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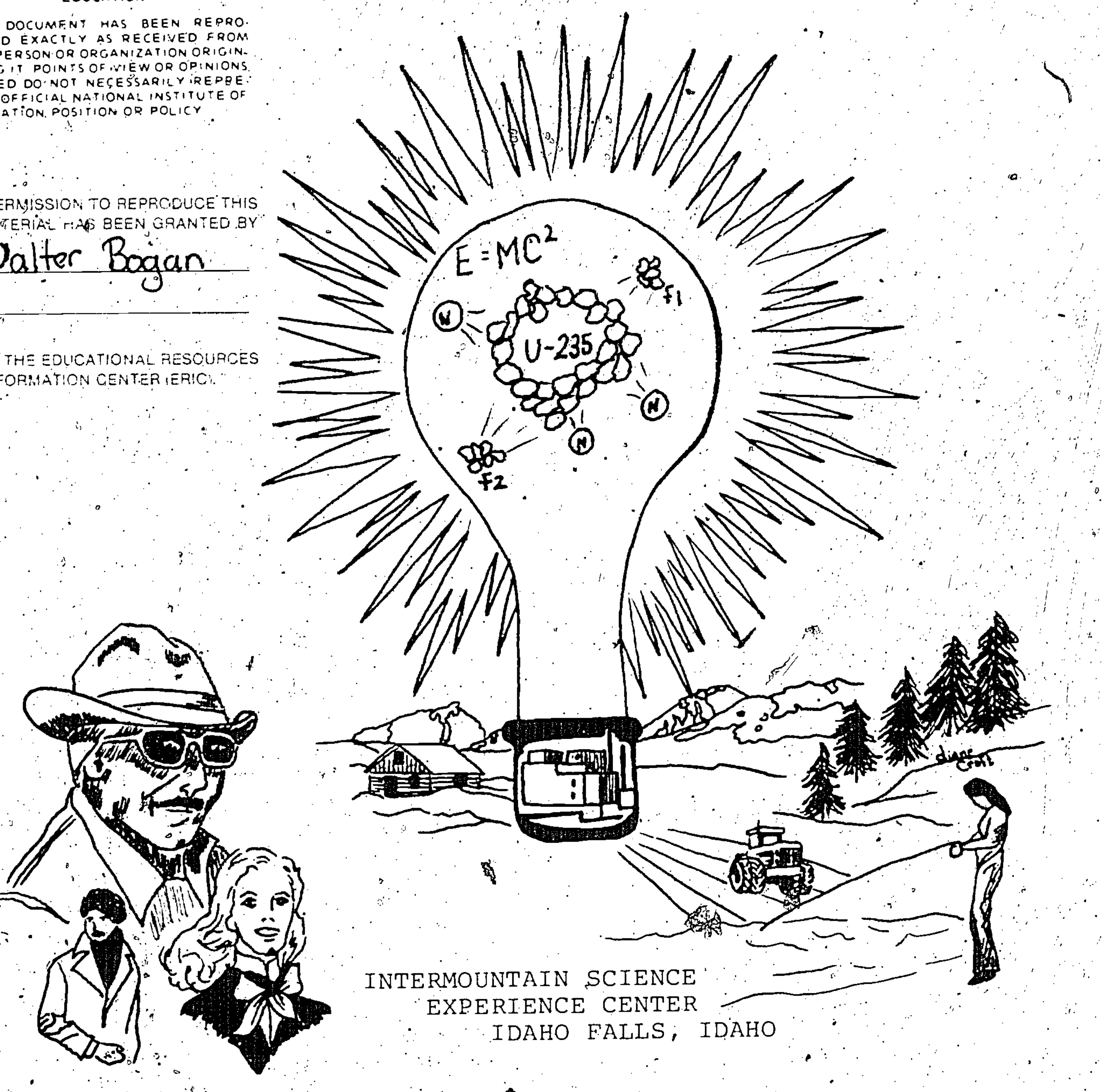
ABSTRACT

Using an interdisciplinary approach, this curriculum focuses on understanding: (1) the fundamental principles of operating a nuclear power plant; (2) the place of nuclear energy in the overall energy supply/demand situation; (3) risk-benefit balance of the major energy sources; and (4) the role of political action in developing nuclear energy sources. It is suitable for both high school courses and adults in communities where nuclear energy has become an issue. The teaching guide presents background information, possible activities and serves as a resource for the successful teaching of a topic. (Author/DS)

Teacher's Guide

INTERSEC 80-1B

CITIZEN EDUCATION ON NUCLEAR TECHNOLOGY



INTERMOUNTAIN SCIENCE
EXPERIENCE CENTER
IDAHO FALLS, IDAHO

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TEACHER'S GUIDE INTERSEC 80-1B

CITIZEN EDUCATION ON NUCLEAR TECHNOLOGY (CENT)

Prepared by the Staff of
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CITIZEN EDUCATION on NUCLEAR TECHNOLOGY (CENT)

PURPOSE AND PLAN OF CENT

The purpose of Citizen Education on Nuclear Technology is to provide students and adults with a balanced understanding of problems associated with the construction and operation of a nuclear power plant. In addition, problems common to any large industrial development, including nuclear, are discussed.

The Citizen Education on Nuclear Technology is a multidisciplinary program. All aspects of the nuclear energy issue are explored as exemplified in the five units. It is imperative, therefore, that the instructor, or instructors, be knowledgeable in all the subjects covered. For integration into a high school program, it is suggested that the material be presented in a single class of perhaps one quarter's (9 weeks) duration. The various segments can then be taught by the different members of the staff who are trained in the various disciplines.

For example, the physical science teacher takes the technology unit; a biology teacher takes the environmental/ecology unit; an economics teacher takes the economic unit; a sociology teacher takes the sociology unit; and the government teacher takes the political unit. Thus, no new teachers would be needed, and the existing staff could integrate the material into their regular classes. It is conceivable, therefore, that the students in the above classes might attend some of the units and thus be in addition to those taking the whole course.

This plan would insure that the various units would be taught by qualified personnel. A further advantage of the plan is that no new teaching personnel would be needed, and the existing curriculum would suffer a minimum disruption.

