U.S. Department of Energy

Solar Energy Education

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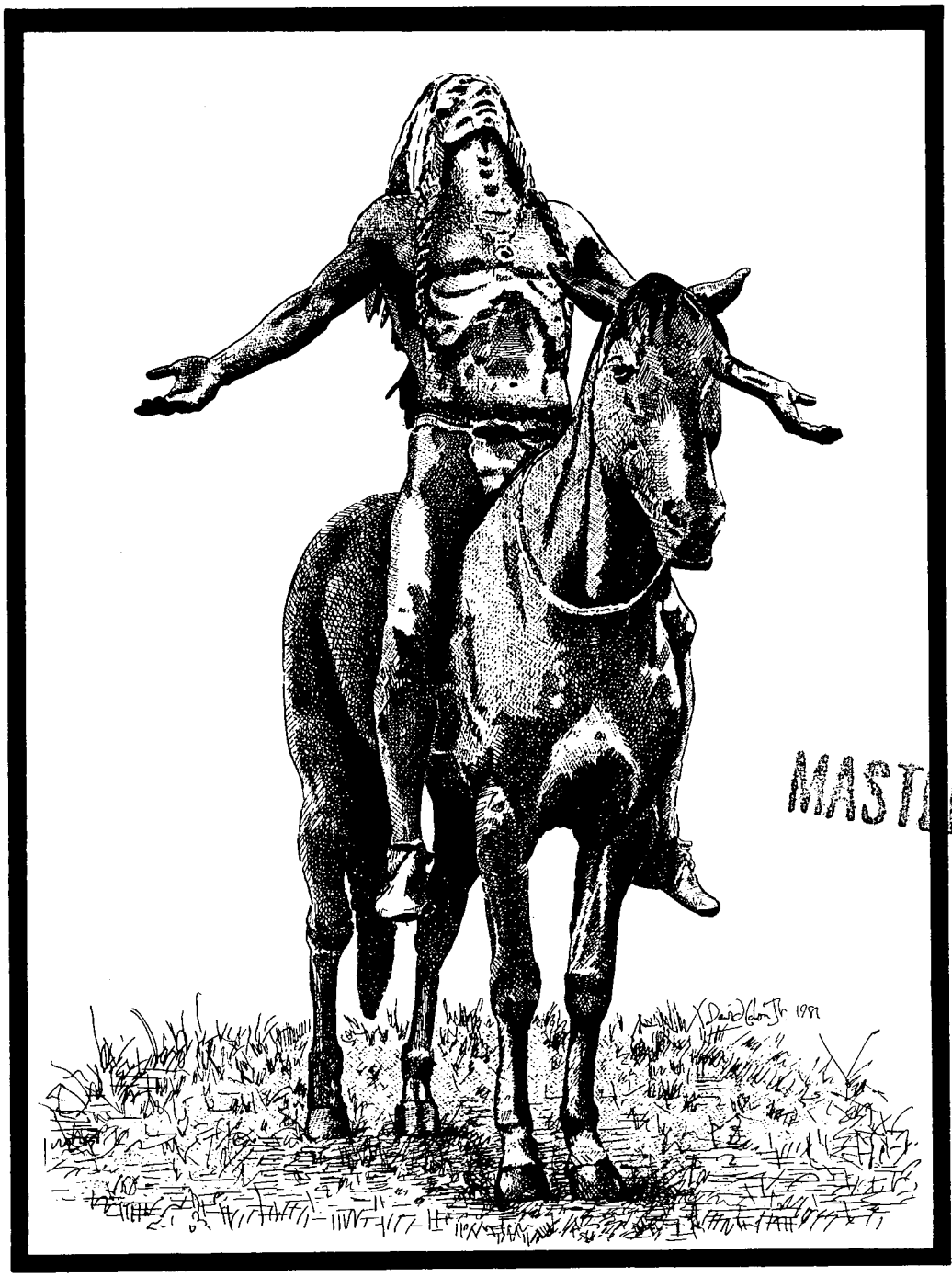

MASTER

HUMANITIES

Activities & Teacher's Guide

Field Test Edition

Release for Announcement in Energy Research Abstracts

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Information on the Solar Energy Education curriculum may be obtained from:

Solar Energy Project
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Albany, New York 12234

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The Solar Energy Education Curriculum

The booklet in your hands is just one part of a series. The Solar Energy Education materials include

a Solar Energy Text

a Solar Energy Reader in four parts:

I. *Energy, Society, and the Sun* (general),

II. *Sun Story* (history and literature),

III. *Solar Solutions* (practical applications), and

IV. *Sun Schooling* (classroom-oriented readings).

Solar Energy Education Activities for

Science,

Industrial Arts,

Home Economics,

Social Studies, and

Humanities (Art, Music, and English), and

Solar Energy Education Teacher's Guides to accompany the above activity booklets.

For more information on the Solar Energy Education curriculum, contact

Solar Energy Project
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New York State Education Department
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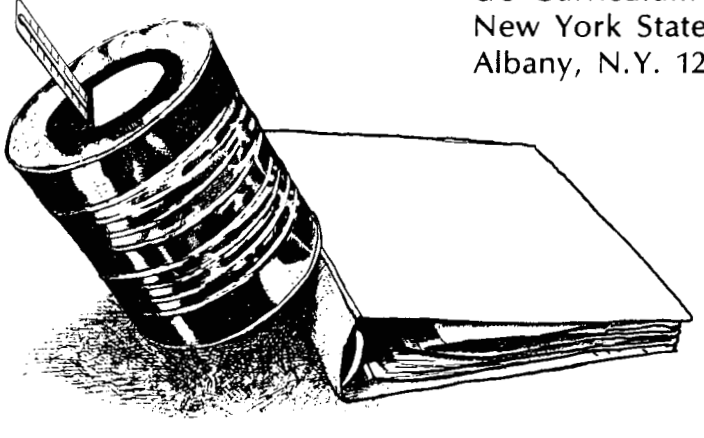

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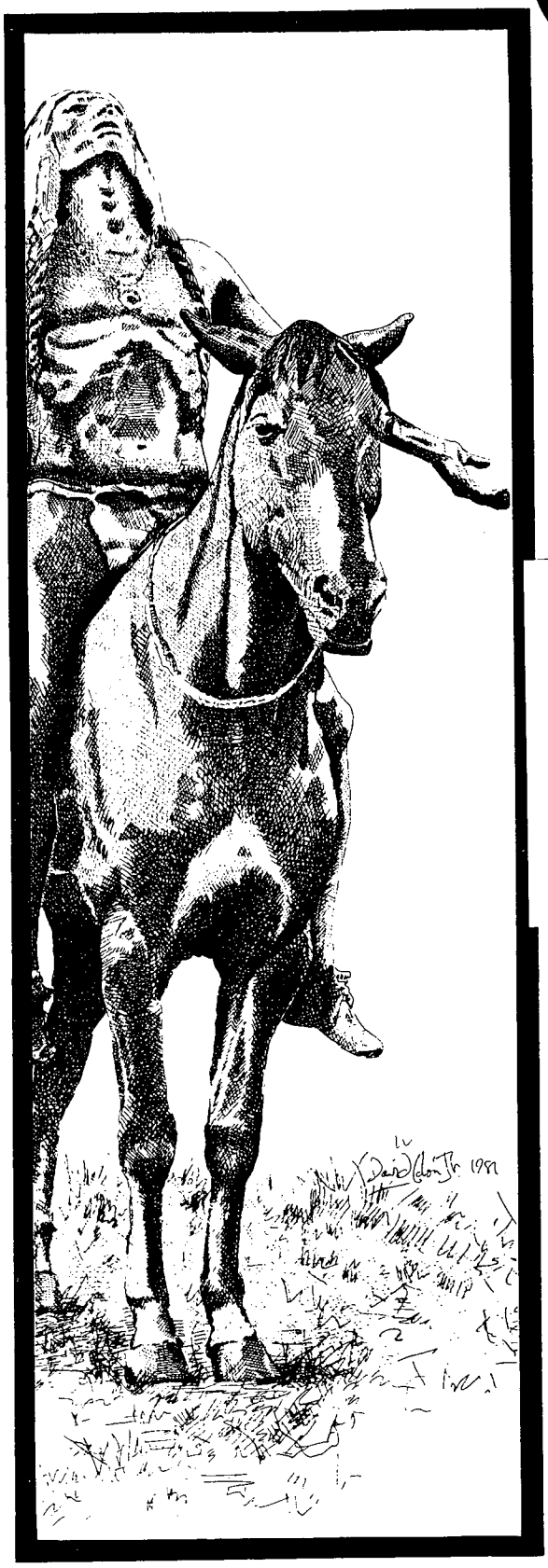

HUMANITIES

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are an adaptation of
Appeal to the Great Spirit
Cyrus Dallin
American, 20th CY
Bronze
13.380, Gift of Peter C. Brooks and Others

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Introduction

For the teacher with a full workload and dozens of important topics to cover and skills to teach, the question that may occur in picking up this booklet is

Why Teach About Energy?

If you are asking that question, try to think of an area of human existence that is not affected by energy resources. Energy permeates our lives; it shapes our careers, our leisure, and our aspirations as well as providing food, clothing, and shelter.

Students are aware of this reality and they see that, as available energy resources change, their lives will also change, in ways as yet unknown. This is why students are deeply interested in energy, especially in solar and other forms of renewable energy. They recognize energy as a factor that will have an impact on them personally, for the rest of their lives, and they want to understand their energy options.

Subject Skills/Energy Content

You can capitalize on your students' strong interest in the topic of energy. With renewable energy as the content matter, the following activities are designed to give students practice in the subject skills that are high on your teaching agenda. Whether it's musical improvisation, reading for comprehension, report writing, photographic technique, or group decision-making, you'll find here a renewable energy activity, ready to use.

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To Teachers

The yellow pages in the front and back of this booklet are intended especially for you. You'll also find a teacher information section (the grey-edged pages) in each student activity.

