Discovery Traveling Trunk

Amazing Astronomy

Teacher's Manual

Museum of Texas Tech University
Education Division

Amazing Astronomy
Discovery Traveling Trunk

Dear Educator,

Thank you for choosing the Museum of Texas Tech University's Amazing Astronomy trunk as a teaching resource for your students. We hope the educational trunk gives your students a stimulating and rewarding experience that enhances the classroom lesson plans you currently have. The field of astronomy is one of the most fascinating sciences, and can be used to stimulate interest in science in general in people of all ages.

In exploring the science of astronomy, various facets emerge, including: the history and development of this science, past and current theories of the universe, and evolution of modern astronomer's tools. The many aspects of astronomy make it one of the most exciting sciences around today. It is quite popular with the general public, and anyone can do it - no need for any special training. Drawing upon various other fields including chemistry, geology, and physics, astronomy incorporates various scientific methods, creating a diverse subject.

The purpose of this trunk is to explore the various aspects of astronomy while providing students with a memorable experience and an appreciation of astronomy. The "Amazing Astronomy" Traveling Trunk is designed to:

* expose students to astronomy;
* introduce students to the language of astronomy;
* invoke curiosity about all aspects of astronomy;
* help students learn through multiple disciplines;
* give students a chance to exercise critical thinking skills;
* encourage students to become better stewards of our planet;
* encourage students to visit the Museum of Texas Tech University and the Moody Planetarium.

This publication was made possible in part by a grant from the Lubbock Independent School District.

Please feel free to make copies as needed of the materials provided in the trunk for your students.

If you have any questions, please to contact us about this trunk or any of the Museum's other educational programs.

Sincerely,
Education Division
Museum of TTU
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email: *museum.education@ttu.edu*

'MoTTU

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What is a Museum?

The American Association of Museums defines the museum as "an organized and permanent non-profit institution, essentially educational or aesthetic in purpose, with professional staff, which owns and utilizes tangible objects, cares for them, and exhibits them to the public on some regular schedule."

The museum is a unique place for many different people. There are numerous reasons why people visit the museum: to view a particular exhibition, for recreational purposes (such as a family outing), to view "one of a kind" objects, or to satisfy their curiosity. Just as people visit museums for different reasons, their experiences are unique with each visit.

The Museum of Texas Tech University

The Museum of Texas Tech University (MoTTU) was established in 1929. The original location of the Museum was the basement of Holden Hall located on the main campus circle. Holden Hall is named in honor of W.C. Holden, Director Emeritus of the Museum. The Museum of Texas Tech University opened at its present location in 1970.

The Museum is an educational, scientific, cultural, and research element of Texas Tech University. A non-profit organization, the Museum collects, documents, preserves, and interprets knowledge about natural and cultural material from the Southwest and other regions related by natural history, heritage, and climate. The collections in the arts, humanities, and sciences are held in trust for public education, exhibition, reference, enjoyment, and research.

The ground floor of the main Museum building is dedicated to exhibits for the public. Some of the Museum's permanent exhibits include Art of Taos and the Southwest, African Art, Pre-Columbian Art, and Diamond M Fine Art Collection. The first floor also holds the Explorium Gallery which presents objects and information from all of the Museum's collections. It is designed as a dynamic, participatory discovery center for all ages. Other features on the first floor include: the Museum Shop, the Education Division, two Assembly Rooms for special events and school programs, and the Moody Planetarium.

The Balcony Gallery, Print Gallery, Kline Rooms, the MoTTU Museum Association, and Administrative Offices are located on the second floor. The basement houses classrooms, curatorial offices, the library, and collections storage. This area is generally not open to the public, except for special events.

The Moody Planetarium

A planetarium is a domed theatre in which a special device in the center of the room (often referred to as a starball) projects a simulation of the night sky onto a dome above the audience. Planetaria are able to show how the nighttime sky looks from anywhere in the world at any time in the past or future. The locations of celestial objects are represented by the planetarium equipment.

