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ABSTRACT

This instructional guide, intended for student use, provides an exposure of career opportunities in space exploration. The program is developed with use of astronomy and earth science topics, while stressing technical aspects. NASA materials are also used extensively. Included in the minicourse are: (1) the rationale, (2) terminal behavioral objectives, (3) enabling behavioral objectives, (4) activities, (5) resource packages, and (6) evaluation materials. This unit is one of twelve intended for use in the second year of a two year vocationally oriented physics program. (CP)

CAREER ORIENTED PRE-TECHNICAL PHYSICS

"Would You Like to Swing on a Star?"

Minicourse

ESEA Title III Project

1974

dallas independent school district

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dallas independent school district

October 8, 1974

Nolan Estes
General Superintendent

This Minicourse is a result of hard work, dedication, and a comprehensive program of testing and improvement by members of the staff, college professors, teachers, and others.

The Minicourse contains classroom activities designed for use in the regular teaching program in the Dallas Independent School District. Through minicourse activities, students work independently with close teacher supervision and aid. This work is a fine example of the excellent efforts for which the Dallas Independent School District is known. May I commend all of those who had a part in designing, testing, and improving this Minicourse.

I commend it to your use.

Sincerely yours,

Nolan Estes

General Superintendent

NE:mag

CAREER ORIENTED PRE-TECHNICAL PHYSICS

"WOULD YOU LIKE TO SWING ON A STAR?"

MINICOURSE

RATIONALE (What this minicourse is about)

It's about jobs and earning money. It's about excitement. It's getting involved in the taming of one of the last and greatest of people's frontiers--SPACE.

Interested? Then lean a little closer and pay attention. In 1970 there were over 30,000 engineers employed in the aerospace industry directly. But you say, "I don't like all of that math!" So don't feel by yourself; many other people don't either. What do you think those engineers could do without their support team? Nothing. Who is in the support team? There are secretaries, technicians, draftsmen, computer programmers, computer operators, and assembly-line people--say ten non-engineering type people in the support team for every engineer; and now you're talking about over 600,000 jobs!

How much do you have to know to get into this? That, like everything else, from putting on makeup to playing baseball, depends a lot on you. How much do you want to learn? What do you want to do with it? The more you learn, the wider your job possibilities and the more you'll know about the adventure that you are a part of.

Still interested? Then, black, white, brown, yellow, female or male, this minicourse can help you to get to "where it's at."

Why study about space?
Where do you study about space?
How do you study about space?
How do you use what you have learned?

This minicourse can help you get started answering these questions. Good luck and have fun.

In addition to RATIONALE, this minicourse contains the following sections:

1) TERMINAL BEHAVIORAL OBJECTIVES (Specific things you are expected to learn from this minicourse)

2) ENABLING BEHAVIORAL OBJECTIVES (Learning "steps" which will help you to reach the terminal behavioral objectives)

3) ACTIVITIES (Specific things to do to help you learn)

4) RESOURCE PACKAGES (Instructions for carrying out the learning activities, such as procedures, references, lab materials, etc.)

5) EVALUATION (Tests to help you learn and to determine whether or not you satisfactorily reach the terminal behavioral objectives) These tests include:

   a) Self-test(s) with answers, to help you learn more.

   b) Final test, to measure your overall achievement.

TERMINAL BEHAVIORAL OBJECTIVES

When you have completed this minicourse, you will be able to:

1) demonstrate an understanding of the study of space by finding and reading some articles, periodicals, or books about the study of space.

2) demonstrate a knowledge of where to study about space by being able to list six (6) different sources of material about the study of space.

3) demonstrate your ability to study about space by planning and executing a project related to space study.

4) apply your knowledge about the study of space to your own life by describing how you might plan to use it.

TERMINAL BEHAVIORAL OBJECTIVE #1:

Demonstrate an understanding of the study of space by finding and reading some articles, periodicals, and/or books about the study of space..

ENABLING BEHAVIORAL OBJECTIVE #1:

Try to list ten (10) NASA spin-offs and tell how at least three (3) were important to you.

ACTIVITY 1-1

Read Resource Package 1-1.

ACTIVITY 1-2

Think about how these spin-offs are important to people in general and you in particular. Outline your ideas.

RESOURCE PACKAGE 1-1

"NASA Spin-offs"

ENABLING BEHAVIORAL OBJECTIVE #2:

Describe how understanding the earth is useful to everyone.

