknoi (1978) published a comprehensive list of astronomy texts and analyzed their content. To help judge the applicability of the texts for use in non-college courses, I have determined the readability of many of the texts on Fraknoi’s list, plus some auxiliary materials that might be used in high school or community/adult astronomy programs. In my study the Fry readability graph was used because of its simplicity and efficiency and because it is the most commonly used method in my school district. Because of variability in reading level, five passages were randomly selected from each book or magazine. The numbers of sentences and syllables in each passage were determined and averaged, and the reading (grade) level found from the readability graph. In determining the readability of Astronomy and Sky and Telescope magazines, a one-hundred-word passage was selected from each of five feature articles that appeared in 1978.

The readability levels of the materials are shown in Table 1. Since variability was often found, the range of readability for the five passages is also given. For comparison purposes, Table 1 also shows the readability as determined by Dukes and Kelly (1979) using the Flesch readability scale.

The Fry readability levels shown are probably accurate to about one grade level. Variability may be due to a varied writing style. Sometimes authors may intentionally make reading easier when covering conceptually difficult topics. The results show that several texts may be appropriate for a high school astronomy course. When judging the appropriateness of written materials, one rule of thumb is that popular non-technical writing, such as a novel, is often at the sixth- to eighth-grade level. For example, Lucifer’s Hammer, a novel by Larry Niven and Jerry Pournelle, is written at the sixth grade level.

Tabulated reading levels and content lists can serve as a starting point when making a choice among possible texts. Once the field is narrowed, a critical examination of the contents must be done to insure that the material is truly appropriate for its intended application.

REFERENCES

<table>
<thead>
<tr>
<th>Title</th>
<th>Publisher</th>
<th>Readability</th>
<th>Fry</th>
<th>Range</th>
<th>Flesch Readability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exploration of the Universe</td>
<td>Holt, Rinehart, &amp; Winston</td>
<td>12</td>
<td>9-14</td>
<td>13-15</td>
<td></td>
</tr>
<tr>
<td>Realm of the Universe</td>
<td>Holt, Rinehart &amp; Winston</td>
<td>10</td>
<td>8-13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Universe</td>
<td>Avon</td>
<td>11</td>
<td>9-16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exploring the Cosmos 2nd Ed.</td>
<td>Little, Brown</td>
<td>12</td>
<td>9-17+</td>
<td>13-15</td>
<td></td>
</tr>
<tr>
<td>New Horizons in Astronomy</td>
<td>Freeman</td>
<td>13</td>
<td>9-17+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic Astronomy</td>
<td>Wiley</td>
<td>13-14</td>
<td>10-17+</td>
<td>13-15</td>
<td></td>
</tr>
<tr>
<td>Contemporary Astronomy</td>
<td>Merrill</td>
<td>13</td>
<td>10-17+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynamic Astronomy</td>
<td>Prentice-Hall</td>
<td>11</td>
<td>10-12</td>
<td>11-12</td>
<td></td>
</tr>
<tr>
<td>Introductory Astronomy</td>
<td>Merrill</td>
<td>12</td>
<td>7-15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Astronomy: The Cosmic Journey</td>
<td>Wadsworth</td>
<td>12</td>
<td>8-14</td>
<td>13-15</td>
<td></td>
</tr>
<tr>
<td>Our Evolving Universe</td>
<td>Dickenson Publ.</td>
<td>12</td>
<td>10-17+</td>
<td>13-15</td>
<td></td>
</tr>
<tr>
<td>Highlights in Astronomy</td>
<td>Freeman</td>
<td>10</td>
<td>7-15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>An Introduction to Astronomy</td>
<td>Holt, Rinehart, &amp; Winston</td>
<td>9-10</td>
<td>7-11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planets, Stars, and Galaxies (4th ed.)</td>
<td>Wiley</td>
<td>12</td>
<td>11-13</td>
<td>11-12</td>
<td></td>
</tr>
<tr>
<td>Red Giants and White Dwarfs</td>
<td>Signet</td>
<td>11-12</td>
<td>9-14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Astronomy: Fundamentals and Frontiers</td>
<td>Wiley</td>
<td>11</td>
<td>8-14</td>
<td>11-12</td>
<td></td>
</tr>
<tr>
<td>The Universe Unfolding</td>
<td>Freeman</td>
<td>10</td>
<td>9-11</td>
<td>11-12</td>
<td></td>
</tr>
<tr>
<td>Essentials of Astronomy (2nd ed.)</td>
<td>Columbia Univ.</td>
<td>12</td>
<td>10-14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introduction to Astronomy</td>
<td>Glencoe Press</td>
<td>10</td>
<td>8-13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Astronomy: How Man Learned About the</td>
<td>Addison-Wesley</td>
<td>8</td>
<td>7-10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Universe</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ideas from Astronomy</td>
<td>Addison-Wesley</td>
<td>7</td>
<td>5-9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introductory Astronomy</td>
<td>Addison-Wesley</td>
<td>10</td>
<td>9-13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Astronomy</td>
<td>Merrill</td>
<td>11</td>
<td>8-17+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Celestial Horizons</td>
<td>Allyn &amp; Bacon</td>
<td>14</td>
<td>7-17+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Astronomy: Structure of the Universe</td>
<td>Adam Hilger</td>
<td>13</td>
<td>11-17+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Principles of Astronomy—A Short Version</td>
<td>Allyn &amp; Bacon</td>
<td>11</td>
<td>9-14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Astronomy: The Evolving Universe</td>
<td>Harper &amp; Row</td>
<td>11</td>
<td>7-16</td>
<td>13-15</td>
<td></td>
</tr>
<tr>
<td>New Frontiers in Astronomy (Scientific American Reprints)</td>
<td>Freeman</td>
<td>13</td>
<td>6-16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Astronomy Magazine</td>
<td>AstroMedia Corp.</td>
<td>13</td>
<td>9-17+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sky &amp; Telescope Magazine</td>
<td>Sky Publishing Co.</td>
<td>15</td>
<td>11-17+</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Ibid, (2), 37-54.


---

Fig. 1: The Extended Readability Graph, by Edward Fry, Rutgers University Reading Center. Grade levels shown are approximate.

---

Back Issues of Society Publications in Print

AVAILABLE TO CURRENT MEMBERS

For information, please write to:
Ann Dreas
Manager, Space Shop
Strasenburgh Planetarium
P. O. Box 1480
Rochester, N.Y. 14603
P. R. PEOPLE MAKE ME NERVOUS!

or

(HOW TO ADVERTIZE YOUR PLANETARIUM)

Philip R. Groee

Director

Alexander Brest Planetarium

1025 Gulf Life Drive

Jacksonville, Florida 32207

Regardless of the type, size, ownership or use of your planetarium, it is in someway a “public” planetarium. If you receive funds and/or salary from a city, a school board, or simply charge admission, you are a “public” planetarium.

With each state toying with its own version of “Proposition 13,” planetariums may become one of those nice luxuries that the public can do without. It is imperative that planetariums rely less on state and city funding and more on self-generated revenue. Even school planetariums may have to re-justify their financial existence to their school boards. Advertising and public relations are a necessary means to this end.

(Oh! No! I refuse to become a peddler of hype! . . . I am an “Educator” . . . “Scientist” . . . “P.R. people make me nervous!” . . . They are the people I avoid at parties! . . . On my distrust list, they are right up there with insurance salesmen!)

Well, like it or not, this article is about advertising your planetarium. What follows are a few examples of advertising used successfully at the Alexander Brest Planetarium.

Brochures

Almost every planetarium publishes a yearly brochure. Its function is to provide general information about the planetarium and to provide a schedule of events. During the last five years, I’ve tried a number of formats and have concluded that the most adaptable is the common three- or four-fold, 8½ x 4” brochure. It is the same format used by every major tourist attraction in the U. S. For this reason, it fits almost every information rack used in hotels, motels, tourist, and city information centers and state Welcome Centers. Other formats may be more innovative, even more attractive, but hotel, motel, and tourist center managers are reluctant to display any brochure that does not fit their brochure racks.

I am always in awe of other planetariums that can plan their entire program schedule a year in advance. But, I’ve noticed that many such schedules are changed in the course of a year, with “Cancelled” or “Held Over” stamped over them. After all, what is the point of providing a schedule if it is not going to be accurate. Many planetarium directors tell me they hate the year schedule, because it locks them into programs that may not reflect current interests. Unfortunately, many planetariums are allowed only one major printing a year.

To solve this problem, we divided our schedule into four three-month schedules, corresponding to the change in seasons. We print one major brochure each year. This brochure contains the usual general descriptions of facility and programs, as well as our twenty-four-hour STAR-LINE phone number. Inserted in this brochure is a card (8½ x 3-7/8) printed on inexpensive paper, with one color ink. This schedule card provides an accurate description and schedule of programs offered in the next three months.