In 1953, the first planetarium was opened in the Museum s Holden Hall location. Open at its present location since 1970, the Moody Planetarium features a Spitz A-4 starball projector in an 82-seat, domed auditorium. The planetarium also includes slide projectors, video and laser disc projectors, and special-effects projectors. Grade-specific school programs are offered with the new shows each semester. The Moody Planetarium is part of the Museum of Texas Tech University building located at Fourth Street and Indiana Avenue.

Support for the Moody Planetarium is provided by the Museum of Texas Tech University Association.

Inventory of Trunk Materials

The trunk contains a teacher s manual, articles, books, and samples of objects to build from the activities. In addition, posters, a video cassette, magazines, additional resources and several kits are included. Each material is marked with a letter followed by a number (eg. A-1, B-1, etc.) and are identified as follows:

SAMPLES — S BOOKS — B VIDEOS — V MAGAZINES — MG
ARTICLES — A POSTERS — P ADDITIONAL RESOURCES — AR
MISCELLANEOUS EQUIPMENT — ME COMET MODEL COSTUME — CMC
THE SKY AT NIGHT ASTRONOMY KIT — SNK
SIMPLE REFRACTING TELESCOPE KITS — STK
SOLAR SYSTEM IN A BAG KIT — SSK

The following inventory provides a complete listing of items contained within the trunk.

SAMPLES —S (of Objects to Build in Activities)

#	✓		#	✓	
S-1	☐	Timeline of Astronomy	S-7	☐	Cygnus Star Distances
S-2	☐	Sundial (2)	S-8	☐	Space Cloud
S-3	☐	Moon Phases Book	S-9	☐	Galaxy Creation
S-4	☐	Asteroid	S-10	☐	Star Finder
S-5	☐	Model of the Sun	S-11	☐	Build Your Own Constellation (2)
S-6	☐	Pinhole Projector	S-12	☐	Astronomer s Observing Log

MISCELLANEOUS EQUIPMENT —ME

#	✓		#	✓	
ME -1	☐	Small Compasses (12 total)	ME -7	☐	5 plastic Planisphere
ME -2	☐	flashlights (20 total)	ME -8	☐	Inflatable celestial sphere
ME -3	☐	1 bag rocks (33 total)	ME -9	☐	Ceramic magnets (20 pairs, 40 total)
ME -4	☐	1 bag marbles - clear, orange, green (35 total)	ME -10	☐	Concave mirrors (5 total)
ME -5	☐	Dollar Bill with Burned Out Eyes	ME -11	☐	4x s plastic magnifiers (12 total)
ME -6	☐	Orion s Yarn Set - Stellar Distances Kit	ME -12	☐	Night Sky Pocket Naturalist Guide

BOOKS —B

#	✓	
B-1	☐	*Eclipse*
B-2	☐	*Beginner s Guide to the Sun*
B-3	☐	*Usborne Understanding Astronomy*
B-4	☐	*Junior Science: The Solar System*
B-5	☐	*Audubon First Field Guide: Night Sky*
B-6	☐	*Peterson Filed Guide: Stars & Planets*
B-7	☐	*Space Exploration*

MAGAZINES —MG

#	✓	
MG-1	☐	*Scientific American Presents: Magnificent Cosmos*
MG-2	☐	*The Planetary Report*, Jan/Feb 02
MG-3	☐	*Discover*, Feb 2002
MG-4	☐	*Discover*, Jan 2000

VIDEOS —V

#	✓	
V-1	☐	*Eyewitness: Planets*

THE SKY AT NIGHT ASTRONOMY KIT —SNK

	✓	
SNK-1	☐	Planisphere
SNK-2	☐	Flashlight with red bulb
SNK-3	☐	*The Star Guide*
SNK-4	☐	*Mapping the Skies*