ACTIVITY 2-1

Read Resource Package 2-1. List five (5) ways that the study of the earth can help you.

ACTIVITY 2-2

Describe in a paragraph how knowledge of space could help you do a better job as a member of the aerospace team.

RESOURCE PACKAGE 2-1

"Understanding the Earth"

ENABLING BEHAVIORAL OBJECTIVE #3:	ACTIVITY 3-1	RESOURCE
Briefly outline the historical development of the study of the earth; i.e., early astronomy.	Read the introductory chapters of a text on astronomy suggested by your teacher.	Teacher or librarian
ENABLING BEHAVIORAL OBJECTIVE #4:	ACTIVITY 4-1	RESOURCE
Make a list of five (5) sources of space information from your school or public library.	Go to the library and locate material about the study of space utilizing, for example, the Reader's Guide, Scientific American, etc.	Public or school librarian

TERMINAL BEHAVIORAL OBJECTIVE #2:

Demonstrate a knowledge of where to study about space by being able to list about six (6) different sources of material about the study of space.

ENABLING BEHAVIORAL OBJECTIVE #5:	ACTIVITY 5-1	RESOURCE
List some materials and some types of information available from NASA.	Tell what you think NASA can provide to you as a citizen.	Librarian or teacher
ENABLING BEHAVIORAL OBJECTIVE #6:	ACTIVITY 6-1	
List types of material available from an observatory.	Examine the sketch on page 20 of this minicourse.	
	ACTIVITY 6-2	RESOURCE
	List some of the educational types of material an observatory supplies.	Librarian or teacher

	ACTIVITY 6-3	RESOURCE
	Find a book on astronomy and scan through it. Outline the topics covered.	Library
ENABLING BEHAVIORAL OBJECTIVE #7:	ACTIVITY 7-1	RESOURCE
List the types of space studies available from a college or university.	Ask your counselor or librarian for some catalogs from three (3) nearby colleges and read the course descriptions. Look for space courses under "Earth Science Dept.," "Astronomy Dept.," or "Physics Dept."	Counselor's library or other library
	* ACTIVITY 7-2 (Optional)	RESOURCE
	Visit a college campus and talk with an instructor in astronomy or aerospace engineering. Discuss with your teacher what questions you should ask.	Teacher
ENABLING BEHAVIORAL OBJECTIVE #8:	ACTIVITY 8-1	RESOURCE
List the types of material available from your local planetarium, if any.	Look up and write the definition of "planetarium."	Dictionary, encyclopedia, or other reference
	ACTIVITY 8-2	RESOURCE
	Visit or write to a planetarium. Investigate activities in which you can participate and see what materials are available to you.	Planetarium

TERMINAL BEHAVIORAL OBJECTIVE #3:

Demonstrate an ability to study about space by planning and executing a project related to space study.

ENABLING BEHAVIORAL OBJECTIVE #9:	ACTIVITY	RESOURCE PACKAGE
Locate a star as to right ascension and declination. Give its magnitude and color.	ACTIVITY 9-1 Read Resource Package 9-1. Locate the Big Dipper. Locate the North Star.	RESOURCE PACKAGE 9-1 "Let's Star Gaze"
	ACTIVITY 9-2 Read Resource Package 9-2. Then build a sextant.	RESOURCE PACKAGE 9-2 "Building a Sextant"
	ACTIVITY 9-3 Read Resource Package 9-3.	RESOURCE PACKAGE 9-3 "Measuring Longitude in the Sky"
	ACTIVITY 9-4 Draw and list the parts of two (2) types of telescopes. Give the function of each part.	RESOURCE Encyclopedia or other reference
	ACTIVITY 9-5 Draw a spectroscope; tell how it works and what it can tell about stars.	RESOURCE Encyclopedia or other reference (also other related minicourses)

ENABLING BEHAVIORAL OBJECTIVE #9:	ACTIVITY 9-6	RESOURCE PACKAGE 9-4
(For a statement of this objective, please see page 6 of this minicourse.)	Read Resource Package 9-4.	"Star Light, Star Bright"
	* ACTIVITY 9-7 (Optional)	RESOURCE
	Build a telescope. Ask your teacher to help you if you should need help.	Teacher
	ACTIVITY 9-8	RESOURCE PACKAGE 9-5
	Read Resource Package 9-5.	"Suggested Space Projects"
	ACTIVITY 9-9	RESOURCE
	Carry out your project. Write up your work as a project report. Have your teacher approve your project.	Teacher

TERMINAL BEHAVIORAL OBJECTIVE #4:

Apply your knowledge about the study of space to your own life by describing how you might plan to use it.