Energy Language

In beginning to understand renewable resources, students need to learn the names of those resources. New words are introduced in several of the activities in this booklet. For your convenience an energy glossary is given at the back of the booklet. The glossary should prove especially useful to students who are doing independent reading or research.

Finding Information

The last few years have witnessed a flood of energy information from public and private sources. Unfortunately, material has been most abundant and available on topics about which people already know a fair amount: fossil fuels and nuclear power. The renewable forms of energy have had a much lower profile.

The "Sources of Information" section at the back of this booklet lists not only books and magazine articles but also newspapers, audio-visual sources, clearinghouses, and other wellsprings of renewable energy information. You will also find a list of specific references at the end of each activity.

Using Copyrighted Material

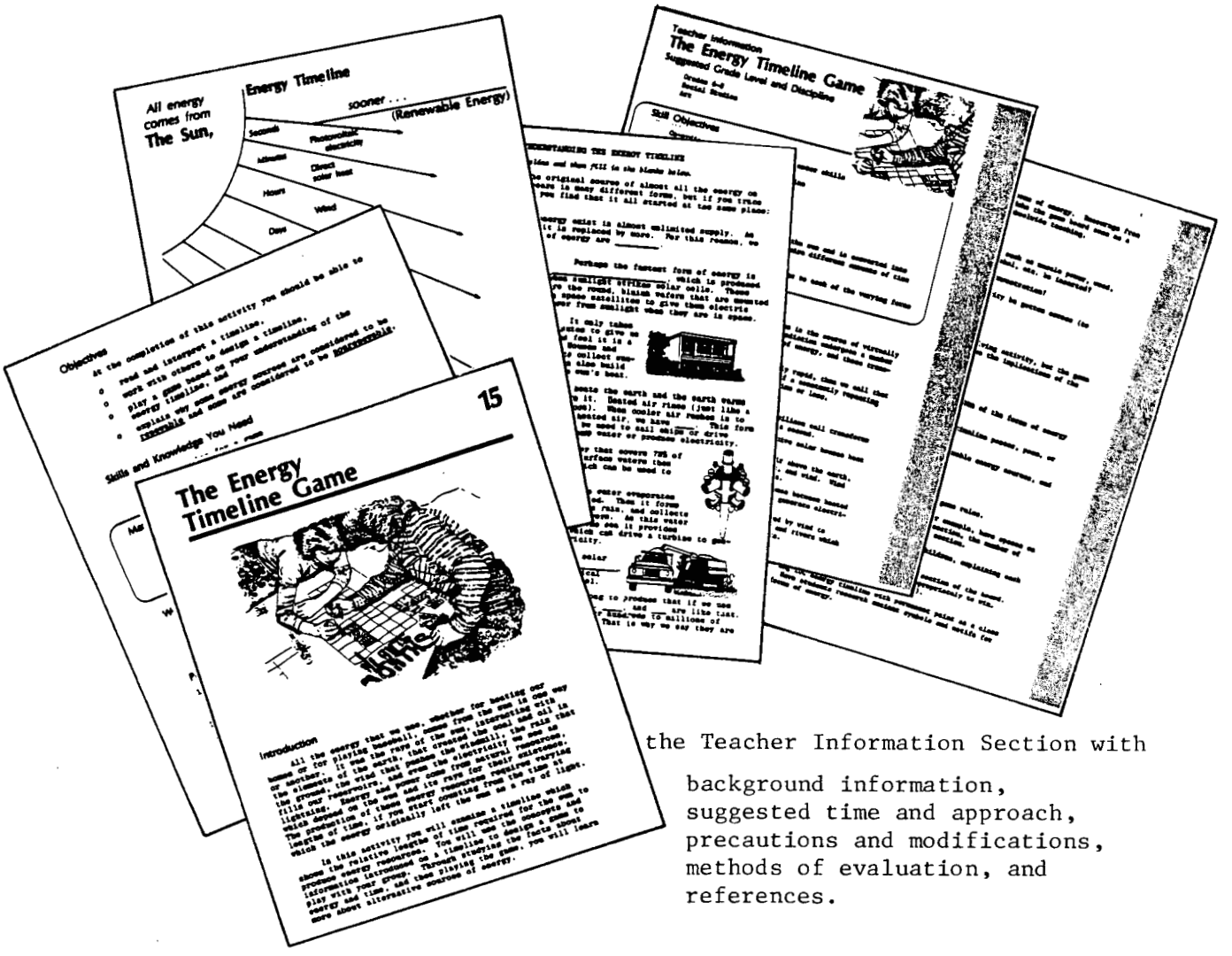
In the rapidly changing energy picture, your best reading material for students can often be found in newspapers and magazines. But what is your legal right to copy these materials to provide your students with up-to-date information? You may be surprised to find how broad your rights are. The Congressional guidelines on copyright are included at the end of this booklet. Asterisks indicate sections that claim your special attention.

How to Use the Activities

The teachers who wrote these activities were considering your convenience. Every activity is complete and ready to use, in two parts:

the Student Activity with

- introduction,
- objectives,
- prerequisite skills and knowledge,
- procedure for the activity,
- worksheets (diagrams, maps, readings, etc.),
- comprehension questions,
- summary ("Looking Back"), and
- enrichment activities ("Going Further"); and



the Teacher Information Section with

- background information,
- suggested time and approach,
- precautions and modifications,
- methods of evaluation, and
- references.

NOTE ESPECIALLY:

All worksheets have a grey tab. These are the essential parts of the activity for the student, and they are keyed so that you may extract these pages and duplicate them at your convenience.

Approaches to Teaching Energy

The excitement of a new learning topic evolves in part from the new teaching techniques that it may encourage. If you plan to teach about energy, consider the following techniques:

Flexible grouping: Suit the group size to the demands of the activity.

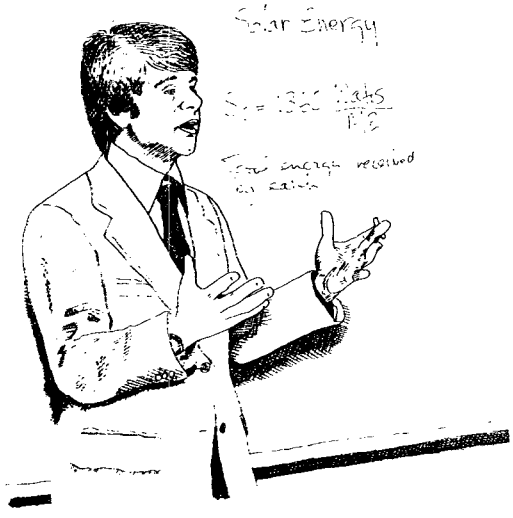
Individualization: Give a whole activity, as is, to a selected student.

Mainstreaming: Use the procedure to break the activity into small steps.

Teaching the Gifted and Talented: Use the "Going Further" section for enrichment ideas.

Teaming: Energy as a topic crosses boundaries; try linking with industrial arts, science, or home economics teachers.

Field trips: Study local energy sites: utilities, homes, architectural firms, etc.



Guest speakers: Identify homeowners, manufacturers, consumer advisors, and utilities with energy messages.

Outreach: Capitalize on public interest in energy with

- an energy fair with student projects, media, etc.;
- an energy workshop for parents or the public in general;
- a resource center: books, brochures, and magazines displayed at PTA meetings, or in the school or public library.