ADDITIONAL RESOURCES —AR

#	✓	
AR-1	☐	*Project Star* Catalog
AR-2	☐	*Astronomical Data Service* Catalog
AR-3-A	☐	*Orion Catalog, Summer 2003* (version 1)
AR-3-B	☐	*Orion Catalog, Summer 2003* (version 2)

POSTERS —P

#	✓	
P-1	☐	*The Planets / Solar System*
P-2	☐	*The Milky Way*
P-3	☐	*Mars and Earth*
P-4	☐	*Secrets of Sunlight*
P-5	☐	*Contact: Observatories of the Southwest*
P-6	☐	*Whisper from Space*
P-7	☐	*Mapping Our Universe*
P-8	☐	*Sky Map*
P-9	☐	*Solar Eclipse*
P-10	☐	*Hubble Space Telescope*
P-11	☐	*The Planets (set of 12 posters)*
P-12	☐	*The Electromagnetic Spectrum*
P-13	☐	*Solar System Exploration Timeline*

SIMPLE REFRACTING TELESCOPE KITS —STK

✓	
☐	2 model scopes
☐	2 Materials Sheets for Simple Refracting Telescope Kits
☐	7 double tubes
☐	7 complete lens kits, including:
☐	red sleeve
☐	foam spacer
☐	small cardboard tube
☐	cardboard ring
☐	large lens
☐	small lens

SOLAR SYSTEM IN A BAG KIT —SSK

✓	
☐	*50-Meter Solar System Data Table*
☐	163 of string with attached beads
☐	baseball
☐	rubber yellow ball
☐	wiffle ball
☐	golf ball
☐	

COMET MODEL COSTUME —CMC

✓	
☐	For Comet
☐	Styrofoam ball
☐	Dowell rod
☐	Straight pins
☐	Streamers
☐	For hair dryer or fan
☐	Sol, the sun
☐	Solar wind arrows

ARTICLES —A

#	✓	
A-1	☐	*Neptune Rising*
A-2	☐	*Like Alaska, Like Europa*
A-3	☐	*The End is Near*
A-4	☐	*Beware Falling Rocks*
A-5	☐	*Look for the Solar Eclipse*
A-6	☐	*Star in a Jar*
A-7	☐	*Cosmic Light Show*
A-8	☐	*A New Look at Quasars*

Teacher _____ School _____

Phone _____ Grade _____ TOTAL # of STUDENTS _____

Date Out _____ Date Due _____

Signature _____

By signing above, you are indicating that the trunk has the above inventory and that you understand the terms of Museum of Texas Tech University Discovery Trunk Check-outs.

Amazing Astronomy Traveling Trunk and the TEKS and TAKS

The "Amazing Astronomy" Traveling Trunk contains research materials, artifacts and activities that relate to the development of astronomy into the science we know today. These materials and activities are designed to enhance the learning currently taking place in the classroom. The lesson plans included in this manual are designed for 4th through 6th grades, and can be modified to suit other grade levels as well as various knowledge and skill levels within these grades. Special attention has been given to adapt the activities in the trunk to the Texas Education Standards, specifically the Texas Essential Knowledge and Skills (TEKS) and Texas Assessment of Knowledge and Skills (TAKS) goals and objectives.

According to the Texas Assessment of Knowledge and Skills (TAKS), an understanding of science will help children be better informed and more capable of making decisions that affect their lives and the environment. Scientific literacy means that students understand important science concepts as well as being able to apply what they know to the health, safety and environmental issues that are at the center of everyday life. The TAKS test is based on the Texas Essential Knowledge and Skills (TEKS), the state-mandated science curriculum. The aim of the Amazing Astronomy Trunk is to provide an additional resource for teachers within the framework of the TAKS and TEKS.

Five over-arching themes have been identified for this trunk based on the Texas Essential Knowledge and Skills (TEKS) and the Texas Assessment of Knowledge and Skills (TAKS). The components provided in the Amazing Astronomy Trunk have been built around these themes, many times incorporating more than one theme within the activities provided. These themes include the following Key Concepts:

- scientific method, processes and safety;
- cycles and patterns;
- forms of matter and energy;
- history, language, and art;
- technology.