CENT was written by the staff of the Intermountain Science Experience Center (INTERSEC) and funded by the United States Department of Education.

TEACHER'S GUIDE

CITIZEN EDUCATION ON NUCLEAR TECHNOLOGY (CENT)

TABLE OF CONTENTS

CITIZEN EDUCATION on NUCLEAR TECHNOLOGY

TEACHER'S GUIDE

FOREWORD

This curriculum is based on material from a broad spectrum of sources as indicated in the student's text. It was obviously impossible to include everything available. The guiding principle was to include such items as were essential to an understanding of (a) The fundamental principles of operation of a nuclear power plant, (b) The place of nuclear energy in the over-all energy supply-demand situation, (c) The risk-benefits balance of the major energy sources, and (d) The role of political action in the development of nuclear energy sources.

A study such as this is bound to raise questions - questions peculiar to the community under study. Who should answer those questions? Many people, beginning with the Utilities, the Nuclear Regulatory Commission, and the news media. If a nuclear plant is to locate near a town, the Utility owes that town more than property taxes -- and it needs more than employees from the town. A wall has been built between the Utility and its customers. If citizens in the area learn a little of the "lingo", the mechanics of power production, and the responsibilities of the Utility, maybe a gate can be opened in that wall.

The target audience is the adult population of a community in which nuclear energy has become an issue. Included in that population are the senior high school students. The authors believe that such students are sufficiently mature that they can make rational judgements, if supplied the factual data. Many will soon be voting, if not already eligible. They, too, should be given the data. For these reasons, alternative time schedules have been prepared for different situations.

Although each of the five units and the Decision Module is treated separately in this guide, they need not be presented in that order. The various suggested schedules draw from these units as seemed desirable for the audience in question. Individual instructors may wish to use a different sequence of topics.

Experience in the pilot workshop that was held in Idaho Falls showed that the general public has an interest in the technical aspects of nuclear energy beyond that generally attributed to them. For this reason, it is recommended that the Technology Unit not be slighted on the mistaken notion that the public is not interested or capable.

While the CENT workshop is not visualized as a laboratory program, simple demonstrations can add materially to an understanding of nuclear energy. These, together with suggested films, also generate interest so essential to the learning process. It is imperative, therefore, that the instructor be competent, not only to present the curriculum material, but also to demonstrate the simple experiments suggested.

A nuclear science curriculum for high school science classes prepared by the National Science Teachers Association (in preparation) contains some simple experiments. Radiation survey instruments and dosimeters can be borrowed from the local Civil Defense office to demonstrate background radiation, radiation from radio-lite watch dials, and, with some sensitive instruments, the K-40 radiation in the human body.

A word about materials. A bibliography at the end of each section lists all the source materials used. They have been divided according to the depth of treatment. A suggested reading list is also provided of some other materials which we have found useful and/or interesting. The reference desk and catalog at the local library are the next stops for the questioning student. The Periodical Guide will give sources for all kinds of articles which are generally concise. They are also generally written with a specific point of view, and students should be encouraged to treat them as a smorgasbord and sample widely.

NUCLEAR TECHNOLOGY

Teacher's Guide

PURPOSE

A better understanding of some basic science is important for all Americans. Hence, simple explanations and examples that can be pictured clearly by the average layman help to dispel fantasies with facts.

The object of "Citizen Education on Nuclear Technology" (CENT) is to present a simplified, but factual picture of those aspects of chemistry, physics, and nuclear physics that will enable the average citizen to see how atomic energy works. By understanding its workings, American people may be better prepared to generate conclusions that are reasonable and in keeping with the real world of nuclear energy. Thus, the effects of nuclear programs on our people and environment will be better understood.

The introduction to the student's text contains a concise statement of some of the highlights in the history of science that culminated in the commercial production of power from nuclear fission.

Additional information on the contributions of the early scientists can be found in the pamphlets, Atomic Pioneers, Books 1 and 2, published by the then Atomic Energy Commission.

LANGUAGE OF TECHNOLOGY

This section lays the groundwork for the textual material that follows.

The glossary is placed early in the student's textual material for a purpose, rather than being relegated to an appendix. The definitions can be used as a means for introducing human interest items to provide a heightened inducement to learning. The names of physical units have been taken from the names of researchers who worked in the subject in question. The names in the following list were honored by having physical quantities named for them.

Alessandro Volta
James Watt
George S. Ohm
Andre Marie Ampere
Marie Curie

Library Assignments

1. Look up biographies of above personages.
2. Report on the work of these people and explain that work.
3. Do the same for other researchers.

Dmitri I. Mendeleev
William Konrad Roentgen
Antoine Henri Becquerel
Francis W. Aston
Otto Hahn
Fritz Strassmann

MATERIALS

Perhaps the most common experience a person has is his daily contact with materials. You can distinguish different materials by their feel, size, shape, color, or temperature. The study of materials as given in the student's text constitutes an area of overlap between physics and chemistry. Should additional questions arise regarding problems of chemistry, answers can be found in standard texts available in high school or public libraries. Specific texts are not listed, since a complete list would be impractical. It is recommended that local teachers or librarians be consulted.

ELECTROMAGNETIC RADIATIONS

An understanding of radiations of both the ionizing and non-ionizing types is crucial to the purposes of this course. The entire electromagnetic spectrum of radiations is placed in the proper perspective. The text strives to show the benign as well as the malignant nature of all radiations.

The teacher should emphasize the pervasive nature of electromagnetic radiation to the end that the student understands the importance of radiation as an unavoidable fact of life.

All radiation, of whatever kind, can inflict severe damage when used to excess; when used wisely, man-made radiations can confer great benefits.

Radiation Sources

Discuss Table I-3

Microwave ovens operate at radio frequencies much beyond broadcast and TV frequencies. They are a non-ionizing form of radiation. The danger is that microwave ovens interfere with heart pace-makers, and may produce burns.