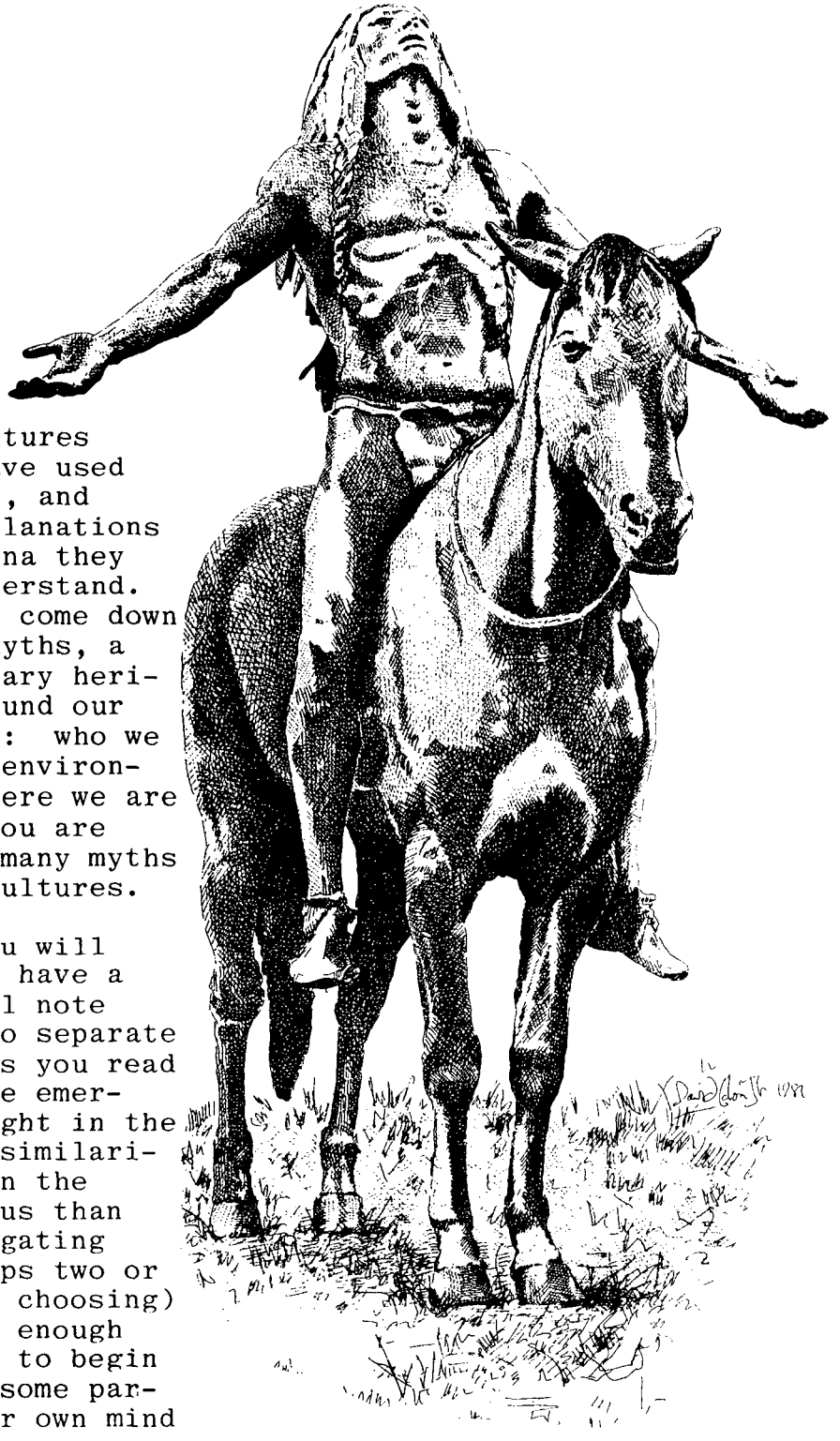
Using the Matrix

Energy is essentially an interdisciplinary topic. Each activity was written by an individual teacher, but with no subject barriers in mind. A glance at the activity matrix will show you the relevance of each activity to a variety of disciplines. The grade level indicators are broad because each activity would appeal to a range of students. Remember, too, that an activity targeted at grades 9-10 could be used for gifted eighth graders or remedial students in grades 11 and 12.

Activity Matrix

	GRADE LEVEL(S)			SUBJECT AREAS										
	6 - 8	9 - 10	11 - 12	English/ Language Arts	Reading	Music	Art	Humanities	Social Studies	Science	Mathematics	Industrial Arts	Home Economics	Multi-disciplinary
Activity 1	○	○	○	○	○			○	○					○
Activity 2	○	○		○			○		○					○
Activity 3	○	○		○	○				○	○		○	○	
Activity 4	○	○		○	○									
Activity 5		○	○	○	○				○	○				
Activity 6		○	○				○		○	○	○		○	○
Activity 7		○	○				○	○						
Activity 8	○	○	○	○			○	○	○			○		○
Activity 9	○	○	○	○	○		○	○						○
Activity 10		○	○				○				○	○		○
Activity 11	○	○	○			○		○	○	○	○			○
Activity 12	○	○	○	○	○	○		○						○
Activity 13	○	○	○			○		○						○

Sun Stories



Introduction

People of all cultures throughout the ages have used imagination, intuition, and feelings to create explanations for events and phenomena they did not completely understand. Quite often these have come down to us in the form of myths, a rich part of our literary heritage which centers around our basic concerns in life: who we are, where we and our environment came from, and where we are all going. No doubt you are already familiar with many myths from Greek and Roman cultures.

The selections you will study in this activity have a common theme. You will note man's universal need to separate light from darkness, as you read these stories about the emergence of the sun or light in the world. You will find similarities and differences in the myths, some more obvious than others. After investigating these three (and perhaps two or three more of your own choosing) you will probably have enough good ideas of your own to begin speculating about how some particular mystery in your own mind came to be.

Drawing by David Colon, Jr., is an adaptation of
Appeal to the Great Spirit
Cyrus Dallin, American, 20th CY
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DRAFT

Objectives

At the completion of this activity, you should be able to

- tell in your own words the meaning of the myths you have read,
- identify the need for light and heat from the sun as told in the myths, and
- explain some new vocabulary related to the sun, light, and heat.

Skills and Knowledge You Need

Understanding the function of myth

Comparing various explanations

Materials

copies of the myths

notebook

pen

pencil

dictionary

Words You'll Learn

In context:

adrift, agony, kashim, shaman, taut

By definition:

ancestress, indignant, jostle, plait, humble

Procedure

Task 1.

Read the three myths and answer the questions on Worksheet 1 in your notebook. Your answers will be used in class discussion of the myths.

Task 2.

Do the vocabulary exercises on Worksheet 2.

Task 3.

In groups of three or four, discuss the questions below. Then list and record in your notebook the similarities and differences noted among the myths.

Questions

1. List two or three character traits of Maui. Why did others follow him?

2. How are Raven (in the Crow myth) and Maui similar?

3. What similarities about the earliest days of creation are seen in the myths?

4. How are Maui and Raven Boy (Eskimo myth) similar?

5. Which of the myths seems most credible? Why?

6. Why was light so important to the characters in all of these myths?

7. What uses did these societies make of light?

8. What uses do we make of the sun? What other ones can you imagine?

9. Why do you suppose the light/sun has been the subject of so many myths?

Looking Back

It is clear that the sun has played an important role not only in the survival of cultures but also in their literature. People have been fascinated by the sun and recognized its importance for centuries. Early people attempted to harness its energy; in the same way concerned people in the 20th century are seeking ways to utilize solar energy.

Going Further

Research and collect additional sun myths and submit them to your teacher for inclusion in a class anthology. Give the anthology to your school library or lend it to elementary classes so that others in the school will become more aware of the importance of the sun in literature.

Read some sun myths from Asian, European, African, or American Indian mythologies. Report to the class what they all share and how they yet remain unique to the culture which generated them.

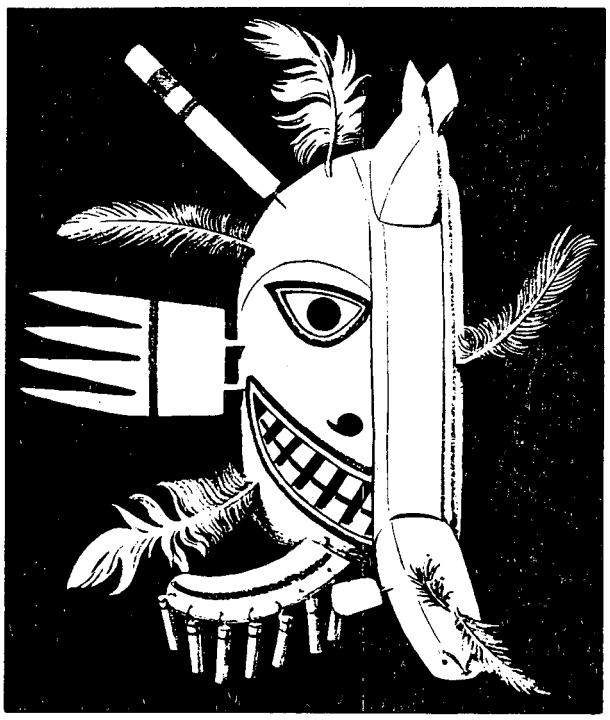
Research and have a round table discussion with three classmates about some "impossible" conquests or accomplishments of man through the ages.

Imagine a story to explain how Raven and Old Crow (in the Crow story) became black. Write your own "story."

Write your own myth or poem about the origin of the sun.

Make a collage, a mobile, or a photo display with the sun as its theme.

Act out a myth as a short play.



Worksheet 1

Guide Questions

How Maui Made the Sun Slow Down
Maori Myth (New Zealand)

1. Why did Maui want to catch the sun? How did he expect to do it?
2. Where did he get the noose?
3. What practice of modern man does Maui's remind you of?
4. The writer expects a reader reaction in paragraph five. What human trait were the Maori people aware of?
5. According to the myth, why are our days longer than they used to be?

How Raven Brought the Light
Crow Myth (Midwestern US)

1. Mention some reasons stated by Old Crow and Raven for needing light.
2. Who owned all the light in the Days of the Animal People?
3. Why do you suppose Sea Gull was so possessive of the light?
4. According to the myth, how did Raven get the light from Sea Gull?
5. What do you think about Raven's method for getting the light from Sea Gull?

The Bringing of the Light by Raven
Eskimo Myth (Lower Yukon)

1. Why do you suppose the orphan boy was despised by everyone?
2. What happened to the boy when he put on the Raven coat?
3. Explain how the boy got the "ball of light" and what he did with it.
4. Why would an Eskimo myth end with a comment about the reason for very long nights?

Worksheet 2

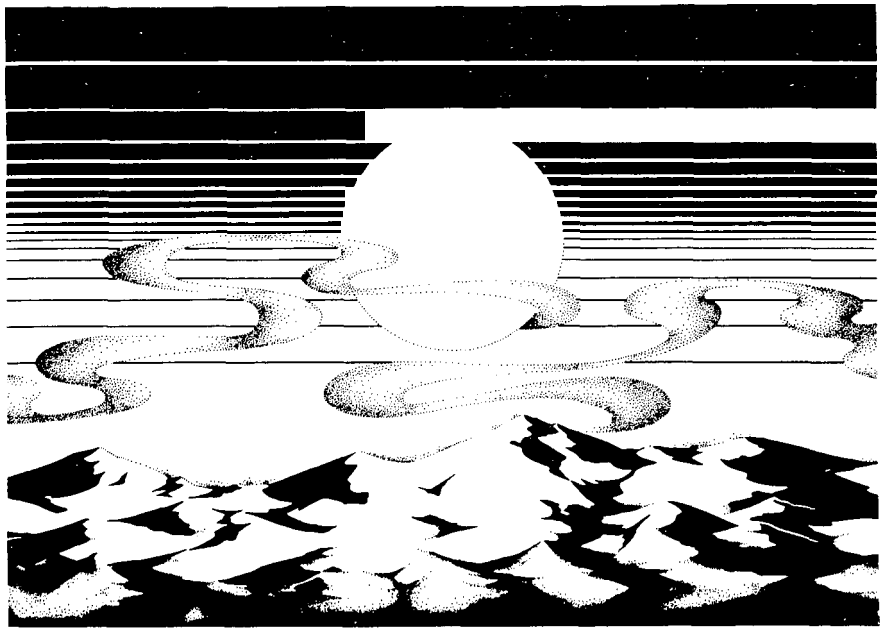
New Words

Some language is special for the passage you are reading. Go back through the stories and figure out a meaning for each of the following words. When you have decided, write it down in the space provided.