In addition, students will develop various skills and abilities needed in everyday life. The skills that the students will use include:

- communication;
- critical and creative thinking;
- class and laboratory safety;
- technology, personal, and social values and skills;
- independent learning.

Trunk Overview

The activities in the Amazing Astronomy Discovery Traveling Trunk are divided into five components, moving from familiar concepts to more unfamiliar themes within the science of astronomy. The materials provided offer opportunities to:

- conduct experiments;
- build models;
- practice safety during experiments, and
- collect, analyze and interpret data.

Each component has several activities, each designed to explore one astronomical concept or aspect. The experiments and activities are designed to be done in the order provided, although this is not required. Further extension activities follow each of the components.

The first three components in the Amazing Astronomy trunk explore the history of astronomy, look at the earth and moon, and follow with a look at the solar system and the sun. The next component focuses on the stars and galaxies. The last component examines stories in the stars, explores the area of astronomy tools, and looks at astronomy activities you can do from your own backyard.

SPECIAL NOTE TO TEACHERS:

Each activity will use materials provided

in the trunk, as well as

materials to be provided by the teacher.

The materials to be supplied by the teacher have been listed separately at the beginning of each activity. Please review each activity well in advance of its being completed. This will ensure the success of each activity, and will also ensure that all materials are ready for the activity.

Additional activities relating to each component are included in the Extension Activities section of the manual.

What is Astronomy?

When you look up at the night sky, what do you see? Stars? The moon? A planet or two? If you are in a dark site, far from city lights, you might also see a faint band of light circling the entire sky - the Milky Way Galaxy, our home. What are the stars made of? How did the moon form? What other galaxies are out there? The one science that can answer these, and thousands more questions about the sky, is the science of astronomy.

The heritage of astronomy dates back to the myths and legends of ancient peoples. For centuries, people have gazed at the sky and wondered about the universe and our place in it. It is this curiosity about the sky and the regular pattern of changes that has inspired the science of astronomy. From the earliest peoples who noted the movements of the sun, moon and five known planets to the discovery of Neptune, Uranus and Pluto, astronomy has inspired humanity.

The word astronomy comes to us from the ancient Greek word meaning "arrangement of stars". The study of the astronomy began as early as 3000 years ago, with the early Babylonians, Egyptians and Greeks. Two ancient astronomers are noted for their contributions to the modern science of astronomy: Hipparchus (150 B.C.) and Ptolomey (A.D. 150). Hipparchus is known for cataloging over 1000 stars, indicating their brightness, as well as noting the precession of the Earth on its axis. Ptolomey is noted for cataloging over 48 constellations as well as 917 stars.

In more recent times, Galileo Galilei (1564-1642) is known for his use of the first telescope to observe objects in the sky. He noted that the movement of the stars is due to the rotation of the earth on its axis over the course of one 24-hour period. Galileo is also known for helping prove that the sun is the center of the solar system.

Defined as the study of objects in the sky, including anything and everything outside the earth's atmosphere, astronomy is the study of the universe in which we exist. It explores not only the planets and the moon, but the sun, stars and galaxies as well. In addition, astronomy explores the very structure of the universe, studying time and space in order to understand where everything came from.

Astronomy is considered an observational science because scientists look at the objects they want to study. Astronomers use special instruments to obtain data and readings from the objects they are studying. They then analyze, or interpret, the data to come up with hypothesis about the object under scrutiny. These hypotheses then lead to theories about the universe as a whole, and can help explain our place in it.

Because of its vastness, astronomy offers many things to be studied. From planets and moons, stars and galaxies, to even stranger things like black holes and quasars, astronomers (those who study the objects in the sky) have a rich and diverse subject matter. Since the universe is so vast and the length of time of astronomical processes is so long, every conceivable type of astronomical process/development is still going on somewhere.