Sources of ionizing radiation:

a. Ultraviolet sunlight
b. Sun lamps
c. Psychedelic poster-illuminating lamps
d. Diagnostic X-rays
e. Cancer treatment sources
f. Nuclear fission products
g. People

Sources of non-ionizing radiation:

a. Bonfires, fireplaces, wood and coal-burning heaters
b. Incandescent light bulbs
c. Sunlight
d. Radio waves
e. Microwave ovens
f. Electrical appliances that produce radio and TV interference
g. Electric toasters and similar heating devices

High-level sources (ionizing and non-ionizing that may be a hazard to health)

a. Sunlight
b. Diagnostic X-rays
c. Cancer therapy sources
d. Open fires - campfires, fireplaces, etc.
e. Nuclear fission products

1. Ask for suggestions of other possible sources in these three categories.
2. Borrow radiation detection instruments from Civil Defense office or from Physics Lab and demonstrate background radiation from luminous watch dials.
3. Interpose various materials between source and detector to demonstrate absorption. (paper, aluminum foil, glass plate)

Particle Radiations

The only significant sources are naturally radioactive ones and nuclear fission products. Cosmic rays are high energy particles. The auroras are the result of particles from the sun, trapped by the earth's magnetic field and reacting with air molecules.

Half-Life

An analogy might be drawn between radioactive decay half-life and human life expectancy. Use American experience mortality tables to illustrate the concept.

Fission

Parents interact to produce offspring who in turn interact to produce more offspring. Population thus increases until brought under control by various factors.

FISSION PRODUCTS

The question of the disposal of fission by-products is a problem that has been solved technically.

Teacher should make certain the participants understand the nature of the technical solution of the problem. Class discussion can air some of the political implications.

1. Obtain a Chart of the Nuclides.
2. Point out fission products, natural radioactive isotopes, stable isotopes.
3. Describe production of trans-uranic elements.

REACTOR SAFETY

The distinction between what is probable and what is possible should be emphasized. Certain events are physically impossible; other events, such as "death and taxes," are a certainty. Between the two is a region of uncertainty described mathematically by numbers between zero and one (1.0) called probabilities. Zero means impossible; one means a certainty.

Only after the occasion for an event has passed is it possible to assign either a zero or a one; for a rare few events, a zero or a one might be assigned in advance. Before the game is played, the probability of the home team winning lies somewhere between zero and one; after the game is played, it is zero if they lost and one if they won.

1. Assign reading in report of President's Committee on Three Mile Island accident, and in Admiral Rickover's testimony.
2. Call for oral reports on work done under (1) above.

Findings of the Kemeny Report briefly outlined.

Questions raised in that report can be made subjects for class discussion. Bring in officials of local nuclear power plant to describe measures taken to assure safe operation.

NUCLEAR REACTOR TYPES

Show block diagrams and flow sheets to illustrate types. Show diagram of typical plant with construction of fuel elements and containment vessels. (Figs. I-1 through I-5)

QUESTIONNAIRE

The questionnaire is to be presented as a learning aid rather than as a test. Answers are to be found by reference to the text. The instructor will explain any parts not understood.

Additional Reading

National Science Teachers Association, Energy From Nuclear Fission. In press.

Material in Bibliography in Technological Unit can be used as a source for special assignments.

CENT

Teacher's Guide

Answers to Technological Unit Questions

1. b
2. a
3. b
4. d
5. a
6. d
7. c
8. c
9. c
10. a
11. a
12. c
13. b
14. c
15. d
16. a
17. b
18. c
19. d
20. d
21. a
22. c
23. a
24. c
25. b
26. a
27. a
28. c
29. c
30. a
31. c
32. b
33. d
34. b
35. e
36. b
37. a
38. c
39. c
40. a
41. b
42. b
43. d
44. b
45. d
46. a
47. c
48. a
49. b
50. d
51. b
52. d

ENVIRONMENTAL/ECOLOGICAL UNIT (E/E)

Teacher's Guide

PURPOSE

The purpose of the E/E Unit is to examine the effect of the presence of a nuclear power plant on the environment and on eco-systems, and the effects on a nuclear plant of various environmental factors.

The environmental/ecological impacts of some alternative energy sources are also examined.

EFFECTS OF EXTERNAL FACTORS ON NUCLEAR PLANTS

As an example, the case of the Idaho National Engineering Laboratory west of Idaho Falls, is discussed at some length.

In preparation for this segment of the workshop, groups of students collect information on items a) through h) for their own location.

a. wind patterns
b. possible flood threats
c. seismic history
d. water sources
e. transportation arteries in relation to plant site
f. other possible uses of proposed site (agricultural, population centers, community services)
g. power use centers and distribution of excess power to other areas
h. relation of plant site to planned future growth

Assignments

1. Assign students to investigate the items a) through h) listed above for their own area.
2. Hear oral reports on Item 1 above.

EXTERNAL EFFECTS OF NUCLEAR POWER PLANTS

Identify the areas of concern:

a. radiation hazards
b. release of radioactive products
c. disposal of wastes
d. accident risk and hazards to plant employees and local residents

Questions raised by the above items constitute material for workshop discussions. Divergent opinions may be held by various community elements, such as public utilities, local government, other local industries, activist groups, the general public. Divide participants into groups representing the above interests and ask each group to discuss these items in the light of their parochial interests.

RADIATION EFFECTS

The student's text contains a form for evaluating personal exposures to natural and man-made sources of radiation. Have each participant fill out the form to evaluate his personal exposure and discuss results and how total exposure might be reduced. Additional data for use in filling out that form is contained in the student's text, Tables II-1 and II-2.

WASTE DISPOSAL

The extreme radiation intensity is reduced considerably with time. Initially, the high level of radiation is due to the many short-lived isotopes which decay quickly. Therefore, waiting a while greatly reduces the problem of handling spent fuel elements. Typically, they will be stored in a pool for 3 to 6 months before processing.

Radioactive gases can generally be released into the air in such a way that they are widely dispersed. The principal gaseous components from fission products are the gases krypton and xenon, which do not react with other elements.

Low-level solid waste materials that cannot be cleaned or decontaminated are sealed in containers and stored in special places called "burial grounds." Items contaminated with alpha-producing material are also disposed of in this way. The INEL has such a burial grounds at which encased radioactive wastes are stored temporarily.

