

# THE EDUCATIONAL VALUE OF THE PLANETARIUM

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The Great Lakes Planetarium Association here sets forth a synthesis of scientists' and educators' ideas on the value of the planetarium in the educational process. Because the planetarium is an astronomical laboratory, the first question which is addressed is "why study astronomy?" The contributions which the planetarium can make in learning astronomy are next considered. The unique role of the planetarium in education beyond the bounds of strictly astronomy is then discussed. Finally, arrangements which help to optimize the presence of a school planetarium are given.

**The value of all students of learning astronomy.** There are many reasons why astronomy should be included within the K-College curriculum:

1. This is indeed a "Space Age" with daily announcements of achievements and discoveries in the space sciences. As Superintendent Richard Rea of the Western School Corporation, Russiaville, Indiana, stated, "There are now youngsters in Kindergarten who are going to be in space - regularly!" Some of today's students will be directly involved in space activities, but all will be surrounded with space-related events and information.
2. Astronomy is the most fundamental of sciences, as well as the oldest. It gives each individual a perspective on his place in space and time. Man has an intuitive desire to know more about the universe about him, to push back barriers of ignorance and comprehend the mysteries of the greater environment.
3. Astronomy is useful to each individual. Time units have astronomical bases. Standard Time, Daylight Savings Time, the seasons, and the calendar are integral aspects of our social - political culture. Some understanding of the celestial sphere and astronomical motions is useful in estimating time and finding directions.
4. Astronomy has an aesthetic value found in few other subject areas. The intricate and awesome dimensions and composition of the universe can produce the perception that the earth is a delicately balanced ecosystem with limited resources and time existence. An additional source of wonder is that Man of insignificant size has the capability of understanding much about his position in time and space.

5. Astronomy is inextricably linked to energy topics. The sun is the source of fossil fuels, wind, and direct solar energy. Radioactive elements important in nuclear energy and the source of geothermal energy are the remnants of processes once inside stars which ended their lives with tremendous explosions. Tidal energy is caused by the gravitational pull of sun and moon. Probably the important energy discoveries, vital to the continued existence of Technological Man, will depend on knowledge of astronomy as well as of other science areas.
6. Astronomy appears in unexpected places: in fictional as well as non-fictional books, in popular songs, in arts, and the comics. It has been harmfully presented within the pervasive speculative topics of UFO's and astrology. Students mislearn astronomy from the media. The schools have a responsibility to help students critically regard media presentations. To do this effectively, they must include responsible introduction to astronomy in their curriculum.
7. Responsible study of the vast numbers of stars and the process of star formation combined with data from interplanetary space missions can promote constructive thought on great philosophical and psychological questions: Are there other intelligent beings somewhere else in the universe? Is earth alone an abode of life?

**The value of the Planetarium in Astronomy Education.** Astronomy learning can be greatly assisted by use of the planetarium.

1. Any topic involving the appearance of the sky can be viewed in three dimensions. Text and chalkboard diagrams cannot reproduce the omnidirectional perspective of the planetarium. Classroom models normally present an outside - earth perspective, while the planetarium recreates the from - earth perspective.
2. The sky may be viewed comfortably with no interference from bad weather.
3. Students do not need to wait half a day or more after receiving teacher directions for night-sky observations before viewing night-sky phenomena. Students immediately respond to directions, and there is far less chance of forgetting or misremembering.
4. The sky as seen from other places than the students home, for other times of the day and the year and at times in history and in the future, can be effectively shown by the planetarium.
5. Sky motions can be illustrated, with entire cycles compressed to intervals which permit students to determine that they are periodic.

6. Many children in cities grow up unaware of most aspects of the sky, because light pollution washes out the stars and planets. Very few children, except those who live in rural areas or who have had rural camping experiences, have seen the Milky Way, the faint banner of light that is the extension of the Galaxy. The planetarium can show the Milky Way and other sky bodies in simulated darkness.
7. Auxiliary effects (e.g. slides, audio aids) can contribute to the realism and promote an aesthetic (peak) experience in the planetarium.
8. The planetarium can motivate students with its interesting, stimulating learning situation. Surveys have shown that students like astronomy more than other sciences, and the stimulating environment can build on initial interest and help it develop into a lifelong interest.
9. Planetarium learning is consistent with many theories of psychology and instruction. Some are:
  - The research of Jean Piaget over the last fifty years has shown that most children, many adolescents, and even some adults, apply concrete reasoning patterns to topics. The planetarium can concretely illustrate astronomy topics, so it should facilitate learning in the majority of students, who are incapable of abstract learning.
  - Hemispheric brain research has revealed that different functions are performed by the two hemispheres of the brain. The schools have traditionally directed their attention to the left-brain functions - verbal and logical learning. The students who are "right-brain dominate" have not been able to learn as they prefer, utilizing the right-brain capabilities of spatial imagery, form and color discrimination, and holistic learning via the senses. The planetarium, where spatial representation is excellent, can help right-brain learners.
  - Perception studies have shown that what is seen in an effective presentation is much better remembered than something which is simply told or discussed.
  - Cognitive mapping studies have shown that students vary widely in their preferred modalities of learning. In the planetarium many modalities can be employed simultaneously-visual sky simulation, slide or model interpretation, lecture, discussion, student drawing or plotting, and prediction- problem solving.