Posters

While some people still read posters, I find them a very ineffective way to reach the public. Large posters are expensive and small ones are lost on bulletin boards and stores. The few posters printed for us were donated by organizations or individuals. Posters are “nice” if you have the money. Otherwise, don’t bother with them.

New Releases

I get tired of hearing from organizations and planetariums on how news media misprint or misinterpret their news releases. Look at it from their point of view: You send a two-page news release to all of the newspapers and radio and T.V. stations. To fit their space, the newspaper cuts your copy to one paragraph, usually leaving out some important information.

Radio and T.V. stations edit your copy to 10-, 20-, or 30-second spots. Naturally, there is something lost between your copy and what they air.

Make your news release brief, never longer than three-fourths of a page, double spaced. A half page of who, what, where, and when is more likely to survive the editing of newspaper and radio. The less edited, the more accurate the final Public Service Announcement (PSA).

P.S.A.’s

Contrary to popular opinion, T.V. and radio stations are not required to air your P.S.A. They are required by the F.C.C. to show community service by airing (free of charge) information about community organizations, not necessarily your organization.

The Golden Rule of P.S.A.’s is, “The easier you make it for a station to produce a P.S.A., the more likely you will get one and the more often it will be aired.”

You make it easy for them by:

1. providing short clean copy exactly the appropriate length (10 sec., 20 sec., 30 sec., and 60 sec.).
2. providing artwork, graphics, and photos of your planetarium in slide format (remember a T.V. station only transmits 85% of the slide area).
3. provide a copy of the appropriate music, either on a record or tape (most stations use 1/2 track tape decks).
4. be flexible; remember they are giving up

Continued on Pages 15 and 16
This part of the survey is based upon a total return of 84 completed survey forms. Approximately 500 survey forms were mailed out. One hundred and twenty-three were returned, of which 84 were completed correctly. This analysis is designed to determine the present operating status of 84 planetaria throughout North America.

STATISTICAL ANALYSIS

<table>
<thead>
<tr>
<th>Planetarium Status</th>
<th>Number</th>
<th>Percent of Total Surveyed</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. School Related</td>
<td>39</td>
<td>46.4%</td>
</tr>
<tr>
<td>B. College or University Related</td>
<td>22</td>
<td>26.2%</td>
</tr>
<tr>
<td>C. Museum Related</td>
<td>23</td>
<td>27.4%</td>
</tr>
<tr>
<td>D. Civic Center</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>E. Other Related</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>84</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Admission Charges</th>
<th>Number</th>
<th>Percent of Total Surveyed</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Charge Applicable for School Students</td>
<td>43</td>
<td>51.0%</td>
</tr>
<tr>
<td>B. Charge Applicable for Adults</td>
<td>41</td>
<td>49.0%</td>
</tr>
<tr>
<td>C. Av. No. of Planetariums Charging Admission</td>
<td>42</td>
<td>50.0%</td>
</tr>
<tr>
<td>D. Av. No. of Planetariums with No Admission Charge</td>
<td>42</td>
<td>50.0%</td>
</tr>
<tr>
<td>E. Av. Charge for Students</td>
<td>$0.60</td>
<td></td>
</tr>
<tr>
<td>F. Av. Charge for Adults</td>
<td>$1.10</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>84</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Average No. of Programs Presented Per 7 Day Week</th>
<th>Number</th>
<th>Percent of Total Programs Presented</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Public Program Presented</td>
<td>4</td>
<td>29.0%</td>
</tr>
<tr>
<td>B. School Program Presented</td>
<td>9.9</td>
<td>71.0%</td>
</tr>
<tr>
<td>C. Total Av. No. of Programs</td>
<td>13.9</td>
<td>100.0%</td>
</tr>
<tr>
<td>D. No. of Planetariums Presenting Public Programs</td>
<td>73</td>
<td>87.0%</td>
</tr>
<tr>
<td>E. No. of Planetariums Not Presenting Public Programs</td>
<td>11</td>
<td>13.0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Categorical Attendance Analysis</th>
<th>Number</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Kindergarten through Eighth Grade</td>
<td>1,205,553</td>
<td>33.8%</td>
</tr>
<tr>
<td>B. Ninth through Twelfth Grade</td>
<td>268,775</td>
<td>7.3%</td>
</tr>
<tr>
<td>C. College or University</td>
<td>110,459</td>
<td>3.1%</td>
</tr>
<tr>
<td>D. Public Program</td>
<td>1,485,335</td>
<td>41.6%</td>
</tr>
<tr>
<td>E. Other (Organized Groups)</td>
<td>498,288</td>
<td>14.0%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>3,568,410</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Groce: Continued from Page 14

...passes to your installation. Their visit will make them better informed about your planetarium. And it doesn't hurt to occasionally thank them in writing for their help.

The Chamber of Commerce Needs You!

Your Chamber of Commerce, your Rotary Club, and other civic groups are there to help sell your city's cultural and educational advantages to businesses. A planetarium is a strong selling point. Ask these civic groups to help inform your community about your planetarium.
This statistical analysis is based on the 1977 Planetarium Directory as printed by William Lazerus and Tom Fleming, Gibbs Planetarium, Columbia, South Carolina. This projection is designed to determine the present operating status of the 919 planetariums listed as in existence by the 1977 Planetarium Directory through the use of the previous random sampling of planetariums throughout North America.

### STATISTICAL ANALYSIS

<table>
<thead>
<tr>
<th>I Planetarium Status</th>
<th>Number</th>
<th>Percent of Total Surveyed</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. School Related</td>
<td>426</td>
<td>46.4%</td>
</tr>
<tr>
<td>B. College or University Related</td>
<td>241</td>
<td>26.2%</td>
</tr>
<tr>
<td>C. Museum Related</td>
<td>252</td>
<td>27.4%</td>
</tr>
<tr>
<td>D. Civic Center</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E. Other Related</td>
<td>919</td>
<td>100.0%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>919</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>II Admission Charges</th>
<th>Number</th>
<th>Percent of Total Programs Presented</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Charge Applicable for School Students</td>
<td>469</td>
<td>51.0%</td>
</tr>
<tr>
<td>B. Charge Applicable for Adults</td>
<td>450</td>
<td>49.0%</td>
</tr>
<tr>
<td>C. Av. No. of Planetariums Charging Admission</td>
<td>460</td>
<td>50.0%</td>
</tr>
<tr>
<td>E. Av. Charge for Students</td>
<td>.60</td>
<td>100.0%</td>
</tr>
<tr>
<td>F. Av. Charge for Adults</td>
<td>1.10</td>
<td>100.0%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>919</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>III Average No. of Programs Presented Per 7 Day Week</th>
<th>Number</th>
<th>Percent of Total Programs Presented</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Public Programs Presented</td>
<td>267</td>
<td>29.0%</td>
</tr>
<tr>
<td>B. School Programs Presented</td>
<td>652</td>
<td>71.0%</td>
</tr>
<tr>
<td>C. Total Av. No. of Programs Presented</td>
<td>13.9</td>
<td>100.0%</td>
</tr>
<tr>
<td>D. No. of Planetariums Presenting Public Programs</td>
<td>800</td>
<td>87.0%</td>
</tr>
<tr>
<td>E. No. of Planetariums Not Presenting Public Programs</td>
<td>119</td>
<td>13.0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IV Categorical Attendance Analysis</th>
<th>Total Planetarium Number</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Kindergarten through Eighth</td>
<td>13,195,533</td>
<td>33.8%</td>
</tr>
<tr>
<td>B. Ninth through Twelfth Grade</td>
<td>2,928,003</td>
<td>7.5%</td>
</tr>
<tr>
<td>C. College or University</td>
<td>1,210,241</td>
<td>3.1%</td>
</tr>
<tr>
<td>D. Public Program</td>
<td>16,240,656</td>
<td>41.6%</td>
</tr>
<tr>
<td>E. Other (Organized Groups)</td>
<td>5,465,606</td>
<td>14.0%</td>
</tr>
<tr>
<td><strong>TOTAL ATTENDANCE</strong></td>
<td>39,040,039</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Respectfully,
James A. Hooks

---

Alexander Graham Bell Answers Our Phone!

The best advertising investment we have ever made, is our STAR-LINE. Dial 398–STAR (7827) and a pre-recorded voice tells you the latest program schedule twenty-four hours, every day. Bell Telephone operates our answering service for a total cost of $600/year. It is called an average of 630 times per week. There are answering devices that can be attached to your phone for a good deal less, but you still have to pay for the phone line. Regardless of which you use, it is a marvelous way to tell the public about your shows.

So What!

