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ABSTRACT

This brochure contains an activity for grades 9-12 that involves students in an examination of real versus perceived risks. Students perform a risk factor analysis, and evaluate benefits and risks of energy sources. The activity can be conducted by individuals or small groups. Students rank a series of life-threatening risks and compare them to other classmates or groups and average the results. The class rankings are compared to rankings created by several professional groups and the actual number of deaths per risk factor in 1982. Students quantify the perceived risk factor associated with each risk and plot the results on a "Risk Factor Analysis Plot Grid." Finally, students apply the method to an analysis of energy decisions related to energy sources and their risks. Teacher instructions provide 10 reference materials and 8 resources, background information, procedure for the activity, discussion questions, and extensions. Worksheets are included. (LZ)

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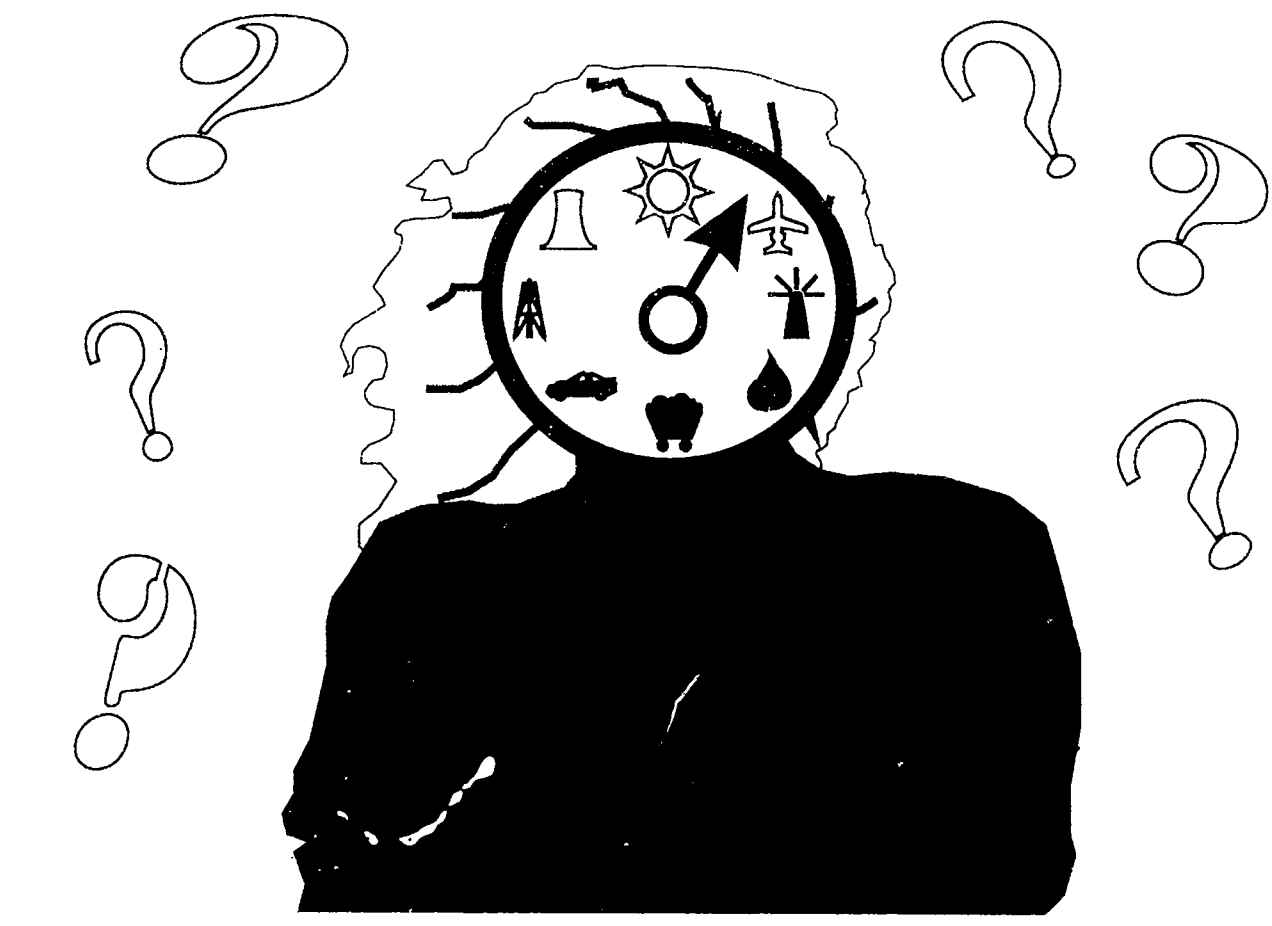