1. shaman--(Eskimo)_____
2. kashim--(Eskimo)_____
3. adrift--(Crow)_____
4. agony--(Maori)_____
5. taut--(Maori)_____

The next five words come from the stories and you should look them up in a dictionary and write down a definition appropriate to the passage.

6. ancestress--(Maori)_____
7. indignant--(Crow)_____
8. jostle--(Crow)_____
9. humble--(Eskimo)_____
10. plait--(Maori)_____



How Maui Made the Sun Slow Down

from Antony Alpers'
Maori Myths and Tribal Legends

One day Maui said to his wife: "Light a fire and cook some food for me." She did so, but no sooner had she heated her cooking stones in the earth-oven than the sun went down, and they had to eat their food in the dark. This set Maui to thinking how the days might be made longer. It was his opinion that they were shorter than they needed to be, and that the sun crossed the sky too quickly. So he said to his brothers: "Let us catch the sun in a noose and make him move more slowly. Then everybody would have long days in which to get their food and do all the things that have to be done."

His brothers said it was impossible. "No man can go near the sun," they said. "It is far too hot and fierce." Maui answered: "Have you not seen all the things I have done already? You have seen me change myself into all the birds of the forest, and back again into a man as I am now. I did that by enchantments, and without even the help of the jawbone of my great ancestress, which I now have. Do you really suppose that I could not do what I suggest?"

The brothers were persuaded by these arguments, and agreed to help him. So they all went out collecting flax, and brought it home, and sat there twisting it and plaiting it. And this was when the methods were invented of plaiting flax into tuamaka, or stout, square-shaped ropes, and paharahara, or flat ropes; and the method of twisting the fibre into round ropes. When they had made all the ropes they needed, Maui took up the jawbone of Muri ranga whenua, and away they went, carrying their provisions with them, and the ropes. They travelled all that night, having set out at evening lest the sun should see them. When the first light of dawn appeared, they halted and hid themselves so that the sun should not see them. At night they resumed their journey, and at dawn they hid themselves again, and in this way, travelling only when the sun could not observe them, they went far away to the eastward, until they came to the edge of the pit from which the sun rises.

On each side of this place they built a long high wall of clay, with huts made of branches at either end to hide in. There were four huts, one for each of the brothers. When all was ready they set their noose and saw that it was as strong as they could make it. The brothers lay waiting in the huts, and Maui lay hiding in the darkness behind the wall on the western side of the place where the sun rises. He held in his hand the jawbone of his ancestress, and now he gave his brothers their final instructions:

"Mind you keep hidden," he said. "Don't go letting him see you or you'll frighten him off. Wait until his head and his shoulders are through the noose. Then when I shout, pull hard, and haul on the ropes as fast as you can. I will go out and knock him on the head, but do not any of you let go your ropes until I tell you. When he's nearly dead we'll let him loose. Whatever you do, don't be silly and feel sorry for him when he screams. Keep the ropes good and tight until I say."

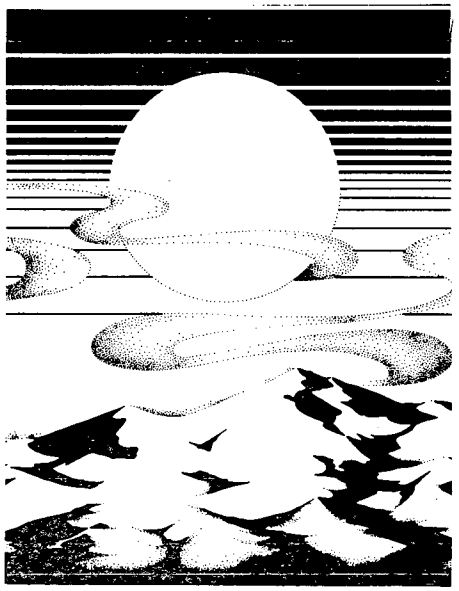
And so they waited there in the darkness at the place where the sun rises. At length the day dawned, a chilly grey at first, then flaming red. And the sun came up from his pit, suspecting nothing. His fire spread over the mountains, and the sea was all glittering. He was there, the great sun himself, to be seen by the brothers more closely than any man had ever seen him. He rose out of the pit until his head was through the noose, and then his shoulders. Then Maui shouted, and the ropes were pulled, the noose ran taut. The huge and flaming creature struggled and threshed, and leapt this way and that, and the noose jerked up and down and back and forth; but the more the captive struggled, the more tightly it held.

Then out rushed Maui with his enchanted weapon, and beat the sun about the head, and beat his face most cruelly. The sun screamed out, and groaned and shrieked, and Maui struck him savage blows, until the sun was begging him for mercy. The brothers held the ropes tight, as they had been told, and held on for a long time yet. Then at last when Maui gave the signal they let him go, and the ropes came loose, and the sun crept slowly and feebly on his course that day, and has done ever since. Hence the days are longer than they formerly were.

It was during this struggle with the sun that his second name was learned by man. At the height of his agony the sun cried out: "Why am I treated by you in this way? Do you know what it is you are doing, O you men? Why do you wish to kill Tama nui te ra?" That was his name, meaning Great Son the Day, which was never known before.

After this feat of laming the sun, Maui and his brothers returned to their house and dwelt there.

It is said that one day Maui was exceedingly thirsty. No doubt this was after his visit to the sun. He asked the tieke, or saddleback, to fetch him a drink, but the bird paid no attention, so he threw it in the water and called another bird, the hihi, or stitch-bird. The hihi also took no notice, so he threw it in the fire and its feathers were singed, which accounts for the colour of that bird. He next tried the totoara, or robin, and when it also disobeyed him he placed a streak of white near its beak as a mark for its incivility. At last the kokako, the crow, complied with his request. It went to the water and filled its ears, and returned to Maui. He drank, and as a reward he pulled kokako's legs to make them long, because it had done as he asked. This is true.



from Maori Myths and Tribal Legends
retold by Antony Alpers (Houghton Mifflin Co.).

How Raven Brought the Light

A Crow Myth

Raven sat one day in the top of a tall fir, chewing a twig. He bit the end very hard because he was much troubled; and he chewed the twig because he had nothing else to do. It was so dark Raven could not see his claw when he put it up before his face. He had done that several times. Then Raven looked at his own wings, but he could not see them, even though they were pure white. Because in those days Raven was white, and so was Old Crow. Neither had a black feather on him. Now both are as black as jet and they became that way because--but that's another story.

As Raven was looking down at his claws, and chewing that twig, and thinking about the darkness, he heard a slight whirring of wings. Somebody was coming. When that somebody alighted on the fir tree, he cried, "Caw! caw! caw!"

"Well, I am glad you cried 'Caw,' Old Crow," said Raven. "In this darkness no one could see who it was."

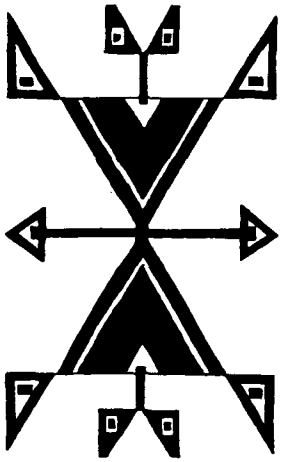
"I am glad you spoke," said Old Crow, "because otherwise nobody would know you were here. This darkness is so thick I can feel it."

Now this happened in the Days of the Animal People, when the Earth-land was very new. Real People had not come yet, because this was even before the Days of the Grandfathers.

"Dear me!" said Old Crow, after a few minutes. "What will the Real People do when they come to the Earth-land if it is so dark?"

"They will think we haven't fixed things up very nicely," said Raven. "They'll be bumping into trees and bushes, and getting into the wrong tepees, and jostling against each other----"

"Just as we do," said Old Crow, "and the animals, too. Why, do you know, Black Bear was coming down a tree the other day, and Elk happened to be standing right underneath. Black Bear couldn't see anything, of course, without any light, and he thought Elk's antlers were branches of his tree, and tried to climb out on them. Elk was terribly frightened and tried to run away, with Black Bear hanging on, and they got tangled up in the underbrush--oh, they both had an awful time. And both were so badly frightened. Black Bear said he was not used to climbing out on tree branches that ran away with him. He was quite indignant. He felt Elk had not treated him nicely, at all."



"I am tired of the dark," said Raven. "Sea Gull is my cousin, but I think he is very selfish about keeping all the light. He owns all the light there is, and the rest of us have to go without it."

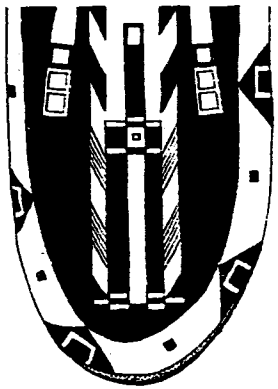
"I have asked Sea Gull over and over again," said Old Crow, "to open his box of light just a little, so we can see where we are flying. But he won't. Dear me!"

Raven chewed on his twig for a long time without answering a word. Old Crow waited in silence, because he knew Raven was thinking. Raven always chewed a twig when he was thinking.

Suddenly Raven said, "I have thought of a way. "I'll *make* Sea Gull give us some light!"

"Oh!" said Old Crow in astonishment. But how are you going to do it?"

"You wait and see. I have thought of a plan," said Raven mysteriously. And Old Crow had to wait, because Raven wouldn't tell him what he was going to do.



Now in those days everything was dark because Sea Gull owned all the light. All the light in the whole world was kept in a box in Gull's tepee. All the Animal People had talked to Gull about giving them light, especially as the Indians were coming so soon to the Earth-land, and they wanted to fix things up nicely. But Gull only said, "*No! no! no!*" and that was why things were so dark.

Sea Gull lived near the ocean, of course, and shortly after Raven and Old Crow had talked things over, Raven flew softly to his house one night. Or perhaps it was day. Raven couldn't tell, because there never had been any light on earth. Raven had once flown right into a tangle of thorn bushes near Gull's house, and had torn his feathers almost to pieces before he got out. He remembered just where those thorn bushes were, and he pulled off several branches with his beak.