Anyone can "hype" a planetarium! Getting people to come to your planetarium is no great accomplishment, if they don't come back. Whatever you promise you must deliver. Don't advertise the end of the universe unless you are prepared to blow up your star projector! The best way to get people into your chamber is to present good programs. Word of mouth is still the best advertising. The successful planetarium is the one that gives the best programs, not the best commercials.
This statistical analysis is based on the 1977 Planetarium Directory as printed by William Lazerus and Tom Fleming, Gibbs Planetarium, Columbia, South Carolina. This projection is designed to determine the present operating status of the 919 planetariums listed in existence by the 1977 Planetarium Directory through the use of the previous random sampling of planetariums throughout North America.

### STATISTICAL ANALYSIS

<table>
<thead>
<tr>
<th>I. Planetarium Status</th>
<th>Number</th>
<th>Percent of Total Surveyed</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. School Related</td>
<td>426</td>
<td>46.4%</td>
</tr>
<tr>
<td>B. College or University Related</td>
<td>241</td>
<td>26.2%</td>
</tr>
<tr>
<td>C. Museum Related</td>
<td>252</td>
<td>27.4%</td>
</tr>
<tr>
<td>D. Civic Center</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>E. Other Related</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>919</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>II. Admission Charges</th>
<th>Number</th>
<th>Percent of Total Surveyed</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Charge Applicable for School Students</td>
<td>469</td>
<td>51.0%</td>
</tr>
<tr>
<td>B. Charge Applicable for Adults</td>
<td>450</td>
<td>49.0%</td>
</tr>
<tr>
<td>C. Av. No. of Planetariums Charging Admission</td>
<td>460</td>
<td>50.0%</td>
</tr>
<tr>
<td>D. Av. No. of Planetariums with No Admission Charge</td>
<td>5</td>
<td>60%</td>
</tr>
<tr>
<td>E. Av. Charge for Students</td>
<td>5,101</td>
<td>50.0%</td>
</tr>
<tr>
<td>F. Av. Charge for Adults</td>
<td>5,101</td>
<td>50.0%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>10,202</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>III. Average No. of Programs Presented Per 7 Day Week</th>
<th>Number</th>
<th>Percent of Total Programs Presented</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Public Program Presented</td>
<td>267</td>
<td>29.0%</td>
</tr>
<tr>
<td>B. School Programs Presented</td>
<td>652</td>
<td>71.0%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>919</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IV. Categorical Attendance Analysis</th>
<th>Number</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Kindergarten through Eighth Grade</td>
<td>14,359</td>
<td>33.8%</td>
</tr>
<tr>
<td>B. Ninth through Twelfth Grade</td>
<td>3,186</td>
<td>7.5%</td>
</tr>
<tr>
<td>C. College or University</td>
<td>3,131</td>
<td>3.1%</td>
</tr>
<tr>
<td>D. Public Program</td>
<td>17,672</td>
<td>41.6%</td>
</tr>
<tr>
<td>E. Other (Organized Groups)</td>
<td>13,159</td>
<td>30.0%</td>
</tr>
<tr>
<td><strong>TOTAL ATTENDANCE</strong></td>
<td>42,481</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

---

**Alexander Graham Bell Answers Our Phone!**

The best advertising investment we have ever made, is our **STAR-LINE**. Dial **398-STAR** (7827) and a pre-recorded voice tells you the latest program schedule twenty-four hours, every day, Bell Telephone operates our answering service for a total cost of $600/Year. It is called an average of 360 times per week. There are answering devices that can be attached to your phone for a good deal less, but you still have to pay for the phone line. Regardless of which you use, it is a marvelous way to tell the public about your shows.

| So What? | Anyone can “hype” a planetarium! Getting people to come to your planetarium is no great accomplishment, if they don’t come back. Whatever promise you must deliver. Don’t advertise the end of the universe unless you are prepared to blow up your star projector! The best way to get people into your chamber is to present good programs. Word of mouth is still the best advertising. The successful planetarium is the one that gives the best programs, not the best commercials. |

---

P.S. One hundred and twenty-three were returned, of which 84 were completed correctly. Approximately 500 survey forms were mailed out. 

---

Robert W. Graham, President.

---

Respectfully,

James A. Hooks
A successful public planetarium show is one which pleases the audience it is serving. In order to please your audience, you must know who they are.

Before you write or design your next planetarium show, stop and ask yourself, “Who am I really trying to please, myself or my audience?” If your show is designed to please yourself and your staff, there is an even chance that it will not please your audience. If your audience is not satisfied with your presentation, you are not doing a good job.

**FIND OUT WHO YOUR AUDIENCE IS**

To design a show to fit your audience you must first know who they are and what they are expecting from you. It is easy to get to know your audience: look at them. Listen to them as they enter and leave your chamber. What age are they? Are their children with them? What are they talking about? As they enter, does it sound like they are looking forward to the show? As they leave, does it sound like they enjoyed the show? Which parts of the show are they talking about?

A formal written survey is an even better way of finding out about your audience. Ask them about their educational background, their astronomy background, their likes and their interests. Try to find out what they are expecting from you.

**DECIDE ON A TYPE OF SHOW WHICH WILL PLEASE THEM**

After you have a clear idea of who is in your audience and what they want to see, you will be able to decide on the type of show to give them. Your type of show must strike a balance between the needs of your audience and the goals of your organization.

Along with public service, the goals of your organization may include: entertainment; education; maximizing attendance; or a combination of all of these. Your audiences may want: diversion and entertainment; science fiction/astrophysics; or introductory astronomy. You will need to develop a type of show which serves the needs of your audience without compromising the basic goals of your organization.

**MAKE SURE YOUR MATERIAL IS AT THE CORRECT LEVEL**

Once your type of show is decided, you need to plan the “educational level” of your material. Whether you are going to entertain or teach your audience, you must have your material at a level understandable to them. An entertaining science fiction story which involves the Big Bang and super novae may totally confuse an audience who has never had an introduction to these ideas. Your concepts must also be as realistic as possible; discussing the constellation of Orion in the summer will frustrate someone who looks for it in the sky that same evening.

**TAPE OR LIVE?**

Whether your show is taped or live depends mostly on your equipment, budget, and staffing potentials. Make sure that you are selecting the best option for your audience, and not just the easiest or most enjoyable for yourself. If you are sincerely trying to provide the best show for your audience, and you are taping an informational program, you will be willing to update it as often as new discoveries occur, which may be as often as every six months. If you have not put your audience first in your priorities, you will most likely see no need to update your program, and will not be doing a very good job.

**SHOW TOPICS CHANGE AS OFTEN AS YOUR AUDIENCE REPEATES ITSELF**

If your audience is always composed of new visitors, your topic need not change with the exception of updating with new information. On the other hand, if your audience is composed of people who return each month, your topic will have to change that often.

**YOU CANNOT PLEASE EVERYONE, BUT YOU CAN PLEASE A LARGE MAJORITY**

It is extremely important that each of us dedicate ourselves to serving and pleasing the large majority of our audience. We all desire respect for our profession. To gain this respect, the public we serve must have a positive attitude toward planetariums and their potential. No respect will be gained for us if we leave people confused and dissatisfied.

Whatever type of show you do, do it to please your audience, and do it well. Please, for the benefit of all of us, think seriously about your public shows, today.
“PANORAMAS”

James Brown

Norwood City Schools Planetarium
2020 Sherman Avenue
Norwood, Ohio 45212

You walk into the planetarium and find a seat. The room darkens and the lecturer begins his program. Today's program is called, "Stars of Egypt." The lights fade into darkness and one by one the tiny points of light begin to make their appearance on the dome overhead. The narrator tells you that this is the sky as seen from Egypt, the way it was 2000 years ago. But all you can see is a sky full of what seems countless stars, and, below that, a very dark room. Where is all this? How much more effective this program would have been if when we first came in, there on the dome were sand dunes and pyramids! The director would have set the stage for the program without even a word! Panoramas, or horizons, can be one of the most effective special effects that can be used in the planetarium. The possibilities are almost as endless as your imagination. Mars, the Moon, the Hills of Bethlehem, the Sun, alien planets, the Earth and various observatories are just a few that are available. But there are some problems. First of all there are very few people who produce commercially available panoramas. Secondly, most small planetariums cannot afford the money for projectors to show panoramas, let alone buy a full panorama that costs over $100. Let me deal with each problem and offer some possible suggestions.