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The universe and its structure. 1976. Beryl E. Clotfelter, PHD. McGraw Hill, New York.
Discovering the universe. 1980. Charles E. Long. Harper and Row, Publishers, San Francisco.

Glossary of Astronomy Terms

analyze - to determine the nature of something through scientific study.

astrolabe - an instrument for measuring the altitude of objects in the sky above the observer's horizon. The observer's time and latitude can be determined from this information.

astrology - the study of the supposed influences of the stars and planets on human affairs by their positions in the sky.

astronomer - one who studies space and objects in space

astronomical unit - the average distance between the Earth and sun; about 93,000,000 miles (93 million miles) or 150,000,000 km (150 million kilometers).

astronomy - the study of space and objects in space; from the Greek word for arrangement of stars

black dwarf - the hypothetical remnant of a dwarf star that has completely consumed its nuclear fuel.

black hole - a collapsed star; the theoretically compact body with such great gravitational force that no radiation can escape from it, including light. Usually detected when material falling into it heats up and gives off detectable x-ray radiation.

brown dwarf - a dim body of less than 1/10 solar mass with not enough gravity to begin the fusion process of converting lighter elements into heavier ones.

celestial sphere - a very large imaginary sphere surrounding Earth and to which the sun, moon, planets and stars seem to be attached.

Central peak - the mountain that forms in the middle of a crater during an impact explosion.

constellation - a group of stars that form a picture on the celestial sphere

declination - the measure of how far north or south of the celestial equator a point on the sky is. Measured in degrees, seconds of arc and minutes of arc. Used in conjunction with right ascension.

ecliptic - the path in the sky where the sun, moon and planets appear. Falls within the zodiac constellations. Also indicates the plane of the earth s orbit around the sun.

ejecta blanket - the material from under the ground that is thrown up during an impact explosion on a planet or moon.

electron - the particle that orbits the center or core of the atom; has a negative charge.

emission nebula - a cloud of gas and dust in space that absorbs radiation from starlight and re-emits it.

equinox - one of two days in the year where the sun s path on the sky (ecliptic) falls exactly on the celestial equator, around March 21(Vernal or Spring Equinox) and September 21(Autumnal Equinox). On this day, day and night have equal length, and the sun rises due East and sets due West for all observers on the earth.

fusion - the process within the cores of stars where lighter elements are combined to form heavier elements. This process gives off tremendous amounts of radiation in the form of light and heat.

galaxy - a collection of billions of stars; come in various shapes including spiral, elliptical, irregular.

hypothesis - a group of ideas that explain something.

latitude - the measure of how far north or south of the earth's equator a point on earth is. used in conjunction with longitude.

light year - the distance light travels in a year; about 6 trillion miles (6 followed by 12 zeros). Used to measure distances in space.

longitude - the measure of how far east or west a point on earth is relative to the prime meridian, running north-south from each pole through Greenwich England. used in conjunction with latitude.

lunar eclipse - when the moon falls into the earth's shadow.

magnification - the ability to make an image larger; telescopes use magnification to make objects in the sky look larger when viewed through the eyepiece.

magnitude - the brightness of a star

model - a conception of how something works;

nebula - a cloud of interstellar gas and dust; remnant of a star explosion.

neutron - the particle in the core of the atom that has no electrical charge.

nova - a star that increases its light suddenly and then fades to its former luminescence in a matter of week, months or years. Usually becomes a planetary nebula.

nuclei (plural), **nucleus** (singular) - the center or core of the atom; contains protons and neutrons.

observation - the act of recognizing and recording something, usually with some type of instrument.

orbit - the path of one body around another, for example, the moon orbiting the earth, the earth orbiting the sun and the electron orbiting the atomic nucleus.

parsec - a unit to measure distance in space: about 3.26 light years.

planet - a non-luminous object larger than a comet or asteroid that orbits a star.

precession - the slow change in the direction of the earth s axis of rotation; one cycle takes nearly 26,000 years.