Grades 9-12
October 1994

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Risk Assessment and Energy Choices

Grades 9-12
October 1994

RISK ASSESSMENT AND ENERGY CHOICES

Grade Level: High school

Subjects: General Science, Technology, Energy Resources, Mathematical Factor Analysis

Objectives: Students will examine real versus perceived risks, perform a risk factor analysis, and evaluate benefits and risks of energy sources.

Materials: Reference materials such as encyclopedia, data bases, etc.
Books such as

Encyclopedia of Energy, McGraw-Hill, Inc.
Energy and Resource Quality: The Ecology of the Economic Process, Charles A. Hall, Cutler J. Cleveland, and Robert Kaufman; John Wiley and Sons.
Energy Deskbook; Samuel Glasstone; Van Nostrand Reinhold Company.
Energy Primer: Solar, Water, Wind, and Biofuels; Portola Institute; Fricke-Parks Press, Inc.
Energy - Readings from Scientific American, W. H. Freeman and Co.
Environmental Hazards: Communicating Risk as a Social Process, Sheldon Krimsky and Alonzo Plough, Auburn House
Future Energy Alternatives, Ray Meador, Ann Arbor Science.
Improving Risk Communication, National Research Council, National Academy Press
Life is in the Balance; Dow Chemical, U.S.A.
Renewable Sources of Energy, International Energy Agency.

Resources:

Safe Energy Communication Council
1717 Massachusetts Ave, N.W.
Suite 805
Washington, D.C. 20036
(202) 483-8491

OCRWM Information Center
Curriculum Department
P.O. Box 44375
Washington, D.C. 20026
(800) 225-6972

American Coal Foundation
1130 17th St., N.W., Suite 220
Washington, D.C. 20036
(202) 466-8630

American Gas Association
4220 King St.
Alexandria, VA 22302
(703) 379-2480

American Nuclear Society
Public Communications Department
555 North Kensington Ave.
LaGrange Park, IL 60525

American Petroleum Institute
Public Relations Department
1220 L St., N.W.
Washington, D.C. 20005
(202) 682-8000

American Solar Energy Society
2400 Central Ave., Suite G-1
Boulder, CO 80301
(303) 443-3130

American Wind Energy Association
122 C St., N.W., Suite 400
Washington, D.C. 20001
(202) 408-8988

BACKGROUND:

Throughout history, people have faced risks in every facet of their lives, especially when new technologies are introduced. Each technology developed offers benefits to humans who accept the risks involved. Fire, electricity, and fuel-powered transportation involve their own unique risks, but now we wouldn't want to live without them. Yet people still oppose new technologies when they don't fully understand the risks and benefits.

Some risks are real and unavoidable, some risks are only perceived, or are controllable. Often the government is involved in regulating risky activities or protecting people from excessive risk. Insurance companies hire actuaries whose jobs are to evaluate risk and help determine costs of coverage.

PROCEDURE:

A. RISKS IN LIFE

1. Individually or in small groups, brainstorm a list of 10 to 20 risky activities people face or engage in. Share your list with the class to compile a class list.

2. Rank 20 items from the class list according to their riskiness. Rank the riskiest behavior as #1, and the least risky as #20.

3. Share your ranking with another group.

Questions:

(a) Do most people agree in their rankings?

(b) What factors did people use to decide the riskiest activity? (physical harm, pain, experience, etc.)

(c) Why do people participate in the riskiest activities?

B. RISK FACTOR ANALYSIS

1. On the "Risk Ranking Chart" rank the risks from 1 to 30, with 1 being the riskiest.

2. In the columns "Rankings of Others" list the ranks from 3 other classmates or groups.

3. In the column "Average Ranking" write the average of your rankings and the other three.

Questions:

(a) Does everyone agree in their rankings?
(b) Can someone be wrong in perceiving risk?

4. Use "1982 Ranking of Causes of Death in the U.S."chart to compare your rankings to the League of Women Voters, college students, business professionals, risk assessors, and the actual statistics about the number of deaths.