In trying to locate commercially available panoramas, I found first the full and partial horizons offered by the Strasenburgh Planetarium, Rochester, New York. Their list of full panoramas, 12 slides, follows:

1. Moon
2. Mars (up-dated with Viking I photos)
3. Swammy Venus
4. Desert Venus
5. Planet “W” (black and white)
6. Planet “X”
7. Planet “Y” (see Fig. 1)
8. Planet “Z”
9. Hypothetical populated planet
10. Cloisters
11. Hill of Judea—Bethlehem in distance
12. Bethlehem
13. Molten Earth
14. Primordial Sea

15. Stylized Jungle
16. Stonehenge
17. Ancient Egypt
18. Classical Greece
19. Rio de Janeiro
20. Solar surface in hydrogen light
21. Rural scene (Earth)
22. Antarctica
23. Cape Canaveral

They also have a nice selection of partial panoramas. These range from Kitt Peak to cords of the Earth and Mercury. Prices and payment policy is that any single slide will cost you $7.50. Partial panoramas are $75.00, and a 12-section panorama will run you $100.

Another source for panoramas, if you are counting your pennies (and who isn’t these days!), are the partial panoramas offered in the Hansen Planetarium programs. Hansen panoramas are 2-, 3-, and 4-slide partials. They also have some 6-slide partials of the moon that are very good. Indian monuments, meadows, Mars, sequential views of the developing Earth, Greenbank Radio Observatory, and spaceship viewing screens are some that are found in their programs. If you have received these programs and have copies, then you already possess these horizons. If not, I suggest that you write to Hansen Planetarium of Salt Lake City, Utah, and request the programs for copy or purchase. In this case, for the small planetarium on a tight budget, the price is right!

There are some other major planetariums that produce their own panoramas, and in some cases are willing to share these with interested planetariums for the cost of duplication. If you are located near such a facility, see if they will share these with you.

In my search for panoramas I found a lack of sources from which to purchase them. I feel that there is a great need for this type of service within the planetarium community.

If you are a small planetarium that does not have projectors that can be spared for a panorama, I make this suggestion: Get in touch with your local media department (school, college, etc.) and try to obtain any and all projectors that they have marked for disposal. It is quite surprising how many can be made to work as single slide projectors. Another source of projectors is Edmund Scientific Co. They sell a 500-watt, single-slide projector for $59.95. 500-Watts is too much light for the planetarium, but the lamp itself can be changed with one of only 150W. This conversion requires that the lamp base be raised, but the total conversion requires less than 20 minutes. If you are fortunate to have a few of the TMC or similar 100W single-slide projectors, then you are all set.

Panoramas can offer such a dynamic addition to any planetarium presentation, that, I think, we should all try to include them in our programs.
PUT SOME EXCITEMENT IN YOUR PLANETARIUM—
WITH ASTRONOMY

Clarence H. Annett
Michael K. Boss
Kansas State University Planetarium
Manhattan, Kansas

Introduction

Since the first planetarium in America opened its doors in 1930, both the philosophy and the equipment used in planetariums have changed rapidly. Whereas originally the planetarium was wholly a "sky theater," which one attended only to learn about the stars and constellations, planetarium shows today encompass a wide variety of subjects, running the whole gamut from educational to pure entertainment. In many cases, astronomy has totally disappeared from the planetarium's agenda. Science fiction, lasers and light shows, wide-screen panoramic scenes, and even old movies and nostalgia are projected on the domes, which formerly displayed only the stars, planets and other wonders of the heavens.

Part of this change is traceable to "modern living"; television, night clubs, theaters, and drive-in movies have given the planetarium serious competition as an entertainment medium. Since our lifestyles inherently involve more leisure time activities than before, it is more difficult to get people excited about coming to a planetarium. In addition, the stars can (but do not have to) be a very dry and unexciting subject if not presented properly.

Furthermore, even though research is increasing our knowledge of the heavens all the time, there are only a finite number of things which can be said about the stars and the planets. Thus the people who come to a planetarium show don't come back for another unless a new approach is available which will give them additional excitement and new experiences. While this was the original reason for putting science fiction shows into the planetarium repertory, even those shows seem to be falling on hard times because of the availability of Star Trek, The Time Tunnel, and other "top-grade" science fiction series on television (as well as the ex-theater movies like The Andromeda Strain which make the early-evening viewing list).

And finally, add to this the reluctance of the general public to attend anything "educational" unless they are forced to by law. The modern public simply doesn't want to be educated; it wants to be entertained. These powerful stimuli to entertain and excite have pushed planetarium programs away from astronomical subjects simply in order to survive. However, this is not a healthy trend, as the question now becomes "What next?" What will planetariums do when the public grows tired of the current generation of offerings (or becomes too offended by such controversial shows as Isaac Asimov's "The Last Question")? And if the planetariums shirk their duty to provide astronomical learning experiences, what will become of astronomy?

A Brief Classification of Planetarium Programs

It is difficult to survey all the types of planetarium programs now in use, simply because there are so many planetariums. However, before proceeding further, it is useful to try to classify the general topics used for planetarium programs. These general topics, although finite in number, are found in an infinite number of forms according to the ingenuity of the author(s) of the show, the facilities of the planetarium, and the type of show demanded by the local environment. This is not meant to be a rigorous, final classification; it is only a brief one which the authors have found useful.

To begin with, shows for smaller children (sixth grade and younger) are usually quite stereotyped. They are nearly always live shows about single astronomical subjects (why we have day and night, why the stars move across the sky, etc.) or about some aspect of earth-space science. Because of the limited attention span of children in this age group, such shows are usually short and limited to one topic. The only variation on this general pattern is the use of background music by some lecturers. Since these shows generally follow this standard form very closely, they will not be discussed further in this paper.

Shows for older children, teenagers, and adults are quite a different story. These programs may be found in infinite variety, but they all seem to fit conveniently into four broad categories:

Type I shows are programs with astronomy as the central theme. They are primarily intended to be educational, although the entertainment aspect must not be neglected.

Type II shows are educational programs which involve astronomy only as a secondary purpose. They are usually an attempt to spice up an otherwise dull subject, such as history.

Type III shows are loosely called "thrillers" and are mainly UFO and science fiction programs. Generally no attempt is made to make these educational, although some do have a marginal educational value. Their prime purpose is entertainment.

Type IV shows are programs which have no connection at all, expressed or implied, with astronomy, and use the planetarium only to create a "visual experience." Such programs are designed exclusively for entertainment and generally have no educational value.

Typical subject headings for shows in these classifications are presented in Tables I, II, and III. Note that the grouping is such that proceeding from Type I to Type IV involves moving away from astronomy, away
from education, and toward the type of programs found in many planetariums today. Again, this is not a rigid classification—many shows overlap between classifications (as for instance incorporating both basic astronomy and recent developments into a survey program). Even so, most every planetarium program now in use can be fitted into this classification scheme.

TABLE I

<table>
<thead>
<tr>
<th>Type I—Typical Program Subjects</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Basic Astronomy—Survey</td>
<td></td>
</tr>
<tr>
<td>2. Recent Developments in Astronomy</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Group A</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The Solar System</td>
<td></td>
</tr>
<tr>
<td>2. Individual Planets (Mars, Earth, Moon are most popular)</td>
<td></td>
</tr>
<tr>
<td>3. Comets, Asteroids, Meteors</td>
<td></td>
</tr>
<tr>
<td>4. Eclipses</td>
<td></td>
</tr>
<tr>
<td>5. The Outer Planets</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Group B</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Constellations—General Survey</td>
<td></td>
</tr>
<tr>
<td>2. Seasonal Constellations</td>
<td></td>
</tr>
<tr>
<td>3. Changes in Sky with Time and Location; Motion</td>
<td></td>
</tr>
<tr>
<td>4. Mythology—Greek, Egyptian, Chinese, American Indian</td>
<td></td>
</tr>
<tr>
<td>5. The Astronomy of Astrology</td>
<td></td>
</tr>
<tr>
<td>6. The Sky Over Your Town</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Group C</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The Stars—Stellar Evolution</td>
<td></td>
</tr>
<tr>
<td>2. The Sun</td>
<td></td>
</tr>
<tr>
<td>3. Deep Space Wonders—Nebulae, Clusters, Black Holes, Novae/Supernovae</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Group D</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Tools of the Astronomer (part thereof)</td>
<td></td>
</tr>
<tr>
<td>2. History of Astronomy (or some part thereof)</td>
<td></td>
</tr>
<tr>
<td>3. Space Travel—Manned, Probes</td>
<td></td>
</tr>
<tr>
<td>4. Celestial Navigation</td>
<td></td>
</tr>
<tr>
<td>5. Stonehenge and other Ancient Observatories (Archaeoastronomy)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Group E</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Life in the Universe</td>
<td></td>
</tr>
<tr>
<td>2. Exobiology</td>
<td></td>
</tr>
<tr>
<td>3. Interstellar Molecules</td>
<td></td>
</tr>
<tr>
<td>4. Evolution of the Universe</td>
<td></td>
</tr>
</tbody>
</table>

