ASTRONOMY AND LINKING LEARNING TO LIFE THROUGH TECHNOLOGY. C. R. Milford¹,² and P. J. Donohue³,

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Introduction: Making the leap from a classical form of education to a technology-enhanced on-line curriculum has been the challenge of the NatureShift! [1] (NS) Linking Learning to Life project. A five-year, U.S. Department of Education Technology Innovation Challenge Grant (TICG), the NatureShift project was awarded in 1997 to the partnership of Dakota Science Center and Grand Forks Public Schools. The project has joined formal and informal education partners from across the state of North Dakota in taking technology and hands-on learning to an information-isolated highway of communities including public schools, tribal schools, parks, museums and libraries. By integrating its teaching and learning model into a web-based curriculum, NatureShift strives to engage young learners with easy access to innovative history and science instruction. NatureShift has faced the challenges involved in delivering instruction indirectly to learners over the medium of the Web by creating a design that fosters exploration and encourages project-based learning.

The Dakota Skies Astronomy Module: This module is one of five curricular-based modules that engage students in guided explorations where they are encouraged to follow their interests and learn by self-inquiry. Dakota Skies investigates the universe of space science, astronomy, meteorology, rocketry, and related studies. In other modules, Ranger Rosie focuses on nature and the environmental sciences, Wounded Hawk explores science and history through the experiences of Native American culture, Memories & Stories presents social studies and the science of history, and Robot Lab investigates the physical sciences, engineering, and technology. Each module is designed with a wealth of resources and a guided learning experience that engages and immerses learners in the subject matter.

All modules ask the learner to take an active role in their own learning. Through engagement, a Web Adventure, and a Real World Adventure, students grasp the subject matter through personal connections with the ideas presented. A visitor to Dakota Skies can begin the module exploration anywhere in its framework. They are led through an investigation of basic astronomy and asked to prove to the Moon Guide (a guide designed to help the learner though the module) where they live on the Earth using astronomical principles.

Student projects require students to submit their proof and then design a solar system of their own creation.

The structure of Dakota Skies shows a home page of windows that look out into the skies, which can take you to one of nine different places. Possible explorations include the Wheel of Wonders, Celestial Stories, Sky Activities, Sky Watcher Tools, Educator Guide, Space Resources, Sky Journal, Sky Feature and the world of the Moon Challenge Exploration.

The Wheel of Wonders takes students into 16 general areas of astronomy. Topics covered include Galaxies, Eclipses, Quasars, Comets, Asteroids, Weather and Climate, Life on Other Worlds, Observing Space, Constellations, Inner Planets, Outer Planets, the Moon, Cool Visuals, the Sun, Stars and Global Positioning. These areas are meant to introduce the visitor to the basics of these astronomical and space science themes.

Celestial Stories is a collection of stories, folklore and legends from many cultures offering a multicultural approach to the understanding of how the sky has been important to civilizations past and present. Special focus is placed on Native American oral histories of the sky and how early cultures viewed the skies for entertainment, to predict the seasons and climate changes, and to tell the history of their peoples.

Sky Activities offers sample projects and an index of activities available. Activities offer explorations in how to use the stars to tell the time of night and the seasons. It also instructs in how to use devices such as a sundial or to chart the orbital motion of the planet Mars and other events.

Sky Watcher Tools gives the visitor information on the tools of the trade that astronomers use. It also gives instructions for developing tools, handling and caring of tools, and the various uses that help astronomers discover the physical properties of the universe.

Sky Resources, located on the main page, is an index of links to the resources available in the module. These also include Internet links, books, videos and periodicals that are useful in understanding the topics covered in Dakota Skies.

The Educator Guide gives instructions on how to use the module in the classroom or for individualized instruction, explains how the module is designed, and provides links to the Teacher’s Instructions for each activity presented. Teacher’s Instructions cover m-
tional standards addressed in the activities, and pro-
vide background knowledge on activities.

One of the most interesting links offered to students
is the *Sky Journal*. This gives students and other
learners the option to keep track of their sky journeys
in an on-line journal or to create a virtual slide show of
all the work they have covered. It also allows students
to create learning challenges for others that are entirely
on-line and require no other software than the Web.

**The Moon Challenge Exploration:** The main goal of
Dakota Skies is to give students a means to understand
the natural science of astronomy at their own pace.
Students take a self-guided journey through this explora-
tion. The Moon Challenge is a directed experience in
which learners must explain in astronomical terms to the
Moon where their home is located on the Earth. It of-
fers student’s unlimited exploration as far as personal
interest is engaged. It also provides students feedback
and all the tools necessary for solving the direct chal-
lenge of proof. Within the pages of the Moon Chal-
lenge are areas that provide learners with help and as-
sistance. All instruction required to answer the Moon
Challenge in the *I Can Prove It* window are found in
the other investigations of the Exploration.

*Spinning in Space* provides instruction on orbital
mechanics and planetary properties. Students learn
how to tell that they live on the Earth and not another
planet, for example, Pluto. This window is intended to
instruct in where the Earth is located in relation to the
other eight planets of the Solar System.

In *Map Your Night Sky* students get instruction on
how constellations are used as landmarks in the sky.
Just as people used the North Star to tell their latitude,
students learn the same skills to aid them in determin-
ing their location on Earth by looking at the sky. They
will learn that the sky rotates because of the Earth’s
motions in space, that those sky movements relate to
what we see, and about what is physically happening
to our Earth.

*Space Radio* covers basic astronomy principles
needed to answer the Moons challenge. Here you learn
other important information in astronomy not covered
in other pages. Subjects such as Right Ascension and
Declination are discussed in detail, as is the topic of
angles and time relating to astronomy and space.

Within each of the Moon Challenge segments lies a
key to answering the final challenge question, “where
do you live on the Earth?” Obtaining the keys is done
through exploring all the areas of Dakota Skies. Once
the student has collected (and understood!) their keys,
they use them to answer a set of proof questions given
by the Moon. Students are then asked to explain their
answer and why they think it is the correct one. This
evokes higher order thinking skills (HOTS) because

students must process what they have learned, make it
meaningful to them, and teach it by their presentation
to others. They are asked to provide proof of what they
have learned and to educate others or their peers.

**Summary:** Dakota Skies offers learners an engag-
ing universe that replicates the mechanics and prin-
ciples of space science. Within this world, free explora-
tion and guided learning experiences help ensure that
learning takes place. The NatureShift Web site has
 mastered the challenges of presenting technical informa-
tion to young learners in a manner that encourages
them to want to learn, and offers all the necessary in-
structional tools to succeed at the challenge.

**References:**