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ABSTRACT

This curriculum guide is prepared for the Aerospace Education III series publication entitled "International Space Programs." The guide is organized according to specific chapters in the textbook. It provides guidelines for teachers in terms of objectives, behavioral objectives, suggested outlines, orientation, suggested key points, instructional aids, projects, and further readings. Page references corresponding to the textbook are given where appropriate. Major concepts in each chapter are listed with brief explanations. (PS)

SEPTEMBER 1973

AE-III

INTERNATIONAL SPACE PROGRAMS

INSTRUCTIONAL UNIT OBJECTIVES - Each student should:

a. Be aware of the international participation in space research.

b. Be familiar with the achievements of other nations in the application of space technology.

c. Know how and to what extent the results of space research are shared in the international community.

d. Understand the position of the United States as a space power in relation to the positions of other space nations of the world.

e. Be familiar with the developmental background of important trends, issues, and international agreements relating to space law.

PHASES IN INSTRUCTIONAL UNIT VI:

PHASE I - THE SOVIET UNION IN SPACE

This phase deals with the foundations of the Soviet space program. More specifically it deals with three primary concepts: (1) the sources of motivation that lead to the Soviet space quest, (2) the development and use of Soviet ground facilities, and (3) the development and use of Soviet launch vehicles. It should be impressed upon the student that without these foundations there would be no Soviet space program. Furthermore, the student should understand that the timing and manner of development of these foundations had a tremendous impact on the development of the entire Soviet space program. This phase covers the role of Konstantin E. Tsiolkovsky in molding Russian opinion about exploration. The development of Government interest in space research is highlighted through the added motivation of Soviet world stature at the close of World War II, concluding with the launch of Sputnik I. This phase analyzes the development of the Soviet ground facilities, detailing their uses and noting the parallel development of US counterpart facilities. Finally, this phase concludes by explaining the development, use, and (where applicable) US counterparts of the Soviet stable of launch vehicles.

1. PHASE I OBJECTIVES - Each student should:

   a. Understand why the Soviet Union elected to engage in space research.

   b. Know the names, uses, and US counterparts, of Soviet ground facilities.

   c. Know the names, origins, uses, and, where applicable, US counterparts of the Soviet launch vehicles.

2. BEHAVIORAL OBJECTIVES: Each student should be able to:

   a. Name the "father of astronautics."

   b. List two reasons the Soviet Union elected to engage in space research.

   c. List the Soviet ground facilities, identifying them by name, location, uses, and US counterparts.

   d. List the Soviet launch vehicles, identifying them by series letter, origin, and most common use.

3. SUGGESTED OUTLINE:

a. Motivation for a Soviet space program

(1) The influence of Konstantin E. Tsiolkovsky

(2) The Soviet Union formed the first rocket society

(3) At the close of World War II, the Soviet Union was no longer a forerunner in rocketry

(4) With the aid of captured personnel and equipment, the Soviet Union embarked on a program of space research.

b. Soviet ground facilities

(1) Baikonur is the Soviet equivalent of Houston Control

(2) Tyuratam is the Soviet Cape Kennedy

(3) The Soviet return to Kapustin Yar was similar to the United States opening Wallops Island and White Sands

(4) Just as the US expanded even further, opening the Vandenberg AFB site, the Soviets opened Plesetsk

(5) The Soviet equivalent of the US Manned Spacecraft Center in Houston, Texas* is Zvezdny Gorodok (Star City)

c. Soviet launch vehicles

(1) The Standard Launch Vehicle (Series A)

(a) Adaptation of the 1957 SS-6 Sapwood ICBM

(b) Used from Sputnik I to the latest Soyuz mission

(c) Estimated thrust 1,323,000 pounds

(d) First public view of the Series A was in 1967

(2) The Small Utility Vehicle (Series B)

(a) Adaptation of the SS-4 Sandal ~~MRBM~~

(b) Used primarily for Cosmos Launches

(c) Estimated lift capacity 600 pounds.

NOTE: *The name of the Manned Spacecraft Center at Houston has been changed officially to that of Lyndon B. Johnson Space Center.

(3) The Flexible Intermediate Vehicle (Series C)

(a) Modified SS-5 Skean IRBM

(b) Lift capacity 2,000 pounds

(4) The Non-Military Large Launch Vehicle (Series D)

(a) Civilian origin

(b) Thrust 3.97 million pounds

(c) Used for Proton satellites

(5) The Military Combat Launch Vehicle (Series F)

(a) Adaption of the SS-9 Scarp ICBM

(b) Used for interceptor/destructor satellites and FOBS

(6) The Super Booster (Series G)

(a) Civilian origin

(b) To be used for MOP component launches

(c) Has not been successfully launched

4. ORIENTATION:

a. This phase is designed to give the student a simple, solid appreciation of the background of the Soviet Union's space program. It assumes that the students knowledge of Soviet motives, launch vehicles, and ground facilities is limited. This phase seeks to provide a relatively detailed overview of the prerequisites to space exploration and to "humanize" the Soviet program in the eyes of the student as much as possible.

b. Although the Soviet Union has fallen behind in lift capacity, it is still significant to realize how long they did lead and realize the potential for them to regain the lead. Although the United States had advanced technically, that lead will be cut if the Soviets regain the ability to lift heavier less sophisticated satellites.

5. SUGGESTED KEY POINTS:

a. The Soviet Union is the only nation in the world whose space program is near the scale of that of the United States. The Soviet program has been carried out without pre-launch publicity for individual launches and with relatively little post-launch publicity. Through a variety of sources, westerners have been able to piece together a picture of how the Soviet program works. (It is interesting to note another US-Soviet contrast in this area. The Soviets are rather expansive about their long-range space plans while the United States says relatively little in this area.)