TABLE II

<table>
<thead>
<tr>
<th>Type II—Typical Program Subjects</th>
<th></th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Group A</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Seasonal Holidays Related to Stars</td>
<td></td>
</tr>
<tr>
<td>1. Christmas</td>
<td></td>
</tr>
<tr>
<td>2. Easter</td>
<td></td>
</tr>
<tr>
<td>3. Columbus Day</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type III Typical Program Subjects</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. UFO’s</td>
<td></td>
</tr>
<tr>
<td>2. Science Fiction Shows Founded in Facts</td>
<td></td>
</tr>
<tr>
<td>3. General Science Fiction Shows (Quasi-Factual)</td>
<td></td>
</tr>
<tr>
<td>4. Non-Factual Science Fiction Shows</td>
<td></td>
</tr>
<tr>
<td>5. Controversial Science Fiction Shows (e.g., Asimov’s “The Last Question”</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type IV “Typical” Program Subjects</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Light Shows</td>
<td></td>
</tr>
<tr>
<td>2. “Laserium”*</td>
<td></td>
</tr>
<tr>
<td>3. Multi-Media “Extravaganzas”</td>
<td></td>
</tr>
<tr>
<td>4. Horror Movies</td>
<td></td>
</tr>
<tr>
<td>5. Terrestrial Panoramas/Wide-Screen Presentations</td>
<td></td>
</tr>
<tr>
<td>6. Patriotic Presentations</td>
<td></td>
</tr>
<tr>
<td>7. Old Movies, Nostalgia</td>
<td></td>
</tr>
</tbody>
</table>

**“Laserium” is the copyrighted name for the Laser Light Show produced by Laser Images, Inc., Van Nuys, California.**

The Kansas State University Planetarium Experience

About a year ago, it became necessary for us to reassess the position and philosophy of the planetarium at Kansas State University. Serving a community of about 40,000 and a college of about 18,000, the planetarium was faced with low attendance, a small budget, limited equipment (a Spitz A3P projector with numerous auxiliary projectors, 20’ dome, and seating capacity of 48
Adults or 65 children), and a small all-volunteer staff. Drastic steps had to be taken if the planetarium was to remain in business. Furthermore, a law regarding state agencies prevented us from charging admission, so no funds were available to us for advertising. This effectively meant that we had to depend on word-of-mouth for advertising, which required us to have shows that were exciting and entertaining as well as educational.

We had previously put together at least one show of each major type, so we sat back and evaluated our options. It was decided to revert to an entire library of Type I shows, and to emphasize the educational aspects of astronomy. Our shows from Types III (UFO’s and Science Fiction) and IV were scrapped entirely, and our Indian legends show (Type II) was rewritten and revised. In Type I, we tried to write a show (or rewrite an existing show, in some cases) from each of the major subgroups which was dramatic and emphasized that aspect of astronomy. The shows we have written to date are listed in Table IV, along with a brief description of their content. Also included are the shows currently being written or rewritten which have not been completed yet. It should be noted that because of a lack of financial resources, all our shows are written and produced by our own staff (primarily the two authors).

Above all, a commitment was made to put good science and good astronomy first. The authors share a basic belief that there is nothing more exciting or challenging than the truth about the Universe and all the things which compose it, from the naked-eye-visible twinkling stars to the unimaginable black hole, and we set about to convey this excitement and challenge to our audiences. Education is our main objective, but the entertainment value of our shows is what brings the audiences back again and again.

A rigorous implementation of this philosophy has resulted in 1975-76 season being a record year for the KSU Planetarium, with the total number of persons viewing our shows being the largest ever. In addition, the word-of-mouth advertising generated has been so effective that we are not able to schedule all the shows requested; there just isn’t enough time. In the remainder of this paper, we would like to share a few of our ideas with you, and urge you to adopt a “back to astronomy” policy for your planetarium.

General Remarks on Producing a Good Show

Live shows should be avoided, except for special cases (i.e., the U. S. Army Field Artillery School Advanced Map & Compass Training Class) and children’s programs. Whenever possible and appropriate, live shows should be accompanied by a suitable musical background. (Of course, all operators should be sufficiently well-versed in astronomy that they can give a live show on the spur of the moment—such as when unexpected VIP’s arrive or the planetarium projector breaks down in front of an audience!) Every show should be followed by a short question-and-answer period.

It is important to use as much of the 360° of your dome as possible for visual effects. If all the slides for a show are projected into one spot or one area on the dome, the show quickly becomes boring. Slides should be carefully opaqued so that they do not look like slides; that is, so no border shows. A properly-opaqued slide will cause the image to appear to be floating in the sea of blackness between the stars. Kodak opaque paint is applied directly onto the slide with a small brush (and a steady hand), for best results.

Think carefully about where your slides are being projected! A picture of a radio telescope floating in mid-air isn’t realistic—it should be placed down or near the horizon line. Do not use black-and-white slides if you can avoid it—color is more exciting (this is where a good artist comes in handy—he can often add semi-transparent color to a slide, or simply repaint the scene in color and photograph it).

Keep your shows short. Between 20 and 30 minutes is a good length for most shows. If a show runs much longer, you may have to work hard to keep your audience’s attention.

Don’t let your planetarium get too cold or too hot. People will not want to return to an uncomfortable place.

Music, Art, and All That

Producing a taped show requires a good narrator. College English and speech/drama departments are
excellent sources of good voices, and they will often work for free. An even better source is a radio or TV disc jockey. The best voice for a planetarium show is one which is deep and resonant. Before you let your narrator make your tape, be sure he knows how to pronounce every word in your script (don’t take it for granted that he can figure out Aristarchus, Betelgeuse, Andromeda, and other such words which are commonplace to an astronomer).

Pick a good title for your show. The title should be catchy but not misleading. For instance, it is clear that the second title in each of these pairs is more appealing:4.1. “The Solar System” or “Children of the Sun”
1. “The Solar System” or “Children of the Sun”
2. “Meteorites” or “Fire in the Sky”
3. “Mythology” or “Kingdom in the Sky”
4. “The Stars Over My Town” or “Nightfall”
5. “The Constellations” “Picture the Stars”

And be sure your script is 100% scientifically correct before you produce it!

In choosing music, the classics are your best source. Use vocal music sparingly; instrumentals are most often the best. Modern music (with a few exceptions) and rock music (with no exceptions) have no place in our planetarium—both detract from our primary purpose of education. Good lists of music are available elsewhere, so we will not expand on them here. Whatever music you choose, don’t play it too loud. Excessive volume will ruin anything. Pre-show and post-show music are a must!

A few words about artwork are in order. Artwork depicting celestial objects (nebulae, planets, galaxies, etc.) is sometimes necessary because the objects themselves are so hard to photograph. Much artwork found in such popular magazines tends to be very “Hollywood” and over-detailed. Your audience probably will not appreciate artwork that they can clearly tell is artwork; realism is the key word, without excessive detail. Avoid pastel colors. A good airbrush is useful in creating color reproductions of black-and-white astronomical photographs.

The final ingredient in a successful show is the operator (or author) himself. Use your planetarium to its utmost, and be professional in your approach to it. Remember that Outstanding Presentations are more the result of the creative ability of those who dream them up than the cost and sophistication of the equipment used to present them5—and that goes for presenting the show, too. If the operator has no understanding of basic astronomy, he can cause an entire show to flop because he cannot answer a question at the end.

Conclusion

Most of these hints are just common sense. When they are all integrated together, however, and coupled with a commitment to astronomy education, they can be a key to success. The time is right to answer the question of “What next?” and we believe that the answer lies in presenting good astronomy so that everyone can share in the wonders of the universe. Controversy will never be a problem if a program of astronomy is adhered to faithfully, and the rewards and benefits will soon become apparent to both operators and audiences.

REFERENCES

1. The first planetarium in the U.S. was Adler Planetarium in Chicago, which opened on May 5, 1930. See Max L. Ary, in The Planetarian Vol. 3, Nos. 1 and 2 (Spring/Summer, 1974), p. 11.
2. Isaac Asimov’s “The Last Question” is a science-fiction planetarium show dealing with the hypothetical question of what would happen if the Universe ran out of energy. It has been shown at several planetariums, and many people have found it quite offensive because it appears to directly attack some of the principles and precepts of the Christian faith.
3. In 1974, ISPE reported that there were more than 700 planetariums.
4. Some of these are borrowed from Von Del Chamberlin, The Planetarian Vol. 1, #1 (June 31, 1972), p. 18.

Special thanks is extended to the Physics Department of Kansas State University for continuing support of the planetarium, and to Roger Facklam for assistance in developing this program for the planetarium.