High radiation level wastes require very special handling. The materials must be doubly contained and then shielded for transport by 4 to 12 inches of lead or equivalent other heavy material to protect people who come near.

Extensive studies have been made to select permanent waste storage sites. Proposals include storage in a deep salt mine, a cave, the sea, and even shooting the waste material into the sun or outer space. The object of waste management is to place such long-lived radioactive materials where they will not endanger man or the environment in the foreseeable future.

Dangers

If some of the high level wastes were to be dispersed, it could pose grave danger to man and to the environment. A case in point is the fear in Idaho that the steel barrels may eventually corrode, releasing lethal doses of radioisotopes to the vast and economically very important underground water aquifer. Water is supplied to this reservoir from streams like the Big Lost, Little Lost, Birch Creek, etc. The chances of contaminating the underground water significantly this way are not very great. Tests have shown that the earth filters out such isotopes in a very short distance. If some should get through, the dilution factor is very great and time also helps in this before it would get to an outlet.

Direct injection of liquid wastes into or below the reservoir has caused considerable adverse comment recently. Such injections have always been monitored closely by sampling from numerous wells down stream. No detectable amounts have ever been found more than 3 or 4 miles away, and none off the site boundary. Alternative disposal methods are currently under study. The most promising method consists of casting the calcined fission products in a pyrex-like glass and molding this material in stainless steel cylinders. This practically indestructable form could then constitute a source of low-potential heat for space heating large buildings.

Supplemental Material - Fossil Fuels

1. Acid Rain - The zoology department at the University of Toronto has expressed fears that all fish species in the 40,000 lakes of south central Ontario will disappear within twenty years. Within lakes polluted by acid rain, the heavy metal pollutants proceed up the food chain. Aquatic plants are also affected and whole lakes may become sterile.

   On land, forest growth is becoming stunted in Ontario, New England, and the Adirondacks. Contaminated snow, accumulating all winter and resulting in concentrated spring run-offs, is particularly hard on new growth. Micro-organisms which decompose forest litter to make new soil also suffer.

   Acid rain also erodes all forms of limestone, including marble. Greek and Roman antiquities are suffering damage which may soon become irreversible.

2. Health Effects - Several studies in the Chicago area have shown that increased levels of these pollutants result in increased respiratory infections, bronchitis, and higher mortality rates. In a base population of 530,000, it has been estimated that four high sulfur dioxide "episodes" per year could result in 53,000 susceptibles (severe bronchitis, asthma, genetic susceptibility to respiratory disease), whose illness responses could cost $10-20 million per year.

3. Scrubbers - Practically speaking, the addition of adequate cleansers has been solved technically, but not politically. The economic costs of installation are high, but the long-range costs to the environment, to health and eventually to industry, will be even higher.

4. Amounts of Pollutants - The amount of oxides being pumped into the air constantly increases. The U. S. is adding 30,000,000 tons per year. In Canada, a smelter puts 2,400,000 metric tons of sulfur dioxide into the air every year, from a quarter-mile high smoke stack. The pollution from that one plant extends across the Atlantic to Britain and Scandinavia.

5. Greenhouse Effect - Recent research on the production of atmospheric CO_2 from the burning of coal has shown that the worldwide average temperature might be increased by as much as 5 to 9 degrees Fahrenheit, depending on the mix of alternative energy sources used. The consequences of such a temperature rise needs to be investigated.

Discussion Questions

1. Can we live in a pollution-free society?

2. What are some other sources of radioactive wastes? (energy producers, industry, medicine, research)

3. Transport of hazardous wastes -

Discussion Points:

-----8,000 - 9,000 accidents a year involving transport of hazardous materials. 15-20 of these accidents involve nuclear materials.

-----November, 1979 - train derailments spilling dangerous chemicals occurred in Florida, Michigan, Indiana, and Ontario, Canada. In the Canadian accident, one-quarter of a million people had to be evacuated.

-----In the past three years, there have been property damages of $104.6 million dollars - all in railway accidents involving hazardous materials.

(Source: "Canada's Lesson on Train Derailments." Business Week, December 3, 1979)

a. Do you believe nuclear shipments need to be even more carefully controlled -- in what way?

b. Why are other hazardous materials not as carefully regulated as nuclear materials?

SOCIOLOGICAL UNIT

Teacher's Guide

PURPOSE

The purpose of the Sociological Unit is to assess community attitudes toward nuclear power and how such attitudes are formed, to provide data on how a community can prepare itself for normal and abnormal operating conditions of a nuclear plant, to provide a program for the dissemination of factual information on nuclear energy, and to study ways the extensive use of nuclear energy might affect a community.

COMMUNITY ATTITUDES

The questionnaire found in the student's text is to be answered, detached from the text, and turned in for analysis.

Answer sheets for the risk game are to be duplicated and handed out for completion as described.

The Risk Game

A risk is defined as the product of a probability and a consequence. In this game, a series of probabilities of a fatal accident is obtained from accident statistics of the National Safety Council and from the Atomic Industrial Forum. The probability is that of an accident and the consequence is a death resulting from that accident. The rate is stated as one death per year for the number of individuals involved. Thus, the larger the number of individuals involved, the safer that activity is.

The materials for the game consist of a game description sheet and three activities lists for each participant. The first, the risk-only list, is designated the "R" List. The second, the activities-only list, is designated the "A" List. The third, that contains both the activities and their associated risks, is designated the "AR" List.

Procedure

The purpose of the game is to evaluate the player's response to the risks of life independently of the external factors associated with the choices that one is faced with in real life. Social pressures, personal preferences, emotional bias, are all factors that could influence choices and it is of interest to discover just how much risk enters into the decision-making process. Thus, the method of conducting the game is given as follows:

Step 1: Distribute a copy of the R-list to the participants.

Step 2: The participants make a number of choices (about 7) and calculate an average by adding the indicated risks and dividing by the number of choices. This is called the R-number.

Step 3: Distribute the A-list.

Step 4: Participants make the same number of choices from the A-list, and calculate an average. This is called the A number.

Step 5: Distribute the AR-list.

Step 6: Repeat Step 4 by use of the AR-list. This is called the AR number.