** (V-9023A)
** (V-9115) pp 46-47

b. Interest in rocketry developed much earlier in Russia than in the United States. This is primarily attributed to the work of Konstantin E. Tsiolkovsky and his disciples. This early interest meant that the Soviet Union had an edge on the United States in the field of rocketry and potentially in the field of space exploration. This advantage was largely offset when the US Army captured "better" German scientists than did the Russians at the end of World War II. It is estimated that Germany had a 10 year lead in rocket development over the rest of the world at that time, and both the United States and Soviet Union made use of that experience. However, even though captured Germans contributed to the Russian space program in its early days, the bulk of the work--especially since early 1950s--has been done by Soviet scientists. Russian interest in the field of space exploration immediately after World War II seems to have been more intense than US interest and this interest put them into space first.

** (V-9004) pp 24-32
** (V-9023A) pp 94-97, 105-110
*** (V-9066) pp 40-66
** (V-9145) pp 49, 52
* (V-9033) Chap. 1
*** (V-9169) Chap. 1

c. The Soviet Union has several launch sites, just as does the United States, and the purpose of the space launch determines the launch site. This binational comparison includes not only a similar distribution of projects between the sites, but also parallel development and opening of the sites.

*** (V-9115) pp 3-10, 64-69
** (V-9145) pp 8-22

d. Booster strength was the prime factor in the early days of space and the Soviets had more powerful boosters. Booster strength is now considered less

*** (V-9169) Chap. 4
** (V-9023A) pp 103-125

critical in the short run, but will be important in the days of space stations and manned interplanetary expeditions. Considering these factors makes the current US lead in booster power and the coming of the series G take on different degrees of importance. The current US lead is less meaningful than might be assumed, while the upcoming Soviet Series G booster could be a very timely development.

6. SUGGESTIONS FOR TEACHING:

a. Suggested time

Number of Academic Periods per Week	Recommended Number of Periods for each Phase					
	1	2	3	4	5	6
2		X				
3				X		
4					X	

b. This phase is critical to understanding phases II and III. Without an understanding of the motives, launch vehicles, and launch sites of the Soviet Union, many details and references about current programs and future programs will be meaningless.

c. Recommend that V-0051 Soviet Space Programs be used as an introduction to this instructional unit. You may want to use selected slides to re-emphasize information brought out in Phases I-III.

d. In this text we are introducing a new system of pronunciation for difficult foreign words. This system used by the Academic Instructor and Allied Officer School (AU) is called "figured spelling." It uses English letters with English values, the stress syllables are shown in capitals.

These pronunciations, if appropriate, will appear under the Words, Phrases and Names to Remember section at the end of each chapter. When you first introduce the text, you should spend a few minutes going over these new words, certainly before any reading assignment.

On p. 17, the name Zvezdny Gorodok is misspelled, but the pronunciation is correct. The name is also misspelled in the index. Other typographical errors are as follows:

p. 73	fig. 51	change "Lunkhod" to "Lunokhod"
p. 108	fig. 73	change "Shiusei" to "Shinsei"
p. 185	Index	change "EEuropa" to "Europa"
p. 187	Index	change "Natonal Space Development Agency" to "National Space Development Agency"; "Okelisk" to "Obelisk"; "Protom" to "Proton"; "Shiusei" to "Shinsei"; "Space Actiivties Commission" to "Space Activities"; "Star City (Zvedzny Gordok)" to "Star City (Zvezdny Gorodok)"

e. You could have your students give one minute talks on areas of interest to them from the chapter. Give them five minutes to prepare in class, then turn them loose.

f. Have the students formulate quiz questions and ask them of one another. Both techniques (e. and f.) may give you added insight into the importance your students give to subject areas.

7. INSTRUCTIONAL AIDS:

a. 35mm slides

(1) V-0051 Soviet Space Programs

b. Periodicals

(1) Aviation Week and Space Technology

(2) Interavia

(3) Space World

(4) NASA - Historical Pocket Statistics

(5) TRW Space Log

8. PROJECTS:

a. Assign a student to prepare a report on the "father of astronautics." Your reference library may contain V-9028A Men of Space, which contains a profile on this famous Russian pioneer.

b. Using a map of the Soviet Union, have a group of students locate the various Russian launch site facilities. Assign selected students to give separate reports on the activities carried out at a given facility. The reports should cover such points as: the designations of spacecraft that have been launched from the site; the US counterpart of the facility; the booster series that have been launched from the site, and the US counterpart of the boosters. The TRW Space Log contains a Summary Log of Space Launches since 1957. Much of the above data can be extrapolated from this summary log. Also, consult Appendix A (V-9169).

c. Assign a student to prepare a report on the Series G booster. What have been the latest developments in this program? Your Reference Library may contain V-9169 Soviet Space Program 1966-70, which contains an account of this vehicle. Consult current and back issues of appropriate periodicals for possible update information on the Series G.

d. Of the things to do listed at the end of this phase, 1 is well suited for either individual or group projects, 3 is best suited for individual projects.

e. Project number 2 will probably be best utilized as a class demonstration. A tip to remember on plotting inclination is to place a protractor parallel to the equator and draw the angle through the launch site angling toward the east.

9. FURTHER READING:

a. The best book listed is Riabchikov's, Russians in Space.

b. Review of the Soviet Space Program is V-9115.

c. Soviet Space Programs, 1966-70 is V-9169.