Questions:

(a) Why was risk evaluated in terms of "Causes of Death" and not injuries or some other factor?
(b) How would statistics such as risk of death be used in business?
(c) If 50,000 Americans died in 1982 from car accidents, but only 1300 died in private aviation accidents, and 2800 died in surgery, why is the fear of flying and surgery so much stronger than the fear of driving?
(d) What factors cause fear?
(e) What factors cause a person's fears to increase or decrease?
(f) Can learning more about a perceived risk cause someone to change his/her mind about how fearful it is?

5. Use the "Risk Factor Analysis Value Rankings" to fill in the "Risk Factor Analysis Value Ranking Sheet" and the "Risk Factor Analysis Plot Grid"

Risk Ranking Chart

RANKINGS	You	Other	Other	Other	Average	1982
1. Alcoholic beverages						
2. Bicycles						
3. Commercial aviation						
4. Contraceptives						
5. Electric power						
6. Fire fighting						
7. Food coloring						
8. Food preservatives						
9. Football (HS and college)						
10. General (private) aviation						
11. Handguns						
12. Home appliance						
13. Hunting						
14. Large construction						
15. Nuclear power						
16. Motorcycles						
17. Motor vehicles						
18. Mountain climbing						
19. Pesticides						
20. Police work						
21. Power mowers						
22. Prescription antibiotics						
23. Railroads						
24. Skiing						
25. Smoking						
26. Spray cans						
27. Surgery						
28. Swimming						
29. Vaccinations						
30. X-rays						

1982 Ranking of Causes of Death in the U.S.

RISK FACTOR	League of Women Voters	College Students	Business Profes-sionals	Risk Assessors	Cause of Death 1982	No. of Deaths 1982
1. Alcoholic beverages	6	7	5	3	2	100,000
2. Bicycles	16	24	14	15	13	1,000
3. Commercial aviation	17	16	18	16	19	130
4. Contraceptives	20	9	22	11	18	150
5. Electric power	18	19	19	9	5	14,000
6. Fire fighting	11	10	6	18	16	195
7. Food coloring	26	20	30	21	26	1
8. Food preservatives	25	12	28	14	27	1
9. Football (HS and college)	23	26	21	27	23	23
10. General (private) aviation	7	15	11	12	11	1,300
11. Handguns	3	2	1	4	4	17,000
12. Home appliance	29	27	27	22	15	200
13. Hunting	13	18	10	23	14	800
14. Large construction	12	14	13	13	12	1,000
15. Nuclear power	1	1	8	20	20	100
16. Motorcycles	5	6	2	6	6	3,000
17. Motor vehicles	2	5	3	1	3	50,000
18. Mountain climbing	15	22	12	29	21	30
19. Pesticides	9	4	15	8	28	1
20. Police work	8	8	7	17	17	160
21. Power mowers	27	28	25	28	22	24
22. Prescription antibiotics	28	21	26	24	29	1
23. Railroads	24	23	20	19	10	1,950
24. Skiing	21	25	16	30	24	18
25. Smoking	4	3	4	2	1	150,000
26. Spray cans	14	13	23	26	30	1
27. Surgery	10	11	9	5	8	2,800
28. Swimming	19	30	17	10	7	3,000
29. Vaccinations	30	29	29	25	25	10
30. X-rays	22	17	24	7	9	2,300

Risk Factor Analysis Instructions

There are many factors that people consider when assessing what RISK means to them. Some of the factors are whether we perceive the risk to be:

- within our control
- voluntary or accidental
- fatal or noninjurious
- catastrophic or just affecting one person
- long or short duration
- feared by everyone or by few
- known or unknown consequences
- damaging to future generations or not

In this risk factor analysis, you will be asked to assess each risk based on two factors:

- FACTOR 1 : Unknown/Known
- FACTOR 2 : Non fear/Dread

Record your assessment on the table provided using a scale of 9 to 1 with 9 being a high value and 1 being a low value. When you have finished all the risks, plot and label each one on the "Risk Factor Analysis Plot Grid".