Raven remembered also that there was a regular trail between Gull's tepee and the place where he always fastened his canoe. Gull always fastened it to one certain tree, and he could always find the tree without trouble, because when he went fishing he took the box of daylight with him. All he had to do to find that tree was to open the cover just a little. Raven remembered all that.

Raven put the thorn branches in the trail, and he moved very softly until the work was done, and then he rushed wildly up to Gull's tepee, shouting, "Your canoe has gone adrift! Your canoe has gone adrift!"

Sea Gull heard Raven, and he remembered the tide was going out. Without waiting to put on his moccasins, he rushed out of his house and down the trail in his bare feet. Then he cried, "*Ah-Ah-Ah*" just as sea gulls do now, because he had stepped on those thorn branches. Gull couldn't go any further, so he shouted to Raven, "Get my canoe! Save my canoe!" and went back to the house. He was much excited. Raven shouted, "All right!" but he never went near the canoe, which was safely fastened to the tree. But he waited around a while, and then went to the house. Gull spoke of those thorns in his feet.

Raven said, "Oh, I can pull them out, if you will let a little daylight out of your box." So Gull sat down on a large carved box in which he kept his dancing apron, and his dancing mask, and put the box of daylight under his wing. He opened the cover just the least little bit. Raven pulled out a thorn with an awl. Then he pulled out another. Then he said, "I could see better if you could give me more light." Gull opened the box a little more, and Raven pulled out more thorns. Soon he said, "I can't see very well. Give me more light." And Sea Gull opened the cover still more.

Raven pulled out all the thorns but one. Then he said, "This last one is hard to get at. I shall need more light." When Gull opened the box still more Raven took out the last thorn and gave his wing a sudden push. The box of daylight went rolling on the floor, and broke. Then all the daylight spilled out, and spread all over the world. Sea Gull jumped up and rushed about and tried to collect it again, but he couldn't do it. The light had spread everywhere.

Raven was so pleased to think that the light had come, that the very same day he brushed his feathers carefully, combed and oiled his hair--Raven taught the Indians how to do that after they came to the Earth-land--and painted his face red and black. Then he went to a little spring where the water was quiet, and sat there looking at himself. Raven thought he looked very well indeed, and it was the first time he had ever been able to see himself.

---

from Sun Songs: Creation Myths from Around the World
Raymond VanOver, ed. (New American Library).

The Bringing of the Light by Raven

An Eskimo Myth

In the first days, the sun and moon were in the sky. Then the sun and moon were taken away and people had only the light of the stars. Even the magic of the shamans failed to bring back the light.

Now there was an orphan boy in the village who sat with the humble people over the entrance way of the kashim. He was despised by every one. When the magic of the shamans failed to bring back the sun and moon into the sky the boy mocked them. He said, "What fine shamans you must be. You cannot bring back the light, but I can." Then the shamans were angry and beat the boy and drove him out of the kashim. Now this boy was like any other boy until he put on a raven coat he had. Then he became Raven.

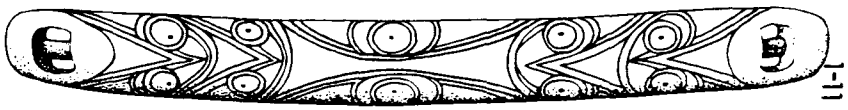
Now the boy went to his aunt's house. He told her the shamans had failed to bring back the light, and they had beaten him when he mocked them. The boy said, "Where are the sun and moon?"

The aunt said, "I do not know."

The boy said, "I am sure you know. Look what a finely sewed coat you wear. You could not sew it that way if you did not know where the light is."

Thus they argued.

Then the aunt said, "If you wish to find the light, go far to the south. Go on snowshoes. You will know the place when you get there."



The boy put on his snowshoes and set off toward the south. Many days he traveled and the darkness was always the same. When he had gone a very long way he saw far in front of him a ray of light. Then the boy hurried on. As he went farther the light showed again, plainer than before. Then it vanished for a time. Thus it kept appearing and vanishing.

At last the boy came to a large hill. One side was brightly lighted; the other side was black as night. Close to the hill was a hut. A man was shoveling snow from in front of it. The man tossed the snow high in the air; then the light could not be seen until the snow fell. Then

the man tossed the snow again. So the light kept appearing and disappearing. Close to the house was a large ball of fire.

The boy stopped and began to plan how to steal the ball of light.

Then the boy walked up to the man. He said, "Why do you throw up the snow? It hides the light from our village."

The man said, "I am not hiding the light. I am cleaning away the snow. Who are you? Where did you come from?"

The boy said, "It is so dark at our village I do not want to stay there. I came here to live with you."

"All the time?" asked the man.

"Yes," said the boy.

The man said, "All right. Come into the house with me." Then he dropped his shovel on the ground. He stooped down to lead the way through the underground passage into the house. He let the curtain fall in front of the door as he passed, because he thought the boy was close beside him.

Then the boy caught up the ball of light. He put it in the turned-up flap of his fur coat. Then he picked up the shovel and ran away toward the north. He ran until his feet were tired. Then he put on his raven coat and flew away. He flew rapidly to the north. Raven could hear the man shriek behind him. The man was pursuing him. But Raven flew faster. Then the man cried, "Keep the light; but give me my shovel."

Raven said, "No, you cannot have your shovel. You made our village dark." So Raven flew faster.

Now as Raven flew, he broke off a little piece of the light. This made day. Then he went on a long time in darkness, until he broke off another piece of light. Thus it was day again. So as Raven flew to the village he broke off the pieces of light. When Raven reached the kashim of his own village he threw away the last piece. He went into the kashim and said to the shamans, "I have brought back the light. It will be light and then dark, so as to make day and night."

After this Raven went out upon the ice because his home was on the seacoast. Then a great wind arose, and the ice drifted with him across the sea to the land on the other side.

Thus Raven brought back the light. It is night and day, as he said it would be. But sometimes the nights are very long because Raven traveled a long way without throwing away a piece of the light.

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from Sun Songs: Creation Myths from Around the World
Raymond VanOver, ed. (New American Library).

Teacher Information

Sun Stories

Suggested Grade Level and Discipline

Grades 7-12
English

Skill Objectives

Reading a variety of myths

Answering specific content questions

Identifying similarities and differences between myths

Major Understandings

Mythology is a valuable part of world literature.

Different cultures often have myths on similar themes.

The theme of light and the sun occurs frequently in mythology.

Background

Where we came from, why we're here and where we're going, how it all came to be and how it will all end, are questions no student can afford to ignore. Mythology study is not merely the investigation of an organized body of uninformed and naive beliefs told repetitively by ancient and ignorant people. The speculations of early people can only be deemed ignorant if we assume that all time is measured by now. H. Ellis Davidson, in her Gods and Myths of Northern Europe, suggests, "the study of mythology need no longer be looked on as an escape from reality into the fantasies of primitive peoples, but as a search for the deeper understanding of the human mind." That mind, moreover, is in flux. Our rockets were inconceivable in our own lifetimes, and looking back on our naivete should offer us the key to the list of theories suggesting that myth is no more than ancient fiction. Myths surround us today and the only proof we need of that fact is a perspective beyond our imaginations. Someone will perceive our "reality" as myth in as short a time as a generation.

Advance Planning

Read the sun/light myths.

Prepare a class set of the activity.

Suggested Time Allotment

Two class periods to introduce and read the myths and answer the preliminary questions

Half a period to do the vocabulary sections

One period (small group work) to discuss the general questions and list similarities and differences

One period for general class discussion and review of vocabulary

Suggested Approach

This short unit could be used as an independent study or class activity.

To introduce the activity, define "myth" and "folk tale." Discuss the value of these forms of literature to our society and to the societies that developed them.

Distribute activities and pace the material to class ability levels. Allow small groups to discuss myths before having the general discussion.

With low ability students you may want to read the myths aloud.

Precautions

Don't label the myths as "primitive." They belong to societies that function differently from our own.

Points for Discussion

Why do people create myths? How do myths satisfy certain needs in society?

Why has the sun been a focal point for mythology?

How does the tone of each myth differ from the others? Are some more sympathetic, humorous, etc.?

How is the geographic setting in each myth described? Which is most realistic, most detailed, etc.?

Evaluation

Ask students to tell the myths in their own words.

Give a vocabulary quiz.

Some teachers may wish to assign and grade the questions.

Have students list some similarities and differences between the myths.

Modifications

Include the activity in social studies classes during a study of ancient cultures or energy awareness. English teachers might also team with social studies teachers for this unit.

References

Asimov, Isaac. "The Flaming God" (Saturday Review, October 30, 1976).

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The Institute for Humanistic Studies, SUNYA. Helios: From Myth to Solar Energy compiled by M.E. Grenander (Institute for Humanistic Studies, State University of New York at Albany, 1400 Washington Ave., Albany, NY 12222).

The Smithsonian Institution. The Fire of Life (New York: W.W. Norton and Company, 1981).

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DRAFT

A Solar Energy Newspaper 2

Introduction

The primary purpose of newspapers is to communicate information. But newspapers also help to shape opinion. Simply by including some news and excluding other news, newspapers express an opinion about what is important and what isn't.

One topic that has been in the news a great deal in the last few years is energy. We've read about oil shortages and oil surpluses and oil prices. We've seen articles about the safety of nuclear power plants. We've heard controversy about coal and natural gas development. And, here and there, we've gotten news about "alternative energy": solar, wind, hydropower, geothermal, wood, methane, gasohol, and so on.

Many people are interested in alternative energy, but it doesn't get as much space in the newspapers as the more conventional forms of energy. So, in this activity, you'll be putting together a newspaper that <u>is entirely</u> about alternative energy. The news articles, columns, editorials, feature stories, ads, comics, etc., will all be about alternative energy.

Objectives

At the completion of this activity you should be able to

- define alternative energy,
- explain how a newspaper is developed from start to finish, and
- write a news story.