PLEASE NOTE ANY SUGGESTIONS FOR IMPROVEMENT OR EFFECTIVE TEACHING METHODS ON THE BLANK AT THE END OF THIS PHASE!

IDEAS FOR IMPROVEMENT OF THE TEXTBOOK AND/OR INSTRUCTORS GUIDE AND TEACHING TECHNIQUES MOST EFFECTIVE FOR THIS PHASE

PHASE II - SOVIET SPACE PROGRAM DEVELOPMENT

This phase deals with the history of the Soviet space program. It examines three areas of program development: unmanned, manned, and military. Each project is contrasted with previous projects in the Soviet programs and compared with counterpart US projects whenever possible. Three characteristics of the Soviet program should be noted for the students; (1) the similarity in development of the US and USSR space programs; (2) the complexity of Soviet undertakings, and (3) the almost extreme economy of flights and funds. In dealing with the area of unmanned space programs, this phase deals with the categories of near-earth, lunar, and planetary programs. (Before discussing the three categories of programs, the early Sputnik and Luna Flights are covered). Primary, in the near-earth category, is the Cosmos series. The Cosmos series, or "Cosmos-cover," is the all inclusive cover name for over 500 near-earth experiments, tests, and failures of all description. Also, included in the near-earth category are the Molniya, Meteor, and Elektron projects. The unmanned Luna program, begins in the second generation of Luna flights. The generations of Luna flights show constant expansion in missions, complexity and sophistication. The final area of the unmanned space program is the planetary program. This is an area of somewhat marginal Soviet success. In dealing with the area of the manned space program the three evolving programs of Vostok, Voskhod, and Soyuz are discussed. Highlights such as the Gagarin flight, the walk in space, and in-flight docking, are noted. Also, noted are such interim programs as Polyot, Proton, and Zond which, although unmanned, are an intricate part of the manned program. Finally, this phase deals with the Soviet military space activities. In covering this area, support systems, fractional orbit bombardment satellites, and interceptor/destructor satellites are covered.

1. PHASE II OBJECTIVES - Each student should:

   a. Know the Soviet space programs

   b. Understand the "direction" of both the Soviet and US space programs

   c. Understand the interrelation between projects

   d. Know the major Soviet "firsts in space"

   e. Understand the significance of various key developments in the Soviet space program

2. BEHAVIORAL OBJECTIVES - Each student should be able to:

   a. List the Soviet space projects

   b. Compare the "direction" of the Soviet space program with that of the US space program

   c. Outline the manner in which the developments and accomplishments of one project are used in later projects

   d. List the major Soviet "firsts in space"

   e. Define the significance of such developments as

      (1) Sputnik I

      (2) Laika

      (3) Orbital launch platform

      (4) Polyot project

      (5) Vostok-Voskhod similarities

      (6) The Cosmos cover

      (7) The deaths of Komarov, Dobrovolskiy, Volkov, Patsayev

3. SUGGESTED OUTLINE:

   a. General characteristics of program development

      (1) The Soviet program has unfolded in an orderly manner

      (2) Simplicity is emphasized with complexity when needed

      (3) Greatest failing is in reliability of many payload components

   b. The Unmanned Space Program

      (1) The Early Sputniks, 1957-58

         (a) Sputnik I shocks the world

         (b) Sputnik II and Laika

         (c) Sputnik III and a 6 year lead on payload weight

(2) The Early Luna Flights, 1959

(a) Luna I the first artificial planetoid

(b) Luna 2 hits the moon

(c) Luna 3 and the photo of the moon's farside

(3) The Near-Earth Program

(a) The Cosmos Series

1. The Small Cosmos Payloads

2. The Intermediate Cosmos Payloads

3. The Military Observation Recoverable Cosmos

4. Precursor Craft and Failures within Cosmos

(b) The Remaining Near-Earth Programs

1. Molniya Series

2. Meteor Series

3. Elektron Payloads

(4) The Luna Program

(a) The Second Generation, 1963-66

(b) The Third Generation, 1968-

1. Returned soil samples

2. The lunar rover

(5) The Planetary Program

c. The Manned Space Program

(1) The Vostok Program, 1960-63

(2) Polyot Payloads, 1963-64

(3) The Voskhod Program, 1964-65

(4) The Proton Payloads, 1965-69

(5) The Soyuz Program

(a) Death of cosmonauts

(b) Salyut

(6) Zond Flights, 1961-

d. Soviet Military Space Activities

(1) Military Support Systems

(2) FOBS

(3) Interceptor/Destructor Satellites

4. ORIENTATION:

a. This phase is designed to give the student a detailed understanding of the Soviet program. It assumes that the student knowledge is limited to front page stories about Sputniks, Kuniks, and spies in the sky. This phase seeks to explain the detail, organization, and interrelations that have made the Soviet space program the second, if not the most important space program in the world.

b. While recent United States successes in space research--notably, the successful Apollo missions--have perhaps counteracted the uneasy feeling that we may trail the Soviet Union in space ability, we should not lose sight of the fact that the Russian space program has been impressive and is by no means at an end. This phase provides material to support this point, and indicates that future Soviet achievements may come in the area of manned space stations.

c. While the average American citizen seems to assume that the Soviet space program is dominated by the Military, there is actually quite a bit of civilian influence and control at work in the program. This phase offers information to back that point while, at the same time, seeking to give an accurate description of the Soviet military space program.