VALUE RANKINGS

FACTOR 2
UNKNOWN
- Not Observable
- Unknown to those exposed
- Effects delayed/long-term
- New risk
- Risks unknown to science

FACTOR 1
NON-DREADED
- Controllable
- Not globally catastrophic
- Non-fatal effects on individual only
- Low risk to future generations
- Easily reduced
- Voluntary
- Risk is decreasing

9
(high)
↑
↑
↑
1 (low)←←←Value Ranking→→→(high) 9
↓
↓
↓
(low)
1

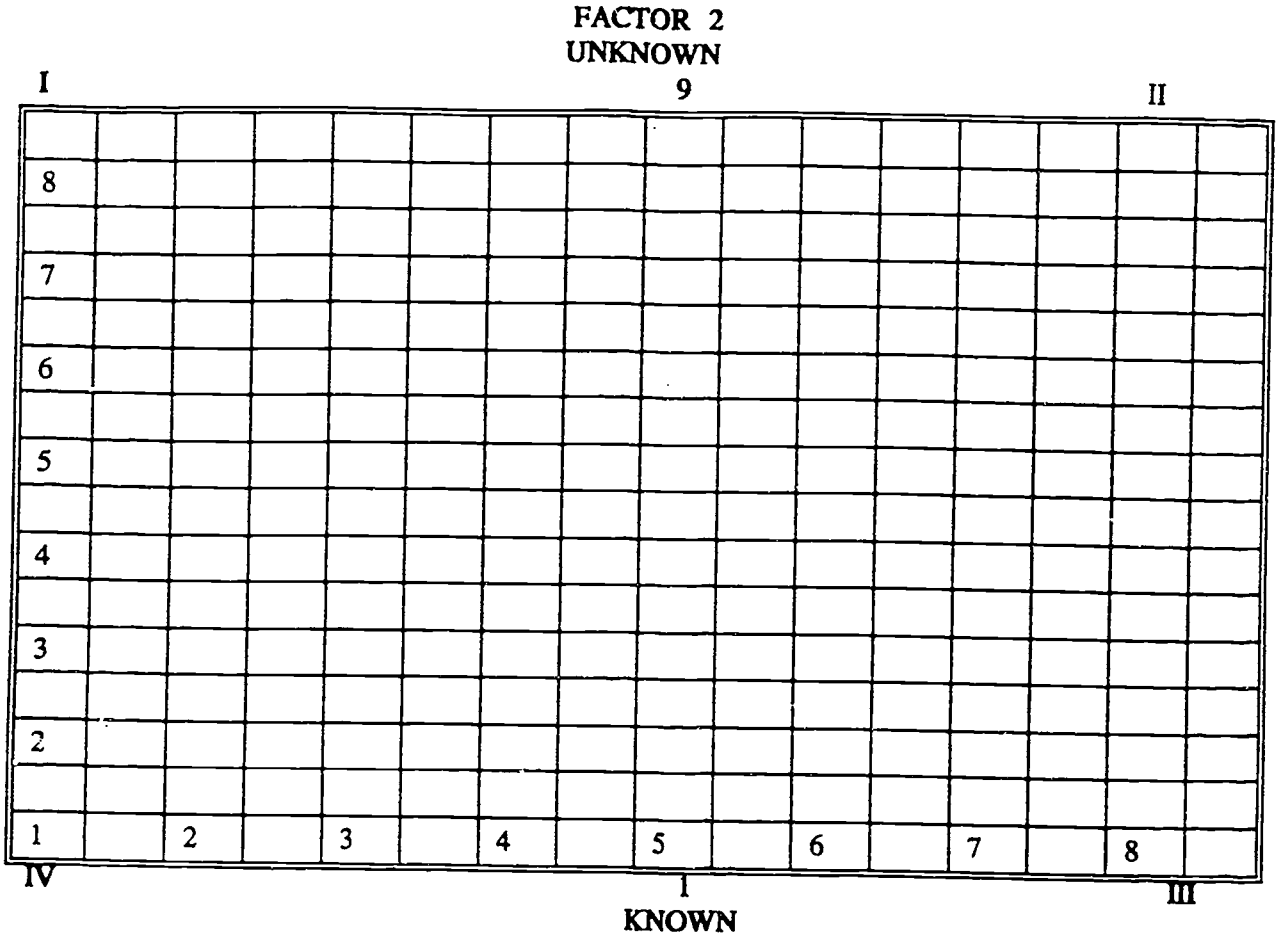
FACTOR 1
MUCH DREADED
- Uncontrollable
- Globally catastrophic
- Always fatal consequences effecting large populations and areas
- High risk to future generations
- Not easily reduced
- Involuntary
- Risk is increasing