Skills and Knowledge You Need

The ability to organize your writing, from general ideas to particular ideas

The ability to write sentences and paragraphs

Materials

pencil, pen, paper

dictionary and encyclopedia

resource books and magazines

typewriter

dry transfer letters (Chartpak, Zip-a-tone, Letraset)

clip art or original artwork

typing correction fluid or tape

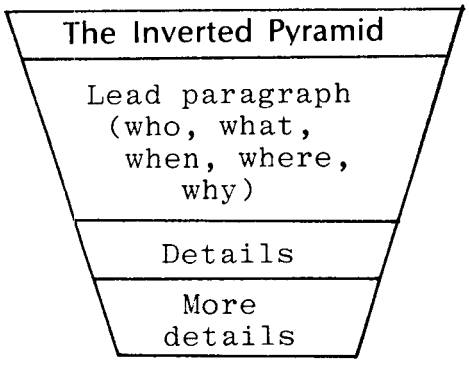
rubber cement

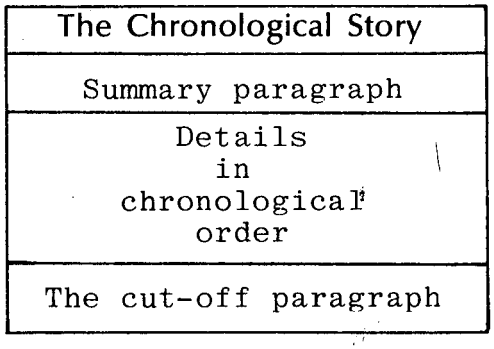
Procedure

In the first part of this activity you will practice writing a news story. Then you with your classmates will plan an alternative energy newspaper and divide up the work.

Part 1: Writing News Stories

There are two major styles for writing news stories: (1) the inverted pyramid and (2) the chronological story. You might think of them this way.





An example of
an inverted pyramid story:

Berossus Invents Sundial

Berossus, a Babylonian priest, made a sundial in 200 B.C. because he wanted to measure time more accurately.

The sundial was based on the observation that the sun caused shadows to appear, and that the shadows shifted as the sun moved across the sky. The inventor, who was also a writer and historian, made his dial by forming a hollow half sphere with a flat edge and a bead in the center.

The accuracy of Berossus' sundial is uncertain, since at that time hours as we know them had not yet been invented.

An example of
a chronological story:

Sun Day at Helios High

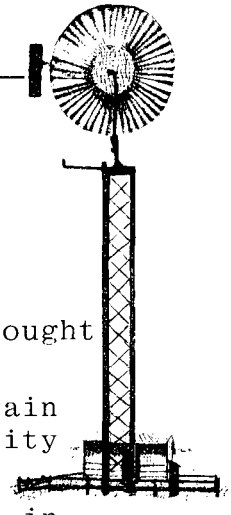
Students at Helios High School celebrated Sun Day yesterday with a schedule of activities that took several months to plan.

Beginning last September a group of students conceived the idea of a schoolwide celebration for Sun Day in May. Committees were formed to plan the program and get support pledges from local businesses and industry.

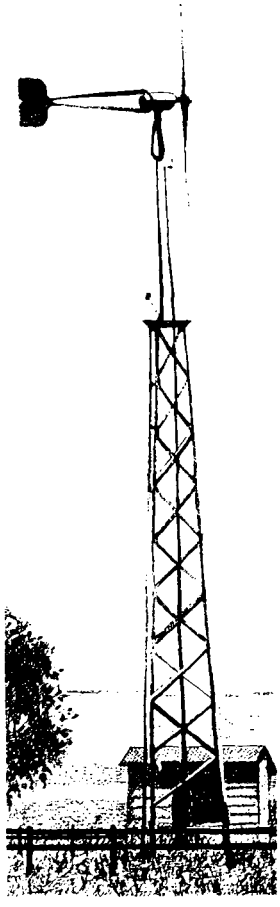
Early in the new year the school band, chorus, drama, and dance clubs began planning and rehearsing their part of the program. By the time Sun Day arrived the entire student body was involved.

Dawn Day, the 10th grader who coordinated Sun Day at Helios High, concluded the program by urging that the Sun Day celebration become an annual school event.

Now you'll practice news writing by organizing the facts below into a news story. Decide which style is most appropriate for these facts, and write the story in paragraph form. Put the sentences in a logical order, and rewrite them if necessary to make the story fit together.



A Scrambled News Story about Wind Power



Government programs in the 1930's and 40's brought power lines to most farms.

With today's energy problems windmills are again being considered as a source of electricity in windy parts of the U.S.

They provided power for settlements and farms in the American West.

The earliest known windmills were built in Persia more than 1000 years ago.

The windmill, with its long and interesting history, is beginning to reappear on the American scene.

Windmills were used for centuries in Europe to pump water, grind grain, and run other machinery.

Having power from a central utility, owners have let their windmills stand idle for many years.

Part 2: Planning an Alternative Energy Newspaper

1. Choose a name for your paper.

2. Give out assignments. The paper has many parts, so there's plenty for everyone to do. The next pages give examples and ideas for the kinds of things you could include.

3. Set deadlines for when the written material must be in, when it must be typed, when it must be laid out and pasted up, and when it will be duplicated.

4. Meet your deadlines!

Looking Back

Putting together a newspaper is a big job. You have participated in putting together a newspaper on alternative energy. In the process you learned about an interesting part of the world energy picture, a part that will probably be getting more and more attention in the news.

Going Further

Visit the offices of a local newspaper or printer to see what is involved in putting out a commercial newspaper.

Interview a solar builder or solar homeowner in your area.

Prepare a series of articles on active solar, passive solar, photovoltaics, wind, hydro, and geothermal power for your regular school paper.

Write letters to the newspapers in your area, encouraging them to give more coverage to alternative energy.

Make a clippings file from newspapers and magazines about alternative energy.

Ideas for Your Solar Energy Newspaper

News/Feature Articles

Who Built the Pyramids?

Not far from Mexico City are the ancient pyramids of Teotihuacan. In Nahuatl myths, these pyramids were the places where the gods came to create the sun and the moon.

The largest monument in the city is the Pyramid of the Sun. It is sixty-five meters high and is made from adobe covered with stucco.

Many mysteries still remain buried at Teotihuacan.

Mysterious Stonehenge

Stonehenge, a monument on England's Salisbury Plain, may have been used as a primitive astronomical observatory when it was built some 3,000 years ago by the Druids.

It is thought by some astronomers that this ancient site was used to mark the summer solstices. One scientist, Gerald Hawkins, believes it was also used to predict lunar eclipses.

However, we may never know the secrets of Stonehenge.

Suggested Writing Topics

Myths - Re (Egyptian sun god)
Shamash (Babylonian)
Surya (India)
Balder (Norse)
Quetzalcoatl (Aztec)
Helios (Greek)
Shimshon (Hebrew)
Ahura Mazdah (Persian)

Machines - windmills
water wheels
wood stoves
solar water heaters
solar reflector (1901, A.G. Eneas)
solar oven (Mouchot)

People in History - Archimedes (attacking the Roman fleet)
Horace De Saussure (greenhouses)
H.G. Wells (predictions)
Socrates (Greek advocate of solar architecture)
Palladius (transparent windows)
Roger Bacon (mirrors for the Crusades)
Leonardo Da Vinci (solar invention ideas)

People Today - Harold Hay
Steve Baer
Denis Hayes
Felix Trombe
William Shurcliff
George Lof
Bruce Anderson
Harry Thomason
William von Arx
Amory & L. Hunter Lovins
Wilson Clark
Barry Commoner
Aden & Marjorie Meinel
Rene Dubos
Lester Brown

Other - Olynthus, Pompeii, Priene (solar cities)
Roman Baths (solar-heated)
Sun-rights laws
Pyramids of Egypt
passive solar architecture
Sun Dance (American Plains Indians, Sioux)

This list is only to get you started. As you read over it, you will undoubtedly think of other solar related or energy related topics.

Advice Columns

Dear Helios:

After spending $2,500.00 two years ago to install solar collectors on my home, the city has now chopped down the deciduous trees which shade my home to make improvements on the sewage system for the city. Whom should I complain to? I am worried about what will happen this summer when my house has no shade.

Yours, Worried Under the Sun

Special Features

Movies of the Week

- Sun Wars
- The Sun Singer
- Sun Crazy
- The Incredible Shrinking Sun

Television Programs

- Mr. Rogers' Sun Company
- Guiding Light
- Star Trek
- One Sun at a Time
- One Sun to Live
- The Sun Boat
- Little Sun on the Prairie
- Sunsmoke

Top Ten Songs

- "Let the Sun Shine In"
- "Here Comes the Sun"
- "Lucky Old Sun"
- "A Place in the Sun"
- "Sunrise, Sunset"
- "Windy"
- "You Are the Sunshine of My Life"
- "Sun King"
- "Sunshine on My Shoulder"
- "You Are My Sunshine"

Puzzles

Solar Word Find

S	Y	N	S	N	B	C	D	A	D	S	G
U	R	E	T	U	R	G	H	I	R	U	O
N	D	W	O	B	N	U	S	J	I	N	F
G	N	K	P	L	M	L	B	O	B	S	S
L	U	P	S	Q	R	S	I	N	N	E	I
A	S	U	N	L	I	G	H	T	U	T	R
S	U	S	U	N	B	E	A	M	S	S	N
S	U	N	S	T	R	U	C	K	W	X	U
E	Z	A	B	C	H	S	I	F	N	U	S
S	U	N	B	O	N	N	E	T	D	E	F

Advertisements

Solarium Cafe

Lunch

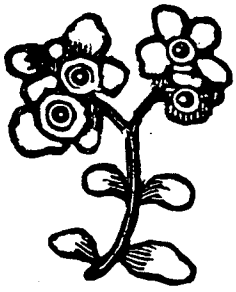
Natural Foods: Grown in our own greenhouse.