5. SUGGESTED KEY POINTS:

a. The Soviet space program, like that of the United States, has both military and non-military uses. Although we often consider the Soviet space program predominantly militaristic, there is in fact a large degree of civilian control over the Russian program, and a large part of the Soviet program is oriented to non-military uses.

** (V-9115) pp 79

b. The orderly evolution of the Soviet space program is evident in almost every project that is undertaken. Threads of the formula near-earth, moon, planetary are obvious in both the unmanned and manned programs. Even in the seemingly disorganized Cosmos series, there is a pattern of testing and experimentation that leads to emerging operational programs such as Molniya and Meteor. Of course, there are programs that are taken out of order, such as Zond beginning its precursor flights ahead of reliable near-earth operations; but this does not deny the formula or order, it merely reflects the extent of future planning and order in the program.

** (V-9169) Chap. 5

c. The Cosmos series is a good example of the entire program. It is very complex yet highly organized. It follows the basic concept of testing under cover, and publicizing operations programs when success is relatively certain. Further it demonstrates the philosophy of hiding failure by refusing to recognize it for what it really represents.

*** (V-9169) pp 170-188

d. The concept of multi-purpose exercises is also well established in the Soviet space program. The use of Polyot and Proton payloads for secondary precursor missions for manned flights, while advertising scientific missions, is one of many examples. The multiple-mission philosophy is typical of the emphasis on economy that is evident in the Soviet space program.

** (V-9169) Chap. 6

e. In considering the relative position of the US and USSR programs, emphasis should be placed on technology. The Soviet space programs are lagging in actual technical accomplishments. They are also lagging in support technology such as miniaturization and photography.

6. SUGGESTIONS FOR TEACHING:

a. Suggested time:

Number of Academic Periods per Week	Recommended Number of Periods for Each Phase					
	1	2	3	4	5	6
2				X		
3					X	
4						X

b. The cut-off date on this book was around 28 December 1972. This phase will give the students an adequate background on the Soviet program, but the instructor should see that information contained in this phase is updated. This is a good area for student projects. One Soviet space program not included in this phase was PROGNOZ "Forecast."

c. This phase is critical to understanding phase III. Without an understanding of the development of current programs references to future programs will be meaningless. Further, a thorough knowledge of program development is essential to fully appreciating discussions about organization, resource allocation, and international involvement.

d. This lesson lends itself to a group technique called "Time Line." Groups research the facts covering a period and transfer them to a chart representing the progression of time. Group size could range from small to full class size, with each group explaining their portion of the "Time Line." The chart could be a long sheet of butcher paper with years marked off, a clothes line with events clipped or taped to it, or a chalkboard outline with clippings taped on or events chalked in.

e. Have students write newspaper articles simulating those that might have been seen in periodicals at the time of the events.

7. INSTRUCTIONAL AIDS:

a. 35mm slides

(1) V-0051 Soviet Space Programs

b. Periodicals

(1) Aviation Week and Space Technology

(2) Interavia

(3) Space World

(4) TRW Space Log

(5) NASA - Historical Pocket Statistics

8. PROJECTS:

a. Recommend the use of selected slides from V-0051 Soviet Space Programs to emphasize portions of this phase.

b. Of the things to do listed at the end of this phase, 1 and 3 are best suited as individual projects.

c. In the case of item 2, long-range assignments would probably be most advisable. Update information may be extrapolated from NASA - Historical Pocket Statistics (latest edition) or articles found in such periodicals as Aviation Week and Space Technology. Your reference library, V-9169, pp 170-188, contains an account of the Cosmos program.

d. The Educators Guide to Free Films, Educators Progress Service, Inc., often contains films of value to the teacher. This source guide may be available in your school library. The Embassy of the Union of Soviet Socialists Republics lists a few films that may support this instructional unit. One such film is "Ten Years of Cosmic Era" (SE-1-11). Recommend that any films obtained from this source be reviewed in advance.

e. One Soviet spacecraft designation not covered in this phase was PROGNOZ "Forecast." Have a student prepare a report on this Soviet space program.

9. FURTHER READING:

a. The best book listed is Riabchikov's, Russians in Space.

b. Review of the Soviet Space Programs is V-9115.

c. The article by Kohler and Harvey will provide the best transition into the next phase. This article is in Readings in Astronautics and Space Operations, V-9170.

d. Soviet Space Programs 1966-1970 is V-9169.

PLEASE NOTE ANY SUGGESTIONS FOR IMPROVEMENT OR EFFECTIVE TEACHING METHODS ON THE BLANK SHEET AT THE END OF THIS PHASE!

IDEAS FOR IMPROVEMENT OF THE TEXTBOOK
AND/OR INSTRUCTORS GUIDE AND TEACHING
TECHNIQUES MOST EFFECTIVE FOR THIS PHASE

PHASE III - SOVIET POLICY AND PLANS

This phase deals with the why (policy) and what next (plans) of the Soviet space program. It has been divided into five major divisions and a summary. These divisions are: Political Goals and Purposes of the USSR in Space; Organization of the Soviet Space Program; Resource Allocation and the Soviet Space Program; Soviet International Involvement; and Projections of Soviet Space Plans. Two characteristics of Soviet space policy should be noted for the students; (1) the degree of commitment to space exploration in terms of politics and economics, and (2) the extreme complexity of the system of command and control. In covering the topic of political goal and purposes of the USSR in space, this phase discusses the image of political analog that has developed around the space program and begins the analysis of the concept of competition/cooperation between the United States and Soviet Union. The division on organization of the Soviet space program, reviews the structure of organization and constrasts it with the US-NASA system. This phase covers resource allocation and places emphasis on the degree of the commitment. The division on Soviet International involvement is divided into three sections: Soviet Attitude, Communist Bloc Programs, and Programs with Free World Countries. In the subdivision on free world - Soviet programs, the concept of cooperation/competition emerges again. The final division of this phase is Projections of Soviet Space Plans. Soviet plans are discussed in terms of both general capabilities and specific program probabilities.