The Risk Game description is given in the student's text. Alternative R-lists can be made up by the use of the AR-list and the Random Number list. R-list (I) means that the order of the items was obtained by using Column I in the Random Number list.

Analysis

The relative values of the average risks calculated for these three series indicate the role of risk.

Then the following permutations are possible:

1. R > A > AR
2. R > AR > A
3. AR > A > R
4. A > R > AR
5. A > AR > R
6. AR > R > A

Since a large number in the tabulated list of risks corresponds to low risk, the symbol R > (R is greater than) means a small risk as compared to the symbol > R (R is less than).

Normally, one would expect a rational person to choose the low risk (large number) activities, if kept in ignorance of their nature. When presented with activities but kept in ignorance of the associated risks involved, it is possible that high risk (low number) choices might be made. With a knowledge of the risk associated with each activity, the rational person would be expected to balance risk against personal preference and score somewhere between the scores on the other two series. The most likely combination, therefore is: 2. R > AR > A

Numbers 1, 4, and 5 are not considered to be of high likelihood, but could result from confusion as to the significance of the risk probabilities quoted; or possibly, some adventurous souls might wish to take chances with activities of particular interest to them. Numbers 3 and 6 might result in the case of an individual over-zealous in selecting safe activities.

NOTE: The inverted nature of the ratings, namely large number-low risk, low number-high risk is bound to cause some confusion and might account for some of the less likely permutations in the results. However, the direct relation, low-number, low risk, high number-high risk would be even more confusing because of the very small numbers involved. Such small numbers are not as readily understood because of their decimal fractional nature. In addition, the wide spread in the indicated risk is not as apparent when decimal fractions are used. It might be helpful to remember that the quoted ratings are actually the denominators of fractions for which the numerator is one (1) in every case.

The risk only list has risk values listed in a different order from that in the A- and AR-lists. The key is given in the random number listings. The (I) column was used in this instance. Different orders of risks can be assembled by use of the attached table.

RISK DATA

R-List (I)

Item	Rate
1	2800
2	7700
3	666
4	526
5	196
6	30300
7	11500
8	3850
9	3850
10	1430
11	5900
12	2,000,000
13	3850
14	9000
15	100,000
16	2860
17	1850
18	1750
19	5,000,000,000
20	2300
21	526
22	1430
23	11500
24	4000
25	11500

ACTIVITIES

A-List

1. Coal Miner
2. Lumber
3. Construction
4. Agriculture
5. Electric Utilities
6. Petroleum
7. Federal Civilian Employment
8. Steel Production
9. Cement
10. Paper Products
11. Food
12. Non-ferrous Metals
13. Chemical
14. Shipbuilding
15. Sheet Metal Products
16. Rubber and Plastics
17. Airplane Trip
18. Automotive Mfg.
19. Communications
20. Steel Products
21. Auto Trip
22. Swimming and Boating
23. Nuclear/Meteorite Strike
24. Home
25. Lightning

AR-List (III)

		x
1.	Coal Miner	196
2.	Lumber	666
3.	Construction	1750
4.	Agriculture	1850
5.	Electric Utilities	1430
6.	Petroleum	1430
7.	Federal Civilian Employment	9000
8.	Steel Production	526
9.	Cement	526
10.	Paper Products	2300
11.	Food	2860
12.	Non-ferrous Metals	2800
13.	Chemical	3850
14.	Shipbuilding	3850
15.	Sheet Metal Products	3850
16.	Rubber Plastics	5900
17.	Airplane Trip	100,000
18.	Automotive Mfg.	11,500
19.	Communications	11,500
20.	Steel Products	11,500
21.	Auto Trip	4000
22.	Swimming & Boating	30,300
23.	Nuclear/Meteorite Strike	5,000,000,000
24.	Home	7700
25.	Lightning	2,000,000

Sources: National Safety Council, Atomic Industrial Forum.

Risk equals one fatality per year per "x" individuals indicated. Hence, the larger the x, the safer the activity.

Random distributions of the numbers from 1-25

Key to be used with AR-List.

	I	II	III	IV
1.	12	24	12	17
2.	24	16	25	22
3.	02	02	21	03
4.	08	07	13	25
5.	01	06	22	19
6.	22	10	24	24
7.	19	12	10	16
8.	14	15	20	21
9.	13	11	03	05
10.	06	23	11	12
11.	16	08	23	08
12.	25	17	19	23
13.	15	22	07	11
14.	07	01	02	15
15.	17	03	08	20
16.	11	04	16	02
17.	04	18	09	18
18.	03	25	06	13
19.	23	13	18	10
20.	10	19	15	09
21.	09	20	17	04
22.	05	14	14	14
23.	18	05	04	01
24.	21	09	01	06
25.	20	21	05	07

COMMUNITY PREPAREDNESS

Community preparedness may be divided into two parts, both of which deal with disruptive influence in the community. The first, which is referred to as Social Readiness, deals with the impact of population changes resulting from rapid changes in industrial activities in the community, whether related to nuclear power or otherwise. The second deals with any calamitous event, whether man-made or natural.

Social Readiness

Examples of methods used in some communities to deal with impact of new industry:

1. Sweetwater County, Wyoming, Priorities Board; bring government and industry together on growth problems.
2. Skagit County, Washington; industry agreed to provide funds for education and law enforcement facilities and personnel as a condition of rezoning.
3. Kitsap County, Washington, Trident Coordination Office; funded by Economic Development Administration, State Office of Community Development, and some county funds - deals with impacts of developing the Trident weapons system.

Class Discussion

1. Have any population shifts occurred in your community within the last twenty-five years? How were they handled?
2. Do you have a planning committee in your community? What preparation has been made for future possible drastic population changes?
3. What are the merits or disadvantages of the steps mentioned in the three instances above?

Disaster Readiness

Since this matter is Federally mandated and responsibility is charged to the Civil Defense director, that individual is best qualified to outline for the workshop participants the plans that have been made for their community. Appendix S-3 of this unit can be made the basis for participant discussion.

COMMUNITY EDUCATION

The following discussion topics may be used to set up additional educational programs for the local community.