†Present address: Omnisphere Planetarium and Earth-Space Center, Wichita, Kansas.
SMALL GROUP UTILIZATION OF PLANETARIUM WHEN BUDGET CUTS CREATE LARGE GROUPS

Gerald L. Mallon

Planetary Director
Methacton School District
Fairview Village, PA 19403

A planetarium with a twenty to thirty foot dome can usually accommodate a group of sixty or more people, in the chamber. However, if this planetarium is one of the many school district facilities found in the United States today, and has education as its main purpose, it can be argued that such a large group cannot be as effectively taught in the facility as a smaller one. Such an argument was offered to the Methacton School District, and agreed upon, when the district’s planetarium first began. However, as time went on, fiscal problems developed and eventually the School Board decreed that, in order to cut the budget, all transportation to the planetarium should now involve two classes (approximately sixty students) and no longer just one.

This move, involving all classes from Kindergarten through twelfth grade, caused a monumental dilemma for the director and the curriculum’s inherent emphasis and concern for the individual. The School Board’s order was district policy and therefore had to be followed, and yet a brief review of research on class size overwhelmingly indicates that smaller classes are educationally more valuable than larger ones.** For example, Steven F. Bolander of Colorado State University, in his study, “Class Size and Levels of Student Motivation,” found that “smaller classes did bring about improved individual, intragroup lateral, and intragroup vertical motivation levels.” Also, Theodore Caplow in his article, “Organization Size,” offers a discussion of the ways in which interaction possibilities are affected by different class sizes. Other studies could be cited but as Bolander points out, “the general implications of these studies (would) show that as the size of the group increases, there is increasing pressure for the group to disintegrate.”

The literature then would suggest that the best utilization of an educational facility is to work as personally as possible with the students involved. This procedure, after all, would allow for participatory type lessons, for better teacher-student rapport, and for concrete, “hands-on” learning in the planetarium. If there is any question that planetarium lessons should be activity oriented, rather than passive, the recent research study by Harold H. Jaus may answer that. In his study, “Activity Oriented Science: Is It Really Good?” Jaus states, “The results of this study showed that not only did activity oriented science instruction significantly improve children’s attitudes towards science, but their attitude towards school were also significantly improved.” George E. Pitluga professed the same feeling when he stated, “that two or three classes can be 'lectured to' is obvious, that this means poorer learning is patent.”

All of this left the Methacton Planetarium with a seemingly impossible riddle. The School Board said that it must teach two classes, but research said that it cannot “teach” two classes. Hours were spent trying to reach some type of solution to the problem. One possibility was that since the director was the one that scheduled all classes and arranged for the transportation for the groups, the schedule could simply be prepared for one class at a time, but this defiant move would certainly mean the director’s dismissal. Yet if two classes at a time were scheduled, how could the director personally justify such an educationally valueless move?

One day, the idea was laughingly suggested that maybe one class could be sent for a walk around the building, just to get rid of them, thus leaving only one class for the planetarium. Then the laughing stopped. Perhaps it could work. The Board’s decision was that two classes must be transported to and from the planetarium, not that two classes must be in the planetarium at the same time. Of course, they couldn’t be sent for a walk or left on the bus, but if an educationally valid alternative could be prepared, the program might work.

Then a seemingly unrelated item offered a possibility. Because of another budgetary move by the School Board, a resigning Home Economics teacher was not replaced, thus leaving only one teacher in the Home Economics Suite. This suite consists of three rooms; a foods room (kitchen), a sewing room, and a standard classroom. After consultation with the building principal and the remaining Home Economics teacher, it was arranged that the planetarium could use the Home Economics classroom for a total of nine weeks during the school year. Those nine weeks were scattered throughout the year and at different grade levels so that the effects on different age groups could be ascertained. Also, the program was scheduled in such a way that the room was not to be used for more than two consecutive weeks at a time. This allowed the Home Economics teacher to still make use of the room without an overly long waiting period.

The decision to split the groups was only part of the problem however, for it still had to be decided as to what to do with them. After a review of the planetarium curriculum, nine elementary lessons were selected that offered the possibility of being divided into two workable units; one to be handled in the planetarium and one in the classroom. Each lesson had to be carefully examined to determine what would best be done using the planetarium’s unique visual capability, and what could best be done in the classroom.

After this task was accomplished, the problem of how the material was to be presented in the classroom had to be considered. The Methacton School District boasts an excellent and cooperative elementary faculty,
yet there are always going to be problems in simply giving a teacher a lesson plan and asking her/him to cover the concepts outlined there. Feelings of inadequacy, lack of background, interest in the subject, pacing of the lesson, etc. all would combine to make many teachers resent this extra burden and prevent them from adequately teaching the lesson.

It was obvious then, that some way had to be devised to take the burden off the individual teacher but still have the concepts and activities presented to the class. Different possibilities were reviewed. Programmed learning booklets were considered. These could be specifically prepared for each lesson, but the different reading levels of the students involved and the substantial amount of paper needed, made this infeasible. Learning Centers and Games could be prepared but there were certain activities and tasks that the classes should do that would be very difficult to communicate through this medium. One medium, however, that is available in many newer school buildings and usually little used by the planetarium, could communicate to the class the activities they should perform; it could keep the concepts presented constant in all groups and would take the burden off the classroom teacher. That medium is television.

The Arcola Junior High School, to which the Methacton Planetarium is attached, is designed with closed circuit television in every classroom, including the Home Economics rooms. The building also has a fully functioning T.V. studio for production and playback purposes. After discussing the proposal with the district A.V. Coordinator, it was decided that seven videotape programs would be produced for playback in the Home Economics classroom (the other two lessons in the classroom would use commercially produced filmstrips, for comparison with the T.V. programs).

The production of the finished T.V. shows required many hours of work for each thirty minute program. An educational T.V. program obviously has to be more than simply aiming a television camera into a classroom and capturing on videotape the things seen there. Each sentence, phrase, and visual has to be selected with the T.V. and its audience in mind.

After all of the production work was completed on the programs, and the faculty meetings were held to explain the new procedures, the system was implemented. A typical Planetarium-Astronomy Laboratory lesson would progress as follows:

Two classes would board a bus for transport to Arcola Junior High School. After entering the Arcola building, one class would go to the Home Economics Classroom while the other would go to the planetarium. The two groups would spend thirty minutes in their respective rooms and would simultaneously be taught their section of the lesson. The planetarium section would stress the visual aspects of the problem whereas the classroom would stress the mechanics of it. For example, in a lesson on the "Changing Moon," the planetarium group, using star charts and the planetarium sky, plotted the motion and apparent shape of the moon over a four week period and then participated in predicting its phase and position for other times either before or after a given phase. The classroom group in contrast, watched a videotaped program that explained why the moon's shape changed. This utilized various photographs of the moon and a simple and often used demonstration of the moon's orbit. Three students acted out the motion of the moon around the earth using a ball (the Moon) and a projector (the Sun). After this was demonstrated on the T.V., the tape paused for five minutes while the class tried this activity using the same materials. The tape then continued its explanation of the mechanics of phases. Towards the end of the tape, the class was instructed to complete a worksheet that asked them to draw the phase of the moon that would be seen one week after the phase seen on the T.V.

After exactly thirty minutes, the two groups left their original rooms and exchanged places to receive the other half of the program and thus complete their lesson.

The simultaneous teaching system outlined above was used with grades K, 3, 4, and 5 during the 1976-1977 school year. Since this was an experimental procedure for this year, some grades received various types of lessons in order to ascertain the most appropriate. For example, Grade Four made four trips to the planetarium during the year. The first trip saw all sixty students in the Planetarium for a one-hour lesson. The other three trips saw the groups taught simultaneously, but the type of classroom treatment used was varied. The second visit's television program was done in a "documentary" fashion, with no student activity except for a worksheet at the end. The third visit was activity oriented and required the class to perform certain tasks per the instructions on the videotape. The fourth visit used a commercially produced filmstrip which also outlined an activity for the class to perform.

Continued on page 26
Two new astronomy education guides, one for a college course presented primarily in video segments and the other for a workshop intended for college astronomy instructors, have recently become available.

The first is Study Guide for Project: Universe—An Introduction to Astronomy, produced by Coastline Community College (1978), published by Kendall/Hunt for $7.95. The guide supplements a series of 39 color video lessons. A text, Exploring the Cosmos by Louis Berman and J. C. Evans, is to be used with the video series.

I was particularly impressed with the first video segment, "The Astronomer's Universe," which I previewed, courtesy of Cleveland's educational station, WVIZ-TV. In this introduction, an overview of the organization of the universe is given which is reminiscent of the William Shatner-narrated NASA film, "Universe." The series host, Edwin Krupp of Griffith Observatory, and a number of other astronomers express which elements of astronomy have drawn them to study it. I think that this segment can make an outstanding introduction for almost any high school and college astronomy course, regardless of the use of subsequent segments.

Topics in the course proceed from historical perspectives through electromagnetic radiation (also re-introduced in later segments when appropriate), the moon and planets, the sun, stars and their evolution, black holes, extraterrestrial communication, galaxies, the expanding universe, origin of the universe, and relativity.