Sundogs.....50¢
(cooked on our own solar oven)
Sun dried fruit.....75¢
Solar tea (glass).....10¢
(brewed in the sun)

For Sale: Franklin Stove. Energy efficient. Uses less fuel than others of its kind. Best offer.

For Sale: One slightly used windmill. See Dorothy and Toto at the Yellow Brick Road.

SOLAR RIGHTS - Have a Problem? Contact Ms. Sunglow, 77 Sunset Strip. Be SUNWISE.



Don't Forget—editorials, comics, movie and book reviews, etc.

Teacher Information

A Solar Energy Newspaper

Suggested Grade Level and Discipline

Grades 6-10
English
Social Studies
Journalism

Skill Objectives

Researching a news story

Using a topic sentence and developing the news story

Writing and revising the story

Generating creative ideas for a group project

Major Understandings

There are two logical styles for presenting news in a news story.

Putting together a newspaper involves many parts and many tasks.

Alternative energy is an interesting topic and one worth knowing more about.

Background

Newspapers play a very important role in determining what people think and talk about. Until the 1973 oil crisis, alternative forms of energy received very little attention in the press. Now renewable energy is "news," and we are beginning to hear more about it, but popular ignorance is still very widespread.

In the process of writing a newspaper about solar energy, students will undoubtedly make some surprising and interesting discoveries about solar energy--like the fact that Mesa Verde was designed to allow winter sunlight to fall on the houses and enter the windows, but an overhanging cliff blocked summer sunlight and kept the houses cool.

Students know that energy is going to be a critical factor in their futures, affecting jobs, incomes, and lifestyles. The newspaper writing activity could be the first step in an expanding learning experience about energy.

Advance Planning

Before beginning an energy newspaper, you will need to introduce "energy" to your students. If this activity could be done as part of an interdisciplinary unit with science, then part of the work can be shared. If not, one or two of the films listed in the reference section might be shown as an introduction to "energy." It

is important that students be helped to generate their material, examine the organizational patterns involved, and learn some editing skills necessary to the task.

Dry-transfer letters (for headlines), correction fluid, and clip art can be bought at local art supply stores, or may be available through the school journalism or art departments.

You and your students will need to use library materials on energy. Books and magazine articles will be most useful, but if you plan enough in advance, you might have your students write a business letter to agencies requesting free materials. A list of books and sources is included at the end of this activity packet. Articles in *Sunstory; Energy, Society and the Sun; Sunworks;* and *Sunschooling* (published by this project) are excellent.

Suggested Time Allotment

Time will vary. Allow one day for films, one for going to the library and selecting materials, and one for reading the materials gathered.

Brainstorming for a magazine or newspaper title will take part of one period and should involve all students.

Time required for writing for the newspaper will vary, depending on how the work is divided. Every student can be given an assignment appropriate to his/her skills.

Suggested Approach

Certain of the tasks will need the teacher's idea-generating abilities. The teacher will also probably have to apply pressure to ensure that deadlines are met.

The teacher must establish a maximum time for this unit (3 or maybe 4 weeks if he has it) and make that clear to the class.

Planning the newspaper could be preceded by a review of local newspapers for ideas.

The typing of the newspaper can be done by students, or the school secretary or someone else could type it. If your students type, use them! Otherwise, allow adequate time to type, duplicate or Xerox, and staple for distribution, (about a week).

The layout group should practice layout on duplicated copies of the articles with handwritten headlines. When a satisfactory "dummy" is completed, they can then go on to paste up the good copy, with dry transfer headlines.

Precautions

The writing assignments will generate stacks of papers to read. Volunteer editors can sort assignments according to category. Editors can then select which category they prefer to edit. They are to strive for variety and quality. As the teacher-in-charge, you will have to strike a balance between ensuring quality work and still allowing students to feel that the paper is really theirs.

Points for Discussion

What seem to be the news items that receive the most attention?

What topics or areas of the world do we hear very little news about?

What underlies a newspaper editor's decisions about "what's news"?

Could alternative energy meet all of our energy needs? What might be a good combination of energy sources that could supply home heating and cooling, transportation, business, and industry?

Typical Results

The finished newspaper provides tangible evidence of student writing. This can be useful in many ways: conferences, public relations, etc. Students enjoy showing off their newspaper, too. Copies placed in the library, teachers' work room, and the administrative offices are well-read.

Evaluation

Perhaps the best advantage of an activity of this nature is the chance for a teacher to know his/her students on a more personal basis. It provides an easy way to determine student capabilities, and find out who needs more structured activities or extra urging, or who works independently.

Evaluate the practice news article which the students unscrambled.

Have students write an essay explaining how a newspaper is developed.

Modifications

Scramble the sentences of short news articles from the local newspapers. Present these as a regular exercise in organizational writing.

Ask the staff of the high school newspaper to talk to the class about how they put the paper together.

Make the energy newspaper a small-group, independent project.

Allow interested students to publish further issues on related topics like the environment, resources, energy in the developing world, etc.

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Golder, Diane. The Newspaper and You: a Reading Skills Workbook (New York: Amsco School Publications, Inc., 1980).

Hollowell, John. "The New Journalism and the Student Voice" Thematic Units in Teaching English and the Humanities: First Supplement (National Council of Teachers of English, 1111 Kenyon Road, Urbana, IL, 1977).

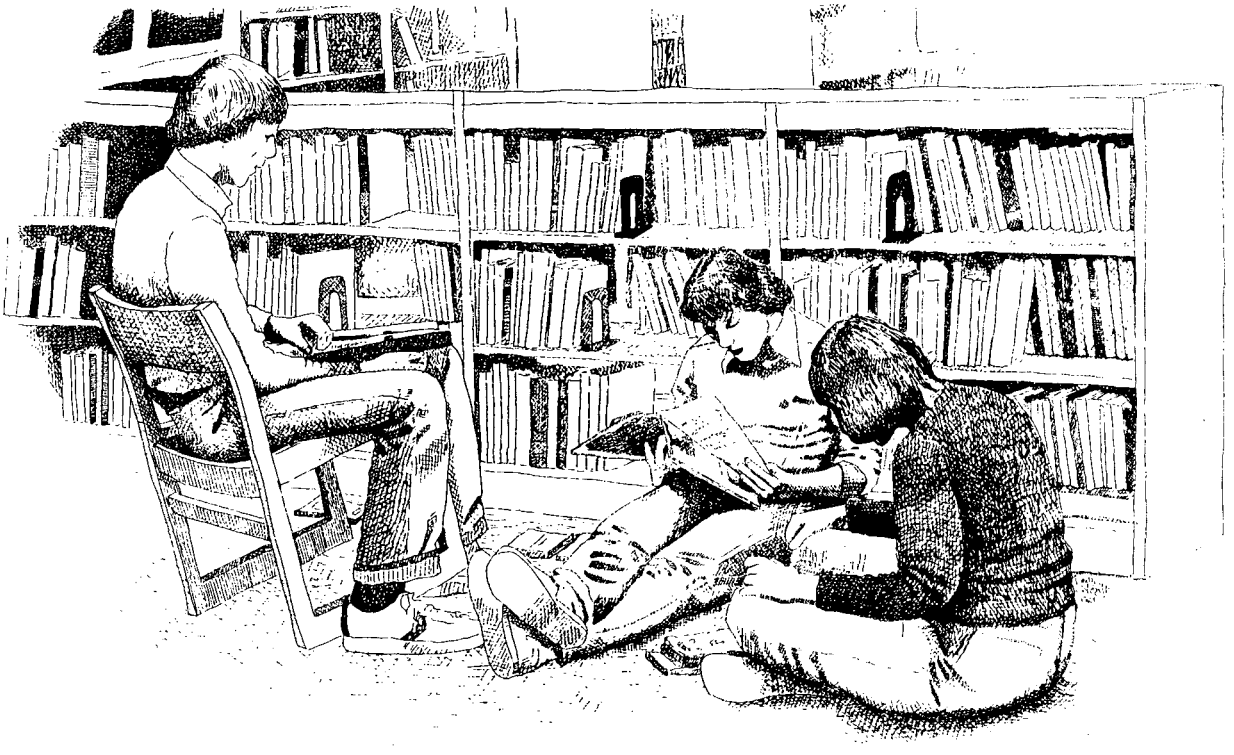
Energy and Power Outlines energy from the caveman to the present. 16mm, 10 min. (Journal Films, 909 W. Diversey Parkway, Chicago, IL 60614).

The Great Search: Man's Need for Power and Energy A Walt Disney production which traces the history of man's attempts at trying to harness solar energy and other energy sources. 16mm, 13 min. (Modern Talking Picture Service, 2323 Hyde Park Road, New Hyde Park, NY 11040).

Here Comes the Sun Solar systems. 16mm, 15 min. (Department of Energy, Film Library, P.O. Box 62, Oak Ridge, TN 37830).

Struggle for Power An overview of energy. 16mm, 25 min. (Modern Talking Pictures Service, 254 Delaware Avenue, Buffalo, NY 14202).

Energy Words 3



Introduction

Solar energy! Nuclear energy! Alternative energy sources! So much talking and writing these days is about energy: use, conservation, sources and supply. Most of the words we use to talk about energy are so new--or so recently combined in new ways--that it's hard to keep track. Can you distinguish the difference between active and passive solar energy right now?

It's possible to get new meanings from what you already know about language. Putting together parts of words--roots and prefixes and suffixes--is a skill you already use each day. Applying that skill will help you avoid vocabulary problems when reading newspapers and magazines or listening to news reports about energy in the 80's.

Many of the words in the English language are obtained by combining root words with Greek or Latin prefixes and suffixes. In this activity, you'll be working with prefixes, suffixes, and roots to help you improve your vocabulary.

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Objectives

At the completion of this activity, you should be able to

- o explain how language develops,
- o identify some energy vocabulary and technical vocabulary, and
- o define some prefixes, roots, and suffixes.

Skills and Knowledge You Need

A language is made up by those people who use it

Prefixes, roots, and suffixes are keys to the meanings of words

Parts of words can be rearranged to produce new words

Materials

pencil or pen

dictionary

Procedure

This activity has four worksheets. Each one gives you some information and then asks you to do something with it.