ENABLING BEHAVIORAL OBJECTIVE #10:	ACTIVITY 10-1	RESOURCE
Prepare a list of jobs and job descriptions of people in the aerospace industry.	See your guidance counselor or consult reference materials or other sources suggested by your teacher.	Teacher and/or counselor; Encyclopedia of Careers and Vocational Guidance

ENABLING BEHAVIORAL OBJECTIVE #11:

Prepare a presentation for your parents or guardians on how astronomy can be used as a hobby.

ACTIVITY 10-2

Listen to a tape presentation on jobs from NASA.

RESOURCE

Teacher

ACTIVITY 11-1

Search the reference material for how astronomy can be used as a hobby.

RESOURCE

Reference section of this minicourse

ACTIVITY 11-2

Outline your material; include pictures in your presentation.

RESOURCE PACKAGE 1-1

NASA SPIN-OFFS

What are NASA spin-offs? NASA has two legal jobs. One is to develop and test devices that will protect our country. The second is to study about space for the benefit of all mankind. In doing these two jobs, many by-products have been produced which make our lives better. These by-products are called spin-offs. Some examples of these are as follows:

a) lower fish prices

b) international television programs, like the Olympics

c) cheaper trans-oceanic telephone rates

d) safer navigation for ships and planes

e) longer-range weather forecasting

f) early spotting of dangerous storms

g) Corning ware

h) world leadership in computer technology

i) better world public relations

j) better health services (telemetry devices in intensive care units)

k) fire-retardant materials

l) better structural safety in buildings and bridges

m) improved safety in automobile tires

n) pollution monitoring

See if you can identify about five (5) of the NASA projects that were the parents of these or other spin-offs.

RESOURCE PACKAGE 2-1

UNDERSTANDING THE EARTH

In the Resource Package on NASA spin-offs there were listed many things that the space program has done for us. What was the basic object of study when things like improved weather forecasting, lowered fish prices, and pollution monitoring were produced as spin-offs? The basic object of study was Earth.

NASA was looking at the earth. From space, one can get "the big picture," including movement of air masses, movement of water masses, and movement of sludge and other pollutants. The earth is our home; and just like taking care of your home or apartment, it is sometimes good to get outside of it and to look at it in relation to its surroundings.

What is happening to our earth as viewed from outer space? Well, it is:

a) moving around its axis (spinning)

b) moving around the sun (orbiting)

c) moving through space (translating)

d) being affected by the moon (gravity pull)

e) being affected by the sun (gravity pull, radiation)

f) being hit in the face with meteors

You may say, "None of these things affect me; and if they did, they're too big to do anything about."

We hope that you don't say these things, because they are untrue. Think about it for awhile and during your study of this minicourse. We can affect the earth, and we can do something about it! This is one reason why studying the earth is so important!

RESOURCE PACKAGE 9-1

LET'S STAR GAZE

You now know some reasons why we're studying about space and where to study about space. From your experiences in the last two terminal behavioral objectives, you even know a lot about how to study space. This section is to show you more about "how." How do you learn how to do something? You learn by doing.

Go outside on the first clear night and describe what you see after looking up at the sky for at least thirty minutes with or without telescope or binoculars. Suggestion: No lights should be near where you are looking, or you will not be able to see the stars well. List the observations that you make and list the questions that you have about what you have seen. (Finish this list before reading further in this resource package! Don't spoil your own find.) You are now an astronomer junior grade.

Now compare your list of questions to the following list of questions:

1. How many stars are there?
2. How far away are they?
3. Are they the same size as the sun?
4. What are the names of the stars?
5. Will man ever be able to visit the stars?

6. Where is the North Star?

7. Where is the Milky Way?

8. Do stars move?

9. How fast do stars move?

10. Will stars appear to be in the same place every night?

11. If I know a star's name, how would I go about locating it?

12. Why am I out here looking at the stars?

13. Why do stars twinkle?

14. Why are some stars different colors?

15. "What is man that Thou art mindful of him?"

Hey, that last one wasn't one of our questions, but it is kind of a heavy feeling you may get standing outside looking up at the stars.