FACTOR 2
UNKNOWN
- Observable
- Known to those exposed
- Effect immediate/short-term
- Old risk
- Risks long known to science

Risk Factor Analysis Value Rankings

RISK	FACTOR 1	FACTOR 2
	Non-Dreaded 1 ——— 9 Much Dreaded	Known Risk 1 ——— 9 Unknown Risk
1. Alcoholic beverages		
2. Bicycles		
3. Commercial aviation		
4. Contraceptives		
5. Electric power		
6. Fire fighting		
7. Food coloring		
8. Food preservatives		
9. Football - scholastic		
10. General aviation		
11. Handguns		
12. Home appliances		
13. Hunting		
14. Large construction		
15. Nuclear power		
16. Motorcycles		
17. Motor vehicles		
18. Mountain climbing		
19. Pesticides		
20. Police work		
21. Power mowers		
22. Prescription antibiotics		
23. Railroads		
24. Skiing		
25. Smoking		
26. Spray cans		
27. Surgery		
28. Swimming		
29. Vaccinations		
30. X-rays		

Risk Factor Analysis Plot Grid



Quadrant I -- Unknown, nonobservable new risk with long-term effects. Very controllable, non-fatal, voluntary risk that is decreasing.

Quadrant II -- Unknown, nonobservable new risk with long-term effects. Uncontrollable, always fatal, catastrophic to many, and risk will damage future generations.

Quadrant III -- Well known, observable, and immediate risk with known short-term effects. Very controllable, nonfatal, voluntary risk that is decreasing.

Quadrant IV -- Well known, observable, and immediate risk with known short-term effects. Uncontrollable, always fatal, catastrophic to many, and risk will damage future generations.

C. ENERGY DECISIONS

1. Fill in the "Energy Ratings Chart #1" according to its directions.
2. Individually or in a small groups, collect information about one of the energy sources from the chart: find benefits, drawbacks, and as much information as you can in the time allotted about the categories on the ratings chart.
3. Share your findings with the class in the form of a computer presentation, video presentation, talk illustrated with posters or transparencies, or dramatic presentation.
4. After hearing the presentations about each energy source, fill in the "Energy Ratings Chart #2".

Questions

(a) Which type of energy had the highest rating in chart #1?
In chart #2?

(b) Which energy source had the lowest rating in chart #1?
In chart #2?

(c) Do other groups agree with your ratings?

(d) Which energy sources did you change your mind about?
Why?

(e) What risks must people accept if they use the #1 rated energy source?

EXTENSIONS

Research the viewpoints of people who opposed new technologies in the past. What were their fears? What actions did they take to protest the technology?

Look for news of people opposed to currently developing technologies. What are their fears? How is government involved in regulation or protection?

What laws have been enacted to protect people from what is believed to be excessively risky activity?

Research famous people in history who took risks, and list the benefits for the individual or society that resulted.

What are some risks people face locally? What can be done to reduce the risk? What are the costs of reducing the risks?

Research recent statistics about causes of death and see if there has been a change since 1982.

Find out what type of safeguards are in place to protect people from excessive exposure to toxins or radiation (occupational safety or public safety).

Energy Ratings Charts

Rate each energy source in the following categories on a scale from 1 to 5.
Very favorable = 1 Very unfavorable = 5
Add up the scores and take an average of the total.

Energy Ratings #1

DESCRIPTION	Nuclear	Natural gas	Coal	Hydro-electric	Wood	Geo-thermal	Solar Power	Wind power	Petro-leum	Shale Oil	Tidal Power
Power Source											
Amount of Energy Produced											
Viability											
Cost											
Air Pollution											
Water Pollution											
Public Acceptance											
Amount of Waste produced											
Aesthetics											
Waste Transport											
Environmental Impact											
TOTAL											
AVERAGE											

Energy Ratings #2

DESCRIPTION	Nuclear	Natural Gas	Coal	Hydro-electric	Wood	Geo-thermal	Solar Power	Wind Power	Petro-leum	Shale Oil	Tidal Power
Power Source											
Amount of Energy Produced											
Viability											
Cost											
Air Pollution											
Water Pollution											
Public Acceptance											
Amount of Waste produced											
Aesthetics											
Waste Transport											
Environmental Impact											
TOTAL											
AVERAGE											