Questions

1. How are new words created?
2. What other languages besides Latin and Greek does English borrow from? Can you give some examples?
3. Why does the energy field have so many new words? In what other fields would you expect to find a lot of new words today?

Looking Back

You and the people around you are creating your language as you make new words. Whenever a new subject or a new problem arises, people invent words with which to talk about it. In inventing words, they often use old, familiar pieces of words, taken from Greek or Latin.

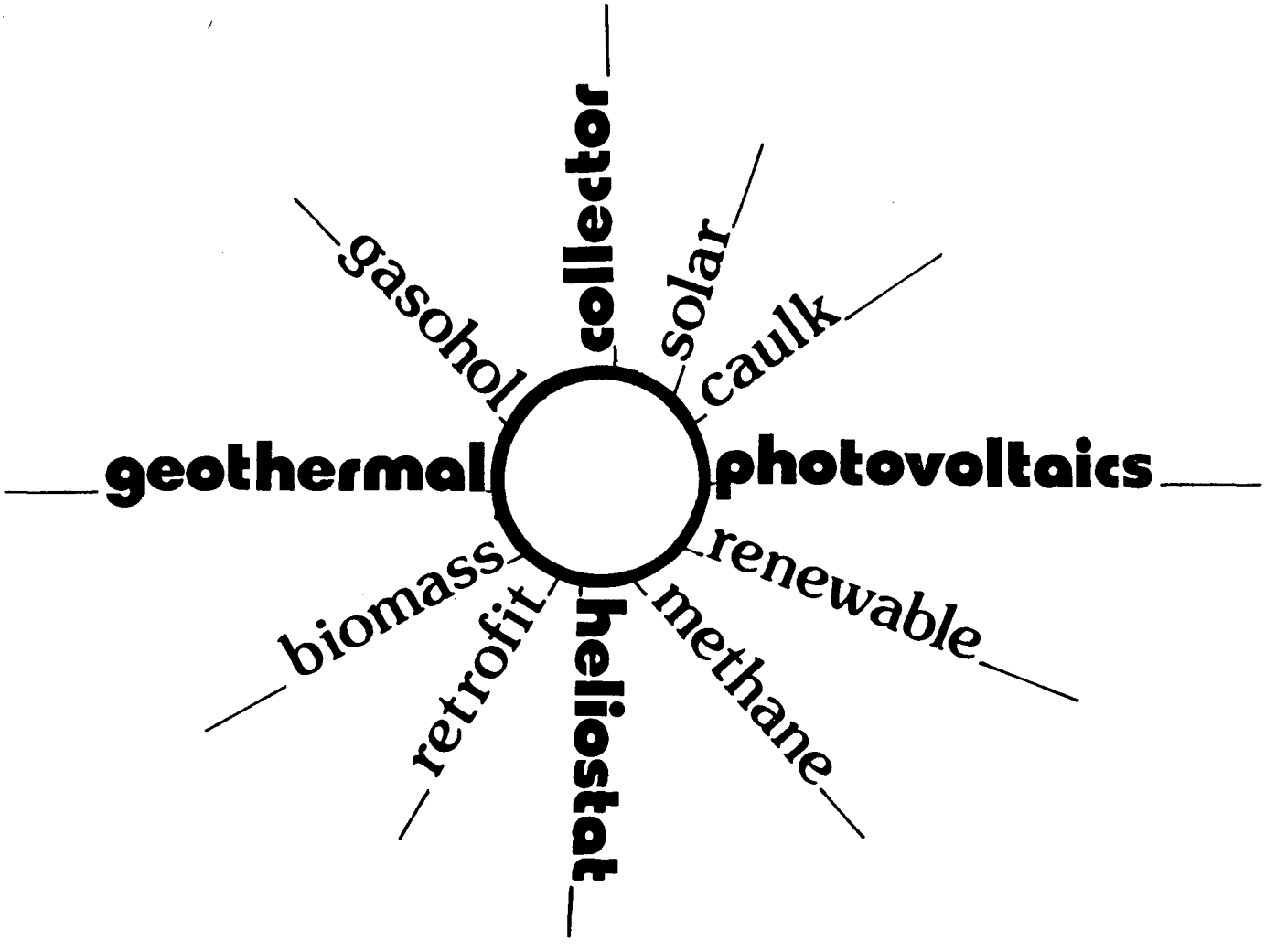
The energy field is just one of the many fields that uses ancient word-pieces to make new words.

Going Further

Make an energy mini-dictionary using at least ten of the vocabulary terms from the list below. Create a cover for your dictionary by making an original drawing or design related to energy. Word list: biomass, bituminous, catalytic converter, coal liquefaction, geopressured reservoir, hydroelectric, photosynthesis, radioactive, thermodynamics, octane, kerosene, anaerobic digestion, biofuels, conservation, entropy, gasohol, infiltration, petrochemicals, pyranometer, reclamation, retrofit, solarium.

Complete the crossword puzzle.

Make a mobile incorporating five or six related energy words and pictures to go with them.



Worksheet 1

Compound Words

When two words are used together often enough they become one word. For example, fire and place have been put together to form our word fireplace. Compound words are faster and easier to use than their original separate parts. An example of an energy word which is a compound word is feedstock. A feedstock is any resource that is used as the raw material for making fuel, medicine, chemicals, fertilizers, etc. Petroleum is a feedstock for many plastics.

Part A. Each word in Column I can be put together with a word from Column II to make a compound word which could be used in discussing energy. Match Column I with II and write the new compound in the space provided.

Column I	Column II	Compounds
1. radio	A. put	1. _____
2. horse	B. scape	2. _____
3. sugar	C. mill	3. _____
4. land	D. kind	4. _____
5. wind	E. house	5. _____
6. steam	F. active	6. _____
7. man	G. power	7. _____
8. green	H. boat	8. _____
9. black	I. out	9. _____
10. out	J. cane	10. _____
11. ground	K. stripping	11. _____
12. weather	L. water	12. _____

Part B. See how many compound words you can find in this word puzzle. The words are "sun" words, and there are fourteen of them in the puzzle. An example of a "sun" word is *sunbeam*. Some of the words are spelled from left to right, some from right to left. Others may be spelled downward, upward, or diagonally.

S	Y	N	S	N	B	C	D	A	D	S	G
U	R	E	T	U	R	G	H	I	R	U	O
N	D	W	O	B	N	U	S	J	I	N	E
G	N	K	P	L	M	L	B	O	B	S	S
L	U	P	S	Q	R	S	I	N	N	E	I
A	S	U	N	L	I	G	H	T	U	T	R
S	U	S	U	N	B	E	A	M	S	S	N
S	U	N	S	T	R	U	C	K	W	X	U
E	Z	A	B	C	H	S	I	F	N	U	S
S	U	N	B	O	N	N	E	T	D	E	F

Part C. Give at least one meaning for each of the following compound words which use "sun" at the beginning. Use a dictionary if you need help.

1. sunflower _____
2. sundial _____
3. sunburst _____
4. sunroom _____
5. sunstroke _____

Part D. List at least ten additional compound words which use "sun" as the first part of the word. Use a dictionary to help you. Do not use any words previously used.

1. _____ 2. _____
3. _____ 4. _____
5. _____ 6. _____
7. _____ 8. _____
9. _____ 10. _____

Worksheet 2

Prefixes

A prefix is a group of letters put in front of a base or root word to form a new word. Prefixes usually have a meaning themselves. These meanings remain nearly the same when prefixes are added to various base or root words. Generally, prefixes are borrowed from Latin or Greek languages to help us make new words. For example, sub means below or under; marine always has to do with the sea. Therefore, submarine means under the sea. Some other common prefixes and their meanings are

pre -- before
super -- over, above
trans -- across
di -- two

As can be seen, a prefix is generally one or two syllables coming before a root word.

Part A. Below are energy words which have a prefix. Underline the prefix for each word and then write the definition of the prefix in the space provided. Use dictionaries as needed.

1. microwave _____
2. demolish _____
3. export _____
4. import _____
5. transparent _____

Part B. Prefixes all have meanings. The meaning of the prefix helps us to understand a word. Here are some prefixes often used in discussions about solar energy or alternative energy resources. Using a dictionary as a reference, fill in the blank provided with a definition of the word. Use the meaning of the prefix as part of the definition.

	Prefix	Origin	Meaning	Word	
1.	ultra	Latin	beyond	ultraviolet	_____
2.	infra	Latin	below	infrared	_____
3.	re	Latin	again	renewable	_____
4.	bio	Greek	life	bioconversion	_____
5.	hydr(o)	Greek	water	hydroelectric	_____
6.	photo	Greek	light	photovoltaics	_____
7.	geo	Greek	earth	geothermal	_____
8.	helio	Greek	sun	heliostat	_____
9.	mega	Latin	million	megawatt	_____
10.	con	Latin	with	concentrate	_____

Worksheet 3

Suffixes

Suffixes are endings added to words to form a new term. Some suffixes will make one kind of word into another kind, as with the suffix *-ment*. For example, *agree* (verb) + *ment* = *agreement* (noun). Here are some common suffixes used to form nouns: *-ion*, *-tion*, *-sion*, *-ist*, *-er*, *-or*, *-ness*, or *-ance*, *-ence*. The following suffixes usually form adjectives: *-ous*, *-ious*, *-able*, *-ible*, *-al*, *-ive*.

Part A. Underline the suffix of each word, and indicate on the line provided whether the word is a noun or an adjective. If you are unsure, check a dictionary.

1. fusion _____
2. gasification _____
3. thermal _____
4. radiation _____
5. conversion _____
6. geologist _____
7. photographer _____
8. reactor _____
9. economical _____
10. inflammable _____

Part B. Each of the words below has both a prefix and a suffix. Underline the prefix once and the suffix twice. Write the definition of the word in the space provided.

1. reflector _____
2. convection _____
3. evaporation _____
4. bioconversion _____