Don't think that the statement about being an astronomer junior grade was just talk. All of the major discoveries about the sky haven't been made just by the "guys" with the big telescopes. Ordinary people nearly every year make discoveries that are later proven to be true by the observatories. How is it that this sort of thing can happen? There are two reasons. You probably figured out one of these already. Since the sky is an "awfully" big place, astronomers can't be watching all of it all of the time.

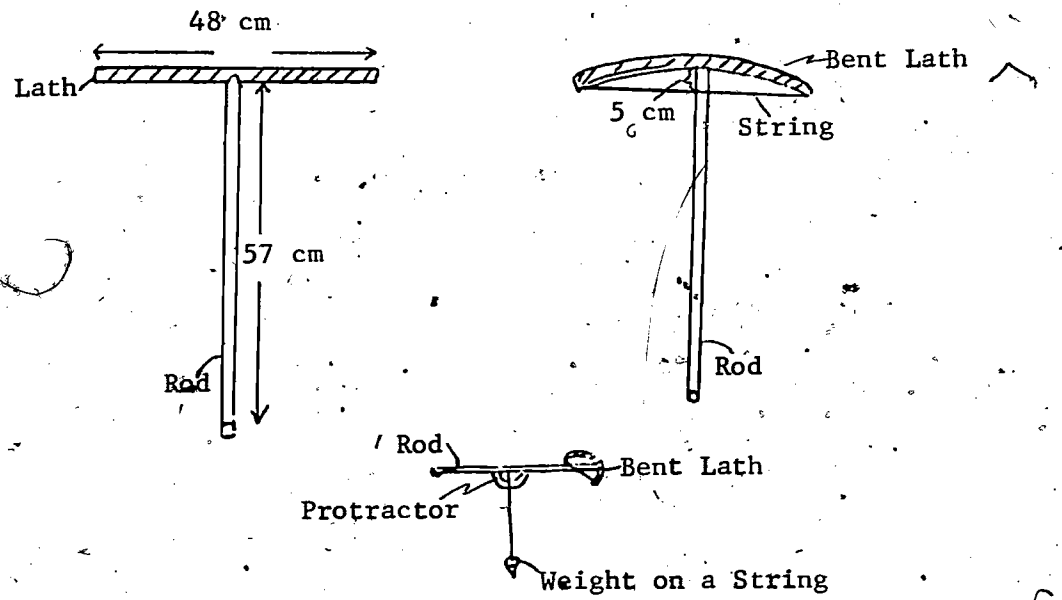
The second of these reasons is that the ordinary people who have made discoveries have spent some time learning how to study the sky and how to locate what they saw. (You are going to learn something of how to do this right now!)

Starting with the Little Dipper, follow the handle to the North Star. In the Big Dipper, follow the stars in the end of the cup to the North Star. You now have the point around which all of the other stars rotate. Watch for a while to see if you can observe this rotation. (Why can you or why can't you?) Do you see any other movement? Think about what you are looking at. How might you locate and/or measure what you are looking at? Could you try taking a time picture with your camera aimed at the North Star?

RESOURCE PACKAGE 9-2

BUILDING A SEXTANT

Take a wooden lath and cut it to a 48 cm length; take a wooden rod and cut it to a 57 cm length. Mark off the lath with 1 cm divisions and attach the rod to the middle of the lath. With a string between the ends of the lath, bend it so that the string hits the rod exactly 5 cm from its attachment to the lath. Point the rod at a point on the horizon beneath the North Star. A protractor and weight attached to the middle of the wooden rod can help keep the rod level (See picture below). Each centimeter mark is a degree of declination. What is the declination of the North Star?



This is the same as your latitude on the earth. How could you check your answer? What other measurements do you need to locate stars?

What other questions do you have after this experiment? What is declination? What is latitude? What is the declination of each of the stars in the Big Dipper?

RESOURCE PACKAGE 9-3

MEASURING LONGITUDE IN THE SKY

There is probably something in the night sky that you've noticed but we haven't talked about. It's the moon; but we'll not talk about it very much right now. But the moon does something that some stars do also. What? It rises and sets. If you have not already made these two observations, perhaps the smog is too thick for you to be outside studying the stars anyway.

Hey, if the stars are moving, how are you going to report your astronomical discovery or even be able to tell where the flying saucers come from? Longitude in the sky is a measurement of how far a star has moved across the sky. Just as the astronomer will not use the simple term, latitude, he won't use longitude either. What he uses is <u>right ascension</u>. Right ascension is measured in hours. Many people can tell time by the position of the sun. How would you like to be able to tell time by the stars?