Discuss ways to disseminate this kind of information in the community.

a. Local high schools
b. Speaker's Bureau - notice to clubs, organizations
c. Additional workshops
d. Local television discussion shows
e. Library - sponsor programs, films, book displays
f. Public information meetings sponsored by elected officials or planning commissions

COMMUNITY USE OF ELECTRICITY

The text gives a list of consumer items, other than fuel uses, made from coal, oil, and gas. Which of these items could be made from other raw materials? Which would be impossible to make from other raw materials? Give examples -

Cotton, linen, wool for fabrics
Leather for certain plastic products

What other agricultural products could be substituted as raw materials for coal, oil, or gas?

Table III-1 lists direct usage of electricity. In what way do hidden uses of electricity enter the picture?

Before the discovery of electricity, other sources of energy were used to operate machinery; direct application of water power as in grist mills was used. Wood and coal-fired steam plants drove machinery directly. In what way do these alternatives change the social structure? Population shifts? Manpower requirements?

Additional Discussion Questions

1. What is society really willing to give up for energy conservation? What are you willing to give up?

2. How safe is safe?

3. Discuss ways to minimize the social impact of a large construction job in your area:

   a. schools
   b. commercial
   c. roads
   d. waste facilities
   e. water
   f. police
   g. fire
   h. finance

4. If an accident were to occur in your area, what communities would be threatened, and what communities might serve as evacuation centers? What preparation has been made for the following activities:

   1) shelter
   2) food services
   3) transportation
   4) medical care
   5) police protection
      a. for goods evacuees bring along
      b. policing of evacuation routes
   6) communications

5. If your community needed to be evacuated, what essential public services must be continued:

   1) police
   2) fire
   3) transportation
      a. evacuation (bus, truck, plane)
      b. for essential personnel
      c. gas stations remain open for cars leaving town
   4) food for essential personnel
   5) medical
   6) communications
   7) coordination between local officials, NRC, state officials

ECONOMIC UNIT

Teacher's Guide

PURPOSE

The purpose of the Economic Unit is to present factual data relative to the production of electrical power by nuclear methods. Comparative costs of alternative energy sources are also presented.

POWER PRODUCERS

Stockholder-Owned Public Utilities

The place of stockholder-owned public utilities in the American economy may be assessed by a consideration of the number and financial magnitude of the public utility companies as compared to government owned and operated systems.

Class assignments: Consult data available from stock brokerage offices on the financial position of local public utilities; list such items as stockholders equity, total capitalization, gross profit, taxes paid, resulting net profit, dividends paid, retained earnings. Inquire as to the disposition of retained earnings; what parts are retained as cash deposits, new equipment, equipment maintenance and replacement, or other uses.

Federal Agency Produced Power

The argument usually advanced in favor of Federally-produced power is that it is cheaper and makes available electric power in areas where it might not otherwise be obtainable.

Class Assignments: Examine the above argument. How do rates compare with public utility rates? How would rates be affected if Federal systems paid taxes?

Federal systems also have capital investments that must be repaid, and on which interest is paid. What is the source of the funds that constitute such investments?

POWER COSTS

The discussion suggested in the above sections implied that cost factors would be included. Not mentioned was the distribution cost; how does the cost of transporting energy affect rates?

Transportation Costs

The reference quotes cost figures for various methods of transporting energy. What factors, other than strictly monetary considerations, might justify the use of the higher-priced transmission by electric high-line? What would be the effect of decentralizing energy production to minimize the need for electric high-lines?

Discussion Topics

1. Effect on local industry due to availability of additional power-
   Suggestions:
   a) existing industry could expand
   b) additional industry could locate in town resulting in:
      1) expanded market for local merchants
      2) more jobs
      3) increase in tax base
      4) multiplier effect of dollars spent in community
   c) strong impetus to construction market
      1) jobs
      2) equipment sales and rentals
2. Adverse economic impact due to existence of nuclear plant -
   Suggestions:
   a) possible loss of potential industry because of fear of locating near nuclear
   b) possible loss of area residents
   c) inflation due to boom during construction period
3. Adverse economic impact due to absence of nuclear plant -
   Suggestions:
   a) unable to attract new industry
   b) loss of job opportunities/multiple effect
   c) loss of big tax payer
   d) loss of salaries
      1) INEL - FY1979-(Oct., 1978-Sept. 30, 1979)
         $120 million + 25% in fringe benefits (payments under medical insurance, etc.)
   e) loss of market
      1) INEL - FY1979 - purchases from local business $14.1 million

4. If states were to redistribute property taxes from nuclear power plants on a statewide basis, what impact would this have on other property tax collections:

-----from other electricity-generating plants?

-----from other industry

-----from other sources? (homes, agriculture, business)

5. Impact of conservation on nation's economy -

Discussion Points:

-----U. S. productivity is tied to an energy-intensive industry.

-----U. S. consumes 30-35% of world's energy today. 20% of it is used by six industries (primary metals; chemicals; petroleum and coal; stone, clay and glass; paper; and food). Other industries use 20%; 25% transports people and goods; 33% is used in commercial and residential buildings, mostly for heating and cooling.

Source: "Citizens Workshop on Energy and the Environment Handbook," U.S. Department of Energy, 1978.

a. What responsibility does this nation have to keep, and expand, its productivity levels?

b. U. S. industry, including agriculture, feeds and supplies many people around the world. To what extent will energy conservation influence our ability to provide for others?

6. If fewer miles are driven, less gasoline is purchased. If less gasoline is purchased, fewer gasoline taxes are collected. In most areas, gasoline taxes help pay for road building and maintenance-if less money is available, how will these necessary activities be financed?

-----Carry this thought over to other areas where energy conservation can be practiced. What are some potential effects?

(By no means is this a criticism of energy conservation. The U. S. has lived with cheap energy and a massive, growing energy appetite; we must all learn to accept limitations of that appetite. However, we must also reckon with the impact which conservation may have on our economy.)

POLITICAL UNIT

Teacher's Guide

PURPOSE

The purpose of the Political Unit is to consider the formation of a national energy policy, including reactor licensing, liability insurance, operating regulations, and the political aspects of policy decisions.