1. PHASE III OBJECTIVES - Each student should:

   a. Understand the Soviet political commitment to space exploration.

   b. Know the structure of the Soviet space program.

   c. Understand the economic commitment to the Soviet space program.

   d. Understand the Soviet commitment to international cooperation.

   e. Be familiar with Soviet/communist bloc cooperation in space exploration.

   f. Know about recent developments in US/USSR cooperative programs.

g. Be familiar with USSR/French cooperative programs.

h. Understand the direction and possibilities of future Soviet space ventures.

2. BEHAVIORAL OBJECTIVES - Each student should be able to:

a. List the reasons for the Soviet political commitment to space exploration.

b. Outline the organizational structure of the Soviet space program.

c. Recall the degree of economic commitment now being made to the Soviet space program.

d. Define the Soviet commitment to international cooperation.

e. List two examples of Soviet/communist bloc cooperation in space programs.

f. List four examples of US/USSR cooperative space programs.

g. List two examples of USSR/French cooperative programs.

h. Outline and define where the various Soviet space projects are apparently headed.

3. SUGGESTED OUTLINE:

a. Political goals and purposes of the USSR in space

(1) Space triumphs have been used to glorify the Communist Party and Soviet state.

(2) Space activities have been used in an effort to tarnish the US image and to weaken the Western alliances.

b. Organization of the Soviet space program

(1) Space policy is made through several organizations in the Soviet government.

(2) There is no single Soviet agency equivalent to NASA.

c. Resource Allociation and the Soviet space program

(1) It is difficult to determine how much the Soviets spend on space research and operations because they have never announced a budget.

(2) It is estimated that the Soviet Union devotes three to four times as much in resources, percentagewise, to space exploration than does the U.S.

d. Soviet international involvement

(1) The Russians have professed to be strong supporters of international space cooperation.

(2) The Soviet Union has established a program of space cooperation with its East European allies.

(a) The Soviets have developed Intersputnik to rival INTELSAT.

(b) Intercosmos is a highly successful cooperative program.

(3) The Soviet Union has begun to extend cooperative programs to include Free World countries.

(a) US/USSR cooperative efforts have experienced little success in the past.

(b) Since the 1971-72 turning point, US-Soviet cooperation appears to be headed into a more promising future.

(c) Franco-Soviet cooperation has experienced the fastest rate of acceptance and success.

e. Projections of Soviet space plans

(1) General technical capability is so broad that intent must be considered.

(2) Unmanned space flight

(a) Earth orbital science

(b) Civil applications

(c) Military applications

(d) Lunar studies

(e) Planetary studies

(3) Manned space flight

(a) Soyuz

(b) Long term space station

(c) Reusable space shuttle

(d) Zond

(e) Manned lunar landing

(f) Manned planetary flight

f. Soviet philosophy toward their space program

4. ORIENTATION:

a. This phase is designed to give the student a basis upon which to assess future possibilities in Soviet space exploration. Since these are primarily predictions and assessments made outside of official Soviet circles they are subject to variations in both dates and sequence. However, because of the long-term nature of program lead times any major deviation that will have taken place over the next decade should have already begun to be apparent.

b. The Soviet Union is committed to space exploration, both politically and economically. Large quantities of both available resources and national prestige have been invested in the space program.

c. Space exploration is an arena for the dual philosophy of cooperation/competition. It is critical to realize this point, so that recent developments in cooperative efforts do not mask the true competitive nature of space exploration.

5. SUGGESTED KEY POINTS:

a. The two most important points to realize about the Soviet space program is the commitment to space exploration and the diffusion of policy making powers. In their concern to make sure that no single governmental body could control the space program, the Soviets have produced a program that has shown continued expansion. In the face of US cutbacks in space efforts the continuing Soviet commitment and the command and control structure support are additional hypothesis. Perhaps, as

* (V-9115) p 79
** (V-9169) Chap 2

a result of the diverse structure, the structure has not only prevented any governmental body from controlling the space program, but it has also prevent a cutback in commitment.

b. The recent attempts at international cooperation should be viewed carefully. With the exception of agreements with the United States and possibly France, most Soviet cooperation has been a case of allowing other countries to furnish parts and personnel to Soviet controlled ventures. Upon realizing this fact the importance of Soviet space cooperation is diminished, however, it does not mean that genuine efforts will not be forthcoming.

** (V-9169) Chap 11

c. New developments in the Soviet space program can be expected to center around manned space flight. Most of the unmanned activity has reached an operational stage, such as Meteor and Molniya, leaving only the manned program in an experimental stage in terms of lunar and planetary activities. Manned activities have always been the focus of the Soviet program. Once the D-1 vehicle is successfully man-rated the return to manned programs can be expected to accellerate.

** (V-9169) Chap 10

6. SUGGESTIONS FOR TEACHING:

a. Suggested time

Number of Academic Periods per Week	Recommended Number of Periods for each Phase					
	1	2	3	4	5	6
2		X				
3			X			
4						X

b. Because of the nature of the material any and all possible forms of Audiovisual aids including blackboard diagrams should be employed.

c. Work with the students on questions for an imaginary interview. Invent a person in the hierarchy of the Soviet space program and draw up a set of questions that would explore Soviet policies and plans.

d. Have your students bring in newspaper or magazine clippings or reprints that deal with Soviet space programs. As an option, they could brief the class on them.