The excellent Guide, written by Stephen P. Lattanzio and David A. Pierce, begins intriguingly, "This is your study guide. Consider it as you would scripture. It is your educational map through the maze of a discipline—astronomy."

The Guide identifies the objectives of each lesson in behavioral terms. It lists required text reading and suggested reading for the interested student from such sources as Scientific American. An Overview, a vocabulary list of Key Terms and Phrases, required and optional activities, and a Self-Test with thoroughful multiple-choice answers (and key) accompany each lesson.

Information in the Guide and video programs is consistent with the known universe as of Summer, 1978. Pluto's moon and the rings of Uranus find their way into discussion. Within "Jupiter," Lesson 13, the 1979 Voyager flyby of Jupiter is discussed in the future tense. Tables in the Guide give eclipse information until 1983, and planet position information until 1984.

One weakness, from the standpoint of a planetarium educator, is the lack of suggestions for visiting a planetarium to observe such phenomena as the effect of earth rotation and revolution on the earth-based view of the sky, moon phases, and planet motions. Of course, it might have been felt that most public planetariums would not currently be giving programs on such topics. But it ignores the availability of many planetariums in college facilities which could present one or more lessons correlated with the course. In the Guide, visits to planetariums are recommended for the purpose of viewing exhibits such as a Foucault Pendulum and meteorite collections. And it is recommended that planetarium personnel be contacted for information about eclipses.

Perhaps inherent in the nature of the video medium is the tendency to focus on physical characteristics of space bodies and methodology, with low emphasis on the earth-based view of the sky. Although outdoor observing is frequently recommended in the Guide, the concept of the celestial sphere is not well developed, constellations are not discussed, and configurations of planets are not included.

The course does not require high mathematical ability. However, the student should be able to manipulate a simple formula, as some problems are included. The student should be able to conceptualize at a beginning abstract level (the beginning formal thinking processes, as identified by Piaget) to meet course objectives.

Although the series is intended as a survey course for college students, it can be used effectively at the high school level. It might be an ideal solution to offering a relatively small number of able and interested students in a small school district the opportunity to receive a good astronomy course, in the absence of a qualified teacher or the inclination of the district to allocate teacher time for a regular class.

Effective Astronomy Teaching and Student Reasoning Ability is the title of a guide for a college astronomy instructors' workshop. It is written by members of the Task Group on Education in Astronomy (TGEA) of the American Astronomical Society (1978), published by the Lawrence Hall of Science, and distributed by the Astronomical Society of the Pacific. The published guide is based on workshops given in the past year in connection with American Astronomical Society meetings.
The authors, Dennis Schatz, Andrew Fraknoi, R. Robert Robbins, and Charles D. Smith, present a collection of exercises and readings to be worked through by teachers to clarify student reasoning patterns, to understand concrete and formal reasoning patterns as identified by Jean Piaget, and to become familiar with a Piaget-based teaching model advocated by Robert Karplus. In subsequent sections, instructors analyze astronomy reading material, astronomy laboratory activities, and astronomy films from the perspective of the concepts of the preceding sections. Excellent appendices include readings on Piaget's Theory, a resource list of non-text reading material, a resource list of laboratory activities, an annotated list of films suitable for an introductory college course, and a checklist for analyzing teaching materials in view of student reasoning ability.

An outstanding "Workshop Planning Manual for Effective Astronomy Teaching and Student Reasoning Ability" concludes the workshop guide. In this section, one who has found the workshop worthwhile learns precisely how to perpetuate the ideas in another workshop. The planning information is a unique and worthwhile feature.

Although I find the materials generally very good, I have an objection to the grouping of concepts requiring primarily spatial ability with those requiring primarily logical ability. Piaget investigated spatial ability development and logical ability development, including the "concrete" and "formal" levels of logical thinking, in separate studies. There is much additional evidence to demonstrate that spatial and logical problems tap different sets of mental processes. I have just completed a research project (my doctoral study) analyzing the ability of students to learn the relationship between two perspectives (on earth and from space) of common astronomical phenomena. An incidental observation is that some students who perform poorly in the classroom on logical thinking exercises perform exceptionally well on spatial astronomical problems. An activity in the TGEA workshop guide to determine the phases of Martian moons as seen by an observer on Mars can be answered quickly and correctly by some students classified as "low concrete" on the basis of certain logical task responses.

I recommend that astronomy instructors at all levels recognize that certain students, although a minority, possess the combination of high spatial and low logical abilities. This type of student probably has what is known as "right brain dominance." The right side of the brain has been found to be responsible for spatial perception and comprehension, while the left side is responsible for analytical thinking. Many more students, reflecting the different neurophysiological make-up of "left brain dominance," have better logical abilities than spatial abilities. This should also be recognized by astronomy teachers. The two different abilities important to astronomy comprehension, spatial ability and logical ability, must be assessed in students. The extent to which a particular astronomy concept requires one ability or the other should also be analyzed. Teaching methods which match the concept to particular students' abilities can then be applied for effective learning.

---

Footnotes


3 Bolander, loc. cit.


REFERENCES


The special effects in this article are certainly easy to build, and almost everyone has an overhead projector. However, they do require that a dimmer be installed into the lamp circuit and an additional source of power be added. The extra "eceptical can be wired into the fan circuit in the overhead. Now in the words of Roger Grossenbacher, who submitted the following article, "you are ready to build hundreds of dollars worth of special effects out of about $25 worth of motors, scrap wood and metal, using everyday home shop tools."

SIX SPECIAL EFFECTS FOR YOUR OVERHEAD PROJECTOR

Roger Grossenbacher
Peters Planetarium
Lancaster, Ohio 43130

1. A METEOR PROJECTOR uses the same basic design as commercial models except this one is much larger. A motor from 1/2 to 4 R.P.M. is mounted shaft down on a swing arm attached to the wooden platform that sits on top of the Fresnel lens. Figure 1 shows how this mounting can be held firmly to the up-right arm of your projector. The motor is plugged into the extra receptacle. Figure 2 shows the lay-out of the two disks needed. These are best cut from manilla cardboard (file folders) so the slits can be cut cleanly with a sharp knife. Disk A is fixed in place just above the fresnel lens of the projector. Focus the projector on Disk A's radial slits. Just above Disk A attach movable Disk B with a metal or wooden hub and a medium speed motor. The numbers of meteors per minute can be made to suit your needs by adjusting the number of slits in Disk B or the motor speed. The slits in Disk B should be be radial, but offset so the inner end of the rotating slit cuts the radial slit on Disk A before the outer edge does. This guarantees that the meteors move away from a radiant point. The actual speed at which the meteors seem to move can be varied by using a different pattern on Disk B or by varying the motor speed. The motor must be very carefully positioned over the fixed disk to obtain a realistic shower effect. A simpler version of this projector can be made by omitting the motor and spinning the disk by hand.

2. A SOLAR ECLIPS PROJECTOR can be used along with a slide projector with a total eclipse slide to simulate a complete eclipse sequence with considerable realism. Begin by cutting a thin plywood base to cover the entire Fresnel lens of your overhead. Cut a 1½ inch hole in the center of this base and a U-shaped slot in one corner. Glue a thick plywood doubler over the slot. Use a 1/4 inch
round-head bolt, tapped through the doubler, to securely attach the base to the projector’s upright arm for a solid support. Then mount an inexpensive variable iris diaphragm over the hole in the base. Edmunds #42121 or #30118 work well. Mount a very low speed motor (1/15 RPM is a good choice) on a wooden arm with the shaft pointing down. The support arm should be able to swing through a sizable arc in order to make the necessary adjustments to be described later. Attach a five- or six-inch clear plexiglass wheel to the motor shaft with an appropriate hub. Very carefully cut out a few circular “moon disks” of 3/8 inch diameter from thin manilla board and glue these to the bottom of the plexiglass wheel, all at the same distance from the hub. This distance must be rather small (one to two inches) so the speed at which the moon-disk eclipses the iris “sun” is sufficiently slow. Figure 3 shows the arrangement of the parts for this projector. Some trial and error will be necessary to get a satisfactory speed for the moon disk. For total eclipses, the moon disks should be slightly larger than the iris opening. For an annular eclipse, use smaller disks; for partial eclipses, either use disks glued farther from the center of the plastic wheel or move the arm that supports the motor-wheel assembly.

Careful preparation is necessary to produce a convincing total eclipse effect. First, focus the overhead on the moon disk so it is clean and sharp. The moon disk must be aligned to totally cover the iris opening. After this is done, run the wheel backwards by hand until the moon disk is not visible, but is externally tangent to the iris on the right (west) side (it helps to attach the plastic wheel to the motor hub snugly but not permanently). Turn on the overhead and use a slide projector with a zoom lens to throw the image of a totally eclipsed sun onto the same spot as the overhead “sun.” Use the zoom lens to match the size. Turn off the slide projector until it is needed.