REACTOR LICENSING

Licensing procedures are discussed in the text. The following questions can be used to spark participant discussion.

1. Can the length of time of the licensing procedures be reduced while protecting the rights of all concerned in the hearing and adjudication process?
2. The nuclear industry is considering the establishment of the Institute of Nuclear Power Operations. The goals of the Institute include better operator training, better emergency management, and evaluation and audit of safety programs. To what extent do you believe the industry can or should police itself?
3. Do you feel all electricity generating plants should go through federal licensing procedures? Why?
   a. Air, water, land pollution crosses jurisdiction lines
   b. Coordination of sites of energy needs and sources
   c. Other

LIABILITY INSURANCE

Discussion Question:

1. What are the reasons for the Price-Anderson Act? Is government-backed insurance preferable to private insurance, or vice versa?

OPERATING REGULATIONS

Since the Three Mile Island incident, there has been a change in the official position on regulations; this is largely the result of the findings of the President's committee to investigate that incident. The report of that committee and the testimony of Admiral Rickover before Congress should be consulted and discussed in the workshop.

NUCLEAR POLICY

United States' policy regarding nuclear energy is set, as in all other matters, by the joint actions of the three branches of government. Congressional action is embodied in the Atomic Energy Act of 1954, the National

Environmental Policy Act of 1969, and the Energy Reorganization Act of 1974. The President has recently made significant policy decisions in specific cases, such as the closing of the Clinch River Fast Breeder project. The courts have also ruled in several nuclear energy-related cases. By means of the following discussion questions, workshop participants should be urged to express their opinions as to the proper role of the three branches of government in setting nuclear energy policy.

1. Nuclear Jurisprudence -

   Discussion Points:

   -----In 1978, the U. S. Supreme Court, in a unanimous decision, accused the U. S. Court of Appeals for the Dist. of Col. of "unwarranted interference with Federal nuclear energy policy." Justice Rehnquist said, "Nuclear energy may some day be a cheap, safe source of power or it may not. But Congress had made a choice to at least try. The fundamental policy questions...are not subject to re-examination in the Federal courts."

   -----In New Hampshire, the utility building the Seabrook nuclear power plant was ordered by the courts to build a sea wall to protect the plant against a tidal wave which might occur once in a million years.

   (Source: "Judges, Stay Out," <u>Newsweek</u>, April 17, 1978
   "Speeding Up the Nuclear Plants," <u>Time</u>, September 5, 1977)

   a. To what extent do you feel the courts should be involved in licensing and construction suits?

   b. How can the rights of those opposed to or concerned about construction of nuclear plants be balanced against the rights of:

      ---the utilities and their stockholders
      ---the citizens who need/want the electricity the plant would produce

2. The political decision-makers of the country are presumed to echo many opinions held by their constituents. How can those opinions best be conveyed to the representatives of the constituents?

   Discussion Points:

   -----Many scientists feel the technical problems of nuclear waste disposal have been solved. It requires a political decision to implement.

   -----Scrubbers could remove 97% of the particulates from fossil-fueled plants. On February 28, 1980, an EPA administrator estimated that it would take 10 years to pass necessary laws to control acid rain.

3. Assuming a decision to require conservation of energy resources, how would you implement the decision to impact everyone fairly?

    a. Increasing cost of energy
    b. Loss of jobs
    c. Inability to transport goods, people, services
    d. Reduction in living standards

Look up and report on the court decisions in the following cases:

1. Calvert Cliffs Coordinating Committee vs. USAEC, U. S. District Court of Appeals, District of Columbia Circuit Court.
2. Scientists' Institute for Public Information, Inc., vs. USAEC, U. S. District Court of Appeals, District of Columbia, Federal Reporter, 481 F. 2nd 1079 (1973).

Discuss the findings of the Media Institute in the case of the role of TV in forming public opinion. See the brochure, "Television Evening News Covers Nuclear Energy," the Media Institute, 1627 K Street N. W., Suite 201, Washington, D. C. 20006.

DECISION MODULE

Teacher's Guide

PURPOSE

The purpose of the Decision Module is to provide a procedure for making decisions based on a rational judgement of all facets of the situation. The decisions may be made by community officials charged with responsibilities of government. Or, they may be made by individual citizens or citizen's committees attempting to formulate recommendations to their representatives in government.

ELEMENTS OF DECISION MAKING

1. Request the class to list priorities. From the list supplied, make up a master list containing those items appearing most often in the individual lists.

2. Repeat 1, in which class lists alternatives, with advantages and disadvantages. Make a master list as before.

Do 3 and 4 as indicated in the text.

A procedure is outlined in the day schedule for high schools for the conduct of mock hearings on a nuclear-power plant proposal. For other class situations, that outline might need to be modified.

MATERIALS FOR DECISION-MAKING

The subject matter of the text, references appended to each unit, and publications from the selected list of readings in Appendix I of this Guide constitute a supply of materials. It is also recommended that inquiries be made at the public library, Office of the Director of Civil Defense, and public relations officers of local utilities.

APPENDIX I

SUGGESTED READING LIST

There are plenty of materials available today on all aspects of energy production, impacts and conservation. The reference desk at the local library is an ideal place to begin your search for more information. The Readers Guide to Periodical Literature will direct you to articles in all kinds of magazines and journals. The Department of Energy, the Atomic Industrial Forum, utility companies, activist organizations such as the Sierra Club, Ralph Nader's organization and others, are all sources of information which originate from a particular point of view. Keep that in mind as you read.