7. INSTRUCTIONAL AIDS:

a. Periodicals

(1) Aviation Week and Space Technology

(2) Intervia

(3) Space World

8. PROJECTS:

a. Both numbers 1 and 2 lend themselves to group reports and the employment of student created audiovisual aids.

b. Project 3 will make a good continuing project for short reports when developments take place, adding variety during further phases and instructional units.

c. Assign one or more students to report on the upcoming Apollo Soyuz Test Project. The report(s) should answer such questions as: What is the current status of this program? What progress has been made to date in the design of a compatible Rendezvous and Docking System? What major items of compatibility are under consideration and evaluation? What is the Mission Description of the test project?

9. FURTHER READING:

a. The best source listed is the Micheal Stoiko book Soviet Rocketry: Past, Present, and Future.

b. The third source, Review of the Soviet Space Program is V-9115.

c. The fifth source, Soviet Space Programs, 1966-70 is V-9169.

PLEASE NOTE ANY SUGGESTIONS FOR IMPROVEMENT OF EFFECTIVE TEACHING METHODS ON THE BLANK SHEET AT THE END OF THIS PHASE!

IDEAS FOR IMPROVEMENT OF THE TEXTBOOK
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TECHNIQUES MOST EFFECTIVE FOR THIS PHASE

PHASE IV - WORLDWIDE SPACE INVOLVEMENT

This phase deals with the "other" space programs of the world. The primary programs are those of the United States and Soviet Union. These programs have already been discussed in previous phases of this instructional unit and three other AE-III instructional units. In this phase, the student will learn about national programs that he may have never thought existed and about international space programs that, combined, could someday rival those of the United States and the Soviet Union. This phase has been divided into geographic regions to facilitate the examination. The first geographic region investigated was Europe. The discussion of Europe is divided into two primary areas: international programs and national programs. There are two major international cooperative programs in Europe, they are the European Space Research Organization (ESRO) and the European Launcher Development Organization (ELDO). Also covered are these other European groups: CETS, EUROSPACE, and the FAI. Of primary importance are the European national space programs, because of the recent retreat to national rather than international efforts. The United Kingdom, Italy, France, and Germany have all had satellites successfully orbited in the past. The Netherlands is currently preparing their satellite, while a number of other nations provide support services for space operations. The discussion covering the Americas is also divided into international and national programs. IACSR and EXAMETNET are the American international programs investigated. At the national level, Canada is the only nation with a satellite in orbit, but Brazil, Argentina, and Mexico are working toward ambitious space objectives. The discussion of Australia-Asian space programs covers only national space programs, since there are no significant regional cooperative programs. In this area Australia, Japan, and Mainland China have enjoyed successful satellite launches. India is currently working with NASA to advance its national program, while Iran, Israel, and Pakistan participate at a lesser level. The final division of this phase concentrated on the United Nations and its role as a world space forum. Notable subdivisions cover the General Assembly, Space Committee and World Meteorological Organization.

1. PHASE IV OBJECTIVES - Each student should:

   a. Understand the development of other national space programs, besides the US and USSR programs.

   b. Know and be able to explain the three most significant international space programs.

   c. Understand how space exploration has directly benefited the common people.

2. BEHAVIORAL OBJECTIVES - Each student should be able to:

   a. List and define at least 10 national space programs.

   b. Name and list some of the activities of the three most significant international space programs.

   c. List eight other nations besides the United States and Soviet Union that have placed satellites in orbit.

   d. Give three examples to show how space exploration has directly benefited the common people.

3. SUGGESTED OUTLINE:

   a. Europe

      (1) European Space Research Organization (ESRO)

      (2) European Launcher Development Organization (ELDO)

      (3) Other Cooperative Programs

         (a) CETS

         (b) EUROSPACE

         (c) FAI

      (4) National Programs

         (a) United Kingdom

         (b) Italy

         (c) France

         (d) Germany

         (e) The Netherlands

   b. Americas

      (1) International Programs

         (a) Inter-American Committee for Space Research (IACSR)

         (b) Inter-American Meteorological Sounding Rocket Network (EXAMETNET)

(2) National Programs

(a) Canada

(b) Brazil

(c) Argentina

(d) Mexico

c. Australia-Asia

(1) Australia

(2) Japan

(3) Mainland China

(4) India

(5) Other Nations

(a) Iran

(b) Israel

(c) Pakistan

d. The United Nations: World Space Forum

(1) The General Assembly

(a) Debate Forum

(b) Space Registry

(2) The UN Committee on the Peaceful Uses of Outer Space

(3) The World Meteorological Organization

4. ORIENTATION:

a. This phase deals with important groups in the world today who are not only concerned with space research, but also concerned with the area of international cooperation. The more important groups are seeking meaningful positions in the space research field for themselves, and thereby for the countries they represent. Accomplishments by

these groups help to spread the benefits of space research more quickly through the world. The instructor should appreciate the importance of such activities to the countries involved, and should communicate that appreciation to the students. As is the case throughout this text, changes have occurred during the time since this material was written. These changes involve membership, contributions, and accomplishments by the groups, and should be brought out to the class. Be careful not to digress into accomplishments by individual members of these groups, as individual national accomplishments often do not relate to group successes. This phase is designed to make the student aware of the existence of international space research efforts of some scale by parties other than the United States and Soviet Union.

b. This phase is designed to give the student an appreciation of just how widespread the Space Age research impact has become. Although, the listing of individual national space programs is by no means complete, it is representative. Recent events have caused changes in some programs, both in emphasis and extent. Still, the listing included here should be sufficient to show that active, first hand space research is not limited to just three or four wealthy nations.

c. This phase should make clear that United Nations interest in space programs has a fairly long history, as the Space Age goes, that several agencies of the UN are taking advantage of space research findings, and that the United Nations has no program of space exploration in its own right. The force of the United Nations in this area is strictly that of worl opinion, as expressed by UN members large and small. Meaningful achievements by the UN, in the area of space agreements or any other international agreements, is inevitably dependent on successful negotiations between the parties involved.