They could do this back in Shakespeare's day, as is shown by this quote from "King Henry the Fourth" in a conversation between two wagon drivers:

> "Heigh-ho! an' it be not four by the day, I'll be hanged.
> Charles Wain is over the new chimney, and yet our horse is not packed."

What were they talking about? Charles Wain was at that time the name for the Big Dipper, and they knew that since it was over the new chimney, the time was after four in the morning.

Now, the Big Dipper moves around the North Star. You've already located these. By knowing that the Big Dipper moves around the North Star, you can use the pointer stars in the Dipper cup as the hour hand on a star clock (See Figure 1, below).

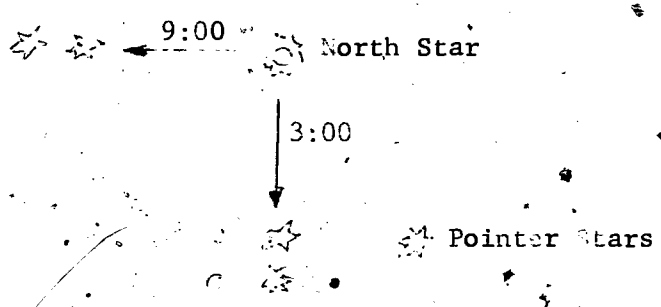


Fig. 1

This figure shows you two things. One is how to use the pointer stars in the Big Dipper for the hour hand on your clock. The second is that the star clock is divided into 24 hours. These hours are the way you can measure right ascension.

There is a star finder that you can build which you can use with a handbook or star chart to locate the right ascension and the declination of any area of the sky. Check with your teacher on instructions

on how to build it. If you do all this, you will be ready for seeing and telling any astronomer about what you have discovered. (Of course, there is more to this than has been told; for example, what about yearly differences in the sky!?)

Why would a watch and a calendar help you in your studies? Again, check with your teacher for a reference that might answer these questions. (Sky and Telescope magazine is an excellent reference.)

RESOURCE PACKAGE 9-4

"STAR LIGHT, STAR BRIGHT"

How bright is a star? How bright is a planet? How bright is the moon? How bright is the sun? Write down your answers to these questions and tell what you know about why the sun looks brighter than other stars. Check your answers with your teacher.

What you are talking about is called "magnitude" by the astronomer. How bright a star appears to you is called its apparent magnitude. A star with a magnitude of <u>one</u> is 2.5 times brighter than a star with a magnitude of <u>two</u>.

If two stars are each ten light years from the observer and both have the same <u>absolute</u> magnitude (look up this word, "absolute," if necessary), what will be their apparent magnitude? If one, however, is five light years closer to the observer, can you tell how much brighter it will appear?

Some stars change their magnitude. Algol, in the constellation Persens, appears to change its magnitude every two and a half days. This is not a true change, but is an example of an eclipse. However, there are stars which actually do change magnitude. Why they do is one of the many unsolved mysteries of the universe.

With a star chart, estimate the magnitude of the stars in the "Dippers" and compare your results with a table of magnitudes. As an aid to use in doing this exercise, locate the head of Draco (the dragon).

The brightest of these four Draco stars is of second magnitude; and the stars of decreasing brightness are third, fourth, and fifth magnitude, respectively.

RESOURCE PACKAGE 11-3

SUGGESTED PROJECTS

Your ideas are better than ours, or, at least, more important to you. This section of the minicourse is written for the student who does not have enough self-confidence to individually choose a project. Remember the statement at the end of the Rationale (page 2), "have fun"; the project could be the most fun you have in this minicourse. Here are some suggested projects:

1) Count meteors (Remember, this is best done in the hours just before dawn.)

2) Locate a source of meteor showers.

3) Examine a star chart and build a star finder (See Sky and Telescope magazine, etc.)

4) Make a temporal observation of "Dipper" rotation (1 rotation/24 hours; ½ rotation/12 hours; ¼ rotation (90°)/6 hours, etc.)

5) Write a paper on the importance of our space program.

6) Develop a time table for the location of artificial satellites in your area.

7) Make an in-depth study of an occupation involved in the study of space.

8) Write suggested activities for other persons who may study this minicourse.

9) Compare current and classic cosmological models.

10) Make a study of sunspots (Caution: Never look at the sun without proper protection to your eyes.

11) Build a telescope and make observations of as many planets as you can find.

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