One of the tried and true publications for readable information is the National Geographic. During the past several years, there have been many articles which you might find interesting. These include:

What About Nuclear Energy, April, 1979
Natural Gas, How Much? How Soon?, November, 1978
Oil: The Dwindling Treasure, June, 1974
New Energy from An Old Source: The Wind, December, 1975
Solar Energy, the Ultimate Powerhouse, March, 1976
What's Happening to Our Climate, November, 1976
Man's New Frontier - The Continental Shelf, April, 1978
Sailing With the Supertankers, July, 1978
World's Worst Oil Spill, July, 1978

and from the Smithsonian:

It Takes Energy to Get Energy, December, 1974

A series of short publications called Factsheets are available from the Department of Energy, Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee, 37830. They were prepared by the National Science Teachers Association. Topics include:

1. Fuels from Plants (Bioconversion)
2. Fuels from Wastes (Bioconversion)
3. Wind Power
4. Electricity from the Sun I: (Solar Photovoltaic Energy)
5. Electricity from the Sun II: (Solar Thermal Energy Conversion)
6. Solar Sea Power (Ocean Thermal Energy Conversion)
7. Solar Heating and Cooling
8. Geothermal Energy
9. Energy Conservation: Homes and Buildings

10. Energy Conservation: Industry
11. Energy Conservation: Transportation
12. Conventional Reactors
13. Breeder Reactors
14. Nuclear Fission
15. New Fuels From Coal
16. Energy Storage Technology
17. Alternative Energy Sources: Environmental Impacts
18. Alternative Energy Sources: A Glossary of Terms
19. Alternative Energy Sources: A Bibliography

APPENDIX II

Post-Course Questionnaire

This questionnaire is designed to measure your evaluation of the material offered in this workshop.

1. How much do you think your attitude has been changed?

   a) Not at all
   b) Only a very little
   c) A moderate amount
   d) A complete reversal

2. What is your present attitude toward nuclear power?

   a) Opposed
   b) Opposed, but with reservations
   c) In favor, but with reservations
   d) In favor

3. What is your present attitude toward alternative sources of energy?

   a) Anything but nuclear
   b) Some nuclear, but mostly other
   c) Some other, but mostly nuclear
   d) All nuclear

4. What is your opinion as to the nature of the material presented?

   a) Factual material, biased
   b) Factual material, somewhat biased
   c) Factual material, only slightly biased
   d) Factual material, fairly presented

5. What is your opinion as to the value of this workshop?

   a) Of no value at all
   b) Of some small value
   c) Valuable, but could be made better
   d) Of great value as presented

6. Indicate which areas you think need improvement:

   a) Technical
   b) Sociological
   c) Environmental/Ecological
   d) Economic
   e) Political
   f) All of the above
   g) None of the above

Additional Comments:

7. What kinds of improvement would you recommend?

a) More factual data
b) Less factual data
c) More time devoted to discussions
d) Less time devoted to discussions
e) More task assignments
f) Fewer task assignments
g) More audio-visual aids
h) Fewer audio-visual aids

Additional Comments:

8. How would you rate the overall organization?

a) Very bad
b) Not so good
c) Not too bad
d) Very good

9. How would you rate the instructors?

a) Very bad
b) Not so good
c) Not too bad
d) Very good

10. What additional suggestions do you have that could improve both the content and the manner of presentation of this workshop?

CITIZEN EDUCATION ON NUCLEAR TECHNOLOGY (CENT)

APPENDIX III

Teacher's Guide
Secondary Schools (11th and 12th)

Instructor Qualifications

The Citizen Education on Nuclear Technology is a multidisciplinary program. All aspects of the nuclear energy issue are explored as exemplified in the five units. It is imperative, therefore, that the instructor, or instructors, be knowledgeable in all the subjects covered. For integration into a high school program, it is suggested that the material be presented in a single class of perhaps one quarter's (9 weeks) duration. The various segments can then be taught by the different members of the staff who are trained in the various disciplines.

For example, the physical science teacher takes the technology unit, a biology teacher takes the environmental/ecology unit; an economics teacher takes the economic unit; a sociology teacher takes the sociology unit; and the government teacher takes the political unit. Thus, no new teachers would be needed, and the existing staff could integrate the material into their regular classes. It is conceivable, therefore, that the students in the above classes might attend some of the units and thus be in addition to those taking the whole course.

This plan would insure that the various units would be taught by qualified personnel. A further advantage of the plan is that no new teaching personnel would be needed, and existing curriculum would suffer a minimum disruption.

Course Schedule

First Week

1st Day

Sociological Unit - Class completes questionnaire on Community Attitudes - Appendix S-1 of Student's Text.

2nd Day

1. Sociological Unit - Class completes Risk Game, Appendix S-2, Sociological Unit.
2. Teacher discusses results of Risk Game.
3. Assigns Introductory material in Student Text for discussion on first day, 2nd week.

3rd Day

1. Complete unfinished business on attitudes questionnaire and Risk Game.

2. Technology Unit - Teacher introduces technological material by use of Teacher's Guide.

3. Assigns Tech. material through Language of Technology and Glossary of Terms in Technology Unit.

4th and 5th Day

1. Teacher explains or amplifies definitions in Glossary, as needed.

Second Week

1st Day

1. Discuss scope of program; pose questions from Teacher's Guide.

2. Assign projects for library work from Environmental, Economic, Sociological, and Political Units.

2nd Day

1. Continue discussion of terms in Glossary as needed.

2. Assign sections on Materials and Radiation in Student's Text.

3rd, 4th, 5th Day

1. Simple experiments from Reference 1.

2. Explain Materials and Radiation, as needed.

3. On 5th day, assign sections Half-life, Fission, Fission Products.

Third Week

1. Assign remainder of Technology Unit.

2. Discuss and explain answers to questions in Technology Unit questions.

Fourth Week

1. Receive reports, oral and written, on assignments made on Environmental Unit.

Fifth Week

1. Receive reports, oral and written, on assignments made on Economic Unit.

41

Sixth Week

1. Receive reports, oral and written, on assignments made on Sociological Unit.

Seventh Week

1. Receive reports, oral and written, on assignments on Political Unit.

Eighth Week

1. Complete discussion of reports on various units.

2. Explain any matters on any questions yet unanswered.

Ninth Week

1. Divide class into three groups:

   A. Industry group proposes to build a nuclear power plant.
   B. A citizen group is to decide whether or not they want the nuclear plant in their community.
   C. An intervenor group representing national and local interests opposes the construction of a nuclear power plant.

2. The week scheduled as follows:[1]

   Day One & Two - groups prepare for the hearings.

   Day Three - Industry group presents its case.

   Day Four - Intervenor group presents its case.

   Day Five - Citizen group discusses the evidence presented and makes its decision.

[1] Use material in Decision Module.