proton - the particle in the center of the atom that has a positive charge.

reflection nebula - a cloud of dust and gas in space that bends and bounces back starlight from the molecules in the cloud.

retrograde motion - the apparent backward (westward) motion of planets as seen against the background stars.

right ascension - the measure of how far east or west a point on the sky is around the celestial equator. Measured in hours, degrees, and minutes. Used in conjunction with declination.

scientific method - an approach to explore the physical reality of the world using observation, logic and skepticism. It requires that the ideas about the world are consistent, or match, what is actually seen and observed.

sidereal period - the period of rotation or revolutions of an astronomical body with reference to the stars.

solar eclipse - when the moon falls between the earth and sun, blocking our view of the sun; three types exist: annular, partial, total.

solar system - the star we call the sun and all the celestial objects that orbit it, including comets, asteroids, and the nine planets.

solar time - time as measured by the earth s position in relation to the sun.

star - a self-luminous gaseous celestial body of great mass, usually spherical in shape. Can be as small as the earth or as large as the earth s orbit (186,000 miles or 300,000km). Nuclear fusion in the core generates the energy which gives the star its light.

summer solstice - the day of the year where the sun s path in the sky (ecliptic) is at its northern-most point above the celestial equator, usually June 21.

supernova - the explosion of a very massive star in which its brightness increases to billions of times that of the sun, and in which most of the mass of the star is lost in the explosion. Usually becomes a nebula. The explosion happens due to loss of nuclear fuel within the star.

telescope - an instrument used to magnify distant objects and make them more visible. It is derived from the Greek word teleskopos, to view a far: tele meaning far, and skopien meaning to view or look.

theory - a system of assumptions and principles applicable to a wide range of phenomena that have been repeatedly verified.

universe - also known as the cosmos - all things known to humanity, including everything on the earth and everything beyond the earth in space, such as stars, galaxies, quasars, etc. All that is contained in the vast expense of space around us.

white dwarf - an old, extremely dense star about as large as the earth but with the mass of the sun and is no longer fusing lighter elements into heavier ones.

winter solstice - the day in the year where the sun s path in the sky (ecliptic) is at its southern-most point below the celestial equator, usually December 21.

zodiac - a band of twelve constellations in circling the sky where the sun, moon and planets appear. Contains the path of the ecliptic.

Resources on the World Wide Web

Astronomy Clubs and Organizations

- South Plains Astronomy Club - http://www.southplainsastronomyclub.org/
- Amarillo Astronomy Club - http://groups.yahoo.com/group/amarilloastronomyclub/
- Astronomical League - http://www.astroleague.org/
- Astronomical Society of the Pacific - http://www.astrosociety.org/index.html
- International Planetarium Society - http://www.ips-planetarium.org/
- World Space Week - www.spaceweek.org

Magazines

- Sky & Telescope Magazine - http://skyandtelescope.com/
- Astronomy Magazine - http://www.astronomy.com/home.asp
- Mercury Magazine - http://www.astrosociety.org/pubs/mercury/mercury.html

Space Missions

- Galileo - http://www.jpl.nasa.gov/galileo/
- Cassini - http://saturn.jpl.nasa.gov/spacecraft/index.cfm
- Mars Rover - http://mars.jpl.nasa.gov/mer/

Miscellaneous Web Sites

- Satellite Information - www.heavens-above.com
- NASA homepage - www.nasa.gov
- Astronomy Picture of the Day - http://antwrp.gsfc.nasa.gov/apod/astropix.html
- Hubble Space Telescope - http://heritage.stsci.edu/
- Paper Plate Astronomy - http://analyzer.depaul.edu/paperplate/
- Jet Propulsion Laboratory - http://www.jpl.nasa.gov/
- Kennedy space Center - http://www.ksc.nasa.gov/
- Space Weather - http://spaceweather.com/
- Students for the Exploration and Development of Space - http://www.seds.org/

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