To run a total eclipse sequence, play some impressive music (e.g., Mahler’s Fourth Symphony), turn on the overhead and explain what’s about to happen. I usually challenge a high school class familiar with the moon’s motions to predict whether the moon will encroach on the sun’s east or west limb. Then flip the switch to start the low speed motor just as the music builds to a climax. When the moon disk completely covers the iris, turn on your pre-set slide projector and turn off the overhead projector. After talking no more than seven minutes about the wonders of totality, fade the slide projector and turn on the overhead and allow the motor to reveal the sun once more.

A RED GIANT PROJECTOR that simultaneously zooms an image of a round star and causes it to redden can be made from the same plywood base used for an eclipse projector. The zoom effect is produced with the set-up shown in Figure 4. A one RPM motor turns a two-inch diameter metal disk. (Mine is from an old Erector set—a great source of useful parts!) An arm is attached to a hole near the edge of the disk and alternately opens and closes the iris diaphragm. The iris arm extension can be made out of a 3/4 inch length of brass tubing slit
halfway down one side with a razor saw, flattened and drilled on one end. A separate switch mounted on the base allows you to start zooming just when the red giant stage begins.

To effect a color change, mount a very low RPM motor and color wheel in front of the main lens of your projector. The color wheel may be divided into thirds, a third clear, a third yellow, and another third red. The motor speed must be judiciously chosen to match the iris zooming rate so that the star goes from white when smallest, to red when largest. One can judge the sizes of the color sectors to synchronize color and star size, especially when using a very slow (~1/10 RPM) motor on the color wheel. It is not difficult to mount a color wheel at the proper location. Bolt the motor to a six-inch length of wood which is then clamped into a ring-stand test tube holder. The test-tube holder can be clamped onto the metal upright which supports the projection lens. On my projector this support is the same diameter as a standard test tube!

If the projector is allowed to continue operating it can go from red giant to white dwarf as the iris recycles and the color wheel turns back to white again.

4. A SCENE SETTER for fall or winter can show falling leaves or snowflakes. I turn this on before the audience arrives to give them something appropriate to watch. The same motor mounting made for the meteor projector can be adapted by removing the two meteor disks. Draw various shapes and sizes of leaves (or snowflakes) on a nine-inch disk of manilla cardboard and carefully cut out the shapes with a very sharp hobby knife. Ordinary cardboard will not work. The cut edges will be too fuzzy. Cut a kidney-shaped opening in a twelve-inch square piece of cardboard and arrange as shown in Figure 5. A one RPM motor will make the leaves appear high in the dome and arc downward. For more impact I cover the top fourth of the kidney opening with green plastic and the bottom three fourths with orange. This makes the leaves change color as they fall! If care is taken to draw real leaf shapes you may even quiz the viewers on what kind of tree the leaves are from.

5. A RELATIVISTIC STAR FIELD for a high speed space flight might be just the thing for an Einstein birthday show. This is a static effect but a colorful one. It shows how aberration and the Doppler effect would combine to alter the appearance of the sky as seen when traveling near the speed of light. Figure 6 shows the layout to be placed on the Fresnel lens of your projector. Cut an annular ring about one inch wide out of a sheet of cardboard and discard the ring. Hold the two other pieces of cardboard together by taping them to a sheet of plastic. Lay two colored rings over the clear plastic ring, a large red one and a small blue one, leaving a clear gap between. Sandwich a square foot of aluminum foil between two sheets of coarse sandpaper to produce lots of tiny “starry” image holes. Then tape this foil sheet over the transparent ring already prepared. Focus carefully on the foil stars.

This effect shows how little science there is in science fiction movies that purport to show what really fast space flight might look like. The stars won’t fan out in front of the ship and zip past on either side! Turn off your regular planetarium star field and flip on the overhead to show how the stars really crowd together in the forward direction. Most of the sky is empty since the Doppler effect has shifted the stars’ visible wavelengths into the invisible IR or UV ranges. It won’t be as dynamic as Star Wars, but it’s a lot more accurate scientifically!

6. ROTATING GALAXY is Bob Andress’ (Warrensville Heights, Ohio) idea. He inspired me several years ago to try a few tricks with an overhead. Bob mounts a big Edmunds (#40602) lazy susan ball bearing over the Fresnel lens of an overhead projector. A low RPM motor operates as a friction turntable drive and a large size Kodalith negative of a galaxy is centered over the ample opening of the bearing.
Jane's Corner

By Jane P. Geohegan
4100 West Grace Street
Richmond, Virginia 23230

MOON SHOTS. . .

. . .July 1979. Ten years ago, we went to the moon. Yes, to the moon! Landed there, walked about, and lived to tell the tale. Bits of the moon are now appearing in classrooms all over the country via the Lunar Sample Education Project. (It's an excellent package. Write your local NASA center if you would like to participate.)

... Students tell me their grandparents say it didn't happen. We didn't go to the moon. I puzzled over this; then I realized. They (grandparents) saw horses change to cars and cars to planes—all during their own lives. Go to the moon? It's beyond the realm of what one person can accept in one lifetime. We have pushed them to the limit of believability.

... I saw us land on the moon on TV. I was there. I know exactly where I was when I saw it, just as I remember where I was when Kennedy was shot. Kennedy and the moon. Did it all really happen? I'm not sure it did, sometimes. But my elementary students weren't there. They were babies. It's history and we have to teach it in the body of past knowledge called "before your time." How lucky I was to have been there.

... It's all over on the moon, I guess. It's sad, really. When ALSEP was closed down due to lack of money to pay personnel to continually monitor the events, George Hastings, Educational Specialist for NASA at Langley Research Center, said it for us in the following:

NEWS RELEASE NO. 77-203
LUNAR SCIENCE STATIONS CEASE FUNCTIONING
OCTOBER 1, 1977

With all the world waiting, we turned our eyes skyward. Remember that day when we all looked through our electric windows on the universe, seeing old spheres from a new point of view?

Three times again, and again, and again, Descending on dancing flames They scurried slow-motion through ancient dust. Who still now remembers their names?

We did the unthinkable, achieved the impossible, Went where none had preceded, and more. "Ho Hum! Another launch, you say? Is football on channel four?"

Mechanical colonists left behind When we blasted back home in our ships Drew life in their bellies from shattering atoms, Energizing electronic chips.

They sensed the heat of ancient fires, Moon-embers banked deep inside.

They felt the star-bits streaming, And the rumbling silent tide.

ALSEP voices, talking to Earth In chattering bits and bytes, Sent their colonial treasures back Through the lunar days and nights.

They measured the limb-shocked solar winds Changing the charges in sputtered lands, And vibrating signals crossed the void;

Twitching inked fingers on metal hands.

The footprints and tire-tracks, unchanging, remain. Like paths to the future, they glisten.

Solipsistic sentinels converse with themselves, But there's nobody left who will listen.

... G. Hastings
October 1, 1977

See if the following sounds familiar: it's the end of an upper elementary lesson on "Solar System, Survey of." There are several minutes for questions. Kid raises his hand. You've been watching him throughout the lesson. He's obviously really fascinated by the Universe; you can tell. He asks: "How did the planets get here?" He really wants to know; you can tell. Before you know it, you are going into the quick 1-minute, 35-sec. explanation of how the Universe got "put together." He listens, taking it all in; you can tell. No one else is particularly paying attention; students are putting on their coats, ready to go.

The teacher is wondering who it is that made that obscene noise in the dark and what she should do about it. The kids says, slowly, carefully, realizing that he is thinking it for the first time, "w-e-I-I, how did Jesus get put together?" You hadn't mentioned "Jesus" or any other deity; he just really wants to know. Now I really want to know; what would you tell him? Write me; share your ideas.

☆☆☆☆☆☆☆☆

Recently Don Hall from the Strasenburgh Planetarium in Rochester, N.Y., went to visit the McLaughlin Planetarium in nearby Toronto, Ontario. While conversing with the staff there, Tom Clarke said, "I've got something to show you," and disappeared into his office to find it. The McLaughlin had recently staged "Alien Odyssey," one of Strasenburgh's shows which uses a bit of narration by Hall at the beginning.

When Clarke returned from his office, he had in his hand one of more than 800 questionnaires which had been completed by members of the "Alien Odyssey" audience. On the third page of the form was the question, "Was there anything about the show that you didn't like?" And the answer was, "Yes, hearing Don Hall's voice while I'm on vacation."

It seems that the questionnaire was completed by one of Hall's part-time staff members who was trying to get away from it all.  

☆☆☆☆☆☆☆☆

Jane's Corner