5. SUGGESTED KEY POINTS:

a. The United States and the Soviet Union are the major and most publicized nations in space, but other countries also are involved. In an effort to accomplsh the most economically effective programs, some of these nations have banded into groups dedicated to space research. These groups

**.(V-9028H)
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may be governmental, industrial, or professional in nature. The organizations covered in this chapter are primarily governmental, however, the student should be informed of other varieties and encouraged to research and identify such programs.

* (V-9111) pp 174-175

b. The most effective space research grouping so far has been done on a regional basis, and the most effective region has been that of Western Europe. The most important group is ESRO, with its extensive plans for satellite usage. There are relatively few multinational group efforts directed toward space research in the Americas.

** (V-9028H) pp 105-191

c. Significant programs of space research require significant outlays of men and money. Few nations can afford to or care to engage in a space race with the two space giants, but many are willing to sponsor meaningful programs in cooperation with the major powers. In most cases, this cooperation is with the United States.

d. While the nations whose individual programs are listed here are considered "small" as far as space research goes -- and in comparison with the US and USSR -- in some instances their contributions to space research have not been small, and in some particulars they have outpaced both of the space giants.

e. Space research affects nations large and small and involves more than just the question of whether a nation can and should invest in it. The stakes include technological advances in many areas, a chance to share more fully in knowledge derived from space research, the need to keep promising young scientists and technicians at home, and national pride. The impact of a nation's entry into space research is felt throughout the country.

f. The function of the United Nations in the area of space is an extension of its functions in other areas: it is a forum for world opinion, it offers all member nations the chance to be heard, and it makes suggestions in the form of resolutions. The UN has a number of committees, subcommittees, and other agencies engaged in questions related to space exploration and research. One of the most important such bodies is the UN Space Registry.

** (V-9028H) Chap 2

g. Although its interest in space research and exploration is active, the United Nations itself has no program of space research and exploration. Rather, it uses the programs of its member nations to its own advantage. The UN has no binding authority over its members. The organization's function in matters of its interest is to suggest, through resolution, and hope that its members will accept the recommendations.

6. SUGGESTIONS FOR TEACHING:

a. Suggested time:

Number of Academic Periods per Week	Recommended Number of Periods for Each Phase					
	1	2	3	4	5	6
2				X		
3						X
4						X

b. Recommend slide series V-0047 International Space Programs be used as an introduction to this phase. It was developed to augment major topics of this phase. The slide series can be most effectively presented in three separate 20-30 minute sessions. A logical sequence would be: First, Launch Ranges through ELDO and ESRO space programs (slides 47-1 thru 47-24); Second, the European National programs (slides 47-25 thru 47-48); Third, the American Nations and Australasian space programs (slides 47-49 thru 47-75).

c. The combined discussion-debate approach may prove to be the best one to use at the beginning of this phase. Discussion can be centered on such topics as:

(1) Should the UN operate a more meaningful space research effort?

(2) Should nations with limited finances engage in space research?

d. After a general review of this phase through lecture, discussion, and debate, you may consider appointing four or five students as "Ministers of Science" for select foreign countries. Each "Minister" would have the challenge of briefing the class on his country's space program. These briefings should be short, but should include some history, some economics, some scientific results and some expectations.

e. A point that may cause confusion, if not clarified early, is when talking of the order in which any given nation made such-and-such an achievement since the beginning of the space program, e.g., the People's Republic of China was the 10th nation to have placed a satellite in orbit. However, China was the 5th nation to orbit a satellite with its own rocket. (The first 4 were the USSR, the US, France, and Japan.)

f. Have your students discuss some of the failures in international space cooperation efforts. They could explain the why's (and why not's) and speculate what might have made the programs succeed.

g. Give them an open end story to finish. Give the details of an operation or a joint venture and stop at a critical point. Your students must supply an ending for the story.

7. INSTRUCTIONAL AIDS:

a. 35 mm Slides

(1) V-0047 International Space Programs

b. NASA Films

(1) HQ 60 International Cooperation in Space. 23 min. Color. 1965.

(2) HQ 58 The First International Satellite. 13 min. Color. 1963.

c. Periodicals

(1) Aviation Week and Space Technology

(2) Interavia

(3) TRW Space Log

(4) Space World

(5) NASA - Historical Pocket Statistics

8. PROJECTS:

Projects in this phase have been designed to supplement the discussion, debate, and briefing periods. In each case they will either update or expand the information provided in the text.

9. FURTHER READING:

a. Most of the government sources cited, plus any additional material requested through Congress.