**The Value of the Planetarium Beyond Astronomy Learning.** In addition to the planetarium serving astronomy learning, as it is incorporated in science programs K-college, planetarium utilization can supplement other subject programs and serve additional objectives. Astronomy (is related to many subjects. A few are:

1. *Mathematics.* There is no better place to present a lesson on circles and spheres in the geometry curriculum than the planetarium. Celestial navigation can enhance a study of trigonometry.
2. *Social Studies.* Programs K-college can benefit from planetarium lessons: Concepts of the sky of Native Americans, Inuit, Aborigines, Chinese, and others can bring ancient and present cultures "to life" for students. Physical geography concepts of longitude, latitude, and climatic changes at different latitudes can be vividly illustrated in the planetarium.
3. *Language Arts.* Creative writing in the stimulating planetarium environment, where poetry and music can be combined with sky views, can be effective in unleashing student potential. Classical mythology units become more meaningful when presented in coordination with at least one planetarium lesson on mythology of the constellations.
4. *Foreign Language.* A planetarium program can be presented in the foreign language, with the assistance of the language teacher and/or class. The sky can be shown as it appears from a city where the language is spoken, and the students can be asked to pretend they are taking a trip to that country where a lecture on the night sky is presented to them in an outdoor amphitheater. Many countries have had famous astronomers, and the main contributions of some can be discussed in this setting.

**Additional Value in Planetarium Learning:**

1. Student observing, hypothesizing, and drawing/plotting skills can be developed with appropriate activities.
2. Right-brain hemisphere capabilities in all students can be developed - spatial imagery can improve in left-brain dominant students.
3. Students with learning disabilities in reading have a chance to succeed in the visual-aural techniques of the planetarium environment.
4. Students become interested in their school work, when tied to the planetarium visit, and express a desire to know more about many topics (history, math, science). This is the experience of many planetarium teachers who have had feedback from classroom teachers.

## **Recommended Arrangements for Optimizing the Presence of a School**

**Planetarium.** A planetarium can accomplish a great deal and be of value in the ways listed above. However, a planetarium is not guaranteed to accomplish a single objective independent of other vital considerations. These considerations and recommendations relating to them are given below.

1. *Establishing Initial Objectives:* Goals, which incorporate a recognition of the potential of the planetarium in education, should be established which are integrated with the goals of the school or school system. Who shall visit and when will be in part determined by the total populations which a planetarium must serve. However, the planetarium curriculum will fall short of its potential if articulation of science and other school program objectives and planetarium capabilities does not take place. If it occurs when a planetarium is first established and continues, with planetarium objectives evolving with school program objectives, the facility can be a maximum impact planetarium.
2. *Planetarium Personnel:* "No other single factor can impose a stronger influence on the effectiveness of a planetarium than the personnel assigned to it." (McDonald, 1966). It is essential that those who operate and give presentations in the planetarium have a wide range of capabilities. A panel of 35 experts have identified the following characteristics, some trainable and some inherent, in effective planetarium teachers: astronomy knowledge, classroom teaching ability, public speaking ability, enthusiasm, knowledge of planetarium methods, creativity, scientific aptitude, mechanical-electrical aptitude, flexibility, ability to write, and dedication to and great enjoyment of, planetarium activities. The planetarium director should be able to work well with both teachers and students. To optimize the skills of the planetarium personnel, schools should make a provision for flexible schedules, opportunities for two-way communication with the administration and with teachers, and opportunities for participation of personnel at professional planetarium association conferences.
3. *Planetarium Budget:* Planetarium curriculum costs in a number of school systems have been analyzed. The cost per student is less than for most other "special facility programs" - including athletics, science laboratories, industrial arts, and home economics. The educational benefit of the planetarium has been observed to be so great that in a cost-benefit comparison, the planetarium frequently surpasses other system programs. However, adequate operating budgets must be provided so that (1) transportation of students can occur as directed by objectives of curriculum, (2) Planetarium personnel have adequate time in their schedules (are not too thinly spread with teaching and other responsibilities) to pursue a quality program, and (3) adequate materials (office supplies, audio-visual supplies and equipment, and facility replacement items) and services (planetarium projector maintenance equipment repairs) are available.

4. *Population Served:* Every child should have the opportunity to benefit from planetarium experiences during his/her elementary and secondary school years. Many educators recommend a minimum of several visits within grades K-6, two visits during junior high, and two visits during high school; however, some recommend many more. School program objectives as well as the total number of students to be served are important considerations in determining the ideal planetarium curriculum for grades K-12. Teachers (in-service programs) and adults (in classes and special programs) should be considered as segments of the population to be served by a planetarium facility. If cost prohibits a school system from owning its own planetarium, plans should be made to use the services of a museum, college, or other school district which does have one. Every effort should be made to coordinate the planetarium experiences with the using schools curriculum objectives. A number of planetariums provide services to a number of schools, and usually they provide printed materials which help teachers integrate planetarium experiences with class programs.

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