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PHASE V - SPACE LAW

This phase deals with the legal aspects of space exploration. It is designed to highlight the issues and treaties as they stand today and offer a limited amount of insight into their importance and development. This phase begins by overviewing some of the first developments in space law, from the Chicago Convention precedent to Sputnik I and the IGY. This overview is followed by an explanation of the critical issue of jurisdiction and sovereignty. From this key issue the discussion expands to cover the principal theories of demarcation, concluding with a summary of the current status of the unanswered question of demarcation. The next mjor division of this phase deals with current progress and the promise of future progress in space law. The first subdivision, the rules of space today, gives an opening overview of current space law by comparing it to nautical law. The second subdivision deals with the topic of law by treaty. This topic is covered by a summary of the more notable preceding actions, followed by a somewhat detailed analysis of the Outer Space Treaty. In this analysis special attention is given to the extreme degree of careful balance built into the treaty. The final two subsections summarize current and future questions of space law, respectively. Such questions as, "What is outer space?" or "Who protect consumers?", still remain unanswered.

1. PHASE V OBJECTIVES - Each student should:

   a. Understand the difference and interrelation between jurisdiction and sovereignty.

   b. Know the theories of demarcation.

   c. Understand the sources of law.

   d. Know the major space Treaties.

   e. Understand the "balance" of the Space Treaty.

   f. Understand the status of international liability in space.

   g. Be able to explain how the jurisdiction/sovereignty issue relates to defining "Outer Space."

   h. Know about some of tomorrows questions about space that will need answers.

2. BEHAVIORAL OBJECTIVES - Each student should be able to:

   a. Define the difference and interrelation between jurisdiction and sovereignty.

   b. List and discuss 8 of 10 theories of demarcation.

   c. Identify the sources of law.

   d. Identify the two major space treaties.

   e. Outline the points of "balance" in the Outer Space Treaty.

   f. Define the status of international liability in space.

   g. Identify to role of the jurisdiction/sovereignty issue in the inability to find an internationally accepted definition of "Outer Space."

   h. List some of tomorrow's questions concerning space law.

3. SUGGESTED OUTLINE:

   a. Prelude to Space Law

      (1) The Wright Brothers

      (2) 1944 Chicago Convention

      (3) Sputnik I in the IGY

   b. Jurisdiction and Sovereignty

   c. Theories of Demarcation

      (1) Usque ad Coelum

      (2) Gravitation Theory

      (3) Airspace Theory

         (a) Atmosphere theory

         (b) Aerodynamic theory

         (c) Biological theory

      (4) Theory of Satellite Orbit

      (5) The Von Karman Line

(6) Theory of Effective Control

(7) Interest Theory

(8) Security Theory

(9) Current Status of the Demarcation Issue

d. Progress and Promise

(1) The rules of space today

(2) Law by Treaty

(a) Outer Space Treaty (1967)

(b) Rescue and Return Agreement (1968)

(3) Current Questions

(a) Definition of Outer Space

(b) International Liability

(4) Future Questions

(a) Criminal Code

(b) Commercial Code

e. Conclusion

4. ORIENTATION:

a. This phase is designed to give the student a simple, but comprehensive overview of space law, its development, its importance, and its future. It assumes that the student has little or no knowledge about either law or space law. This phase seeks to create a genuine appreciation for the successes and obstacles that dominate the topic.

5. SUGGESTED KEY POINTS:

a. The most critical issue in the field of space law is the conflict between jurisdiction and sovereignty. This issue underlies almost all other issues that remain unsolved. This is the issue that has prevented agreement on a line of demarcation, a definition of outer space, and the jurisdiction to begin meaningful work in areas like space liability, criminal codes, and commercial codes.

b. There is a wide range of theories of demarcation, only a few of which have been discussed in this phase. The student should not only attempt to evaluate the ideal and practical status of the theories listed, but each student should also consider and evaluate other such theories.

c. Space law is still evolving. It has borrowed facets of both the law of the sea and the law of the air but is still unique in itself. To date, there have been but two major space treaties, and both were long in obtaining ratification by the significant space powers.

d. The challenge of the future will be to refine and apply the sound general guidelines of the Outer Space Treaty. Each student should spend some time in attempting to formalize and answer specific questions. In this manner, the student should gain an understanding of the importance of space law and the quality of the present treaties.

6. SUGGESTIONS FOR TEACHING:

a. Suggested teaching time

Number of Academic Periods per Week	Recommended Number of Periods for each Phase					
	1	2	3	4	5	6
2		X				
3			X			
4					X	

b. This phase seems conducive to student debate on a number of questions, such as the rights of sovereignty of nations over which a space satellite is flying. This question could extend to include aircraft that fly on the fringes of space. Another possible question for debate could be whether military-oriented or secret satellites should be allowed.

c. Have them devise plans for laws dealing with UFO's in inner and outer space.

d. Have your students brainstorm effective uses for space.

e. Have your students explore the problem of garbage in space (space junk).

7. INSTRUCTIONAL AIDS:

   a. Periodicals

      (1) Aerospace Historian

      (2) Aviation Week and Space Technology

      (3) Space World

      (4) Interavia

8. PROJECTS:

   a. Projects 1, 3, and 4 would make good individual and possibly group reports.

   b. Project 2 would be most effective if conducted in a mock United Nations setting with each student responsible for the position of a particular country or bloc of countries.

9. SUGGESTED READING:

   a. The best source listed is Gyula Gal. Space Law.

   b. A limited amount of support material on some of the current questions can be found in V-9115 and V-9169, Chapter 12.

PLEASE NOTE ANY SUGGESTIONS FOR IMPROVEMENT OF EFFECTIVE TEACHING METHODS ON THE BLANK SHEET AT THE END OF THIS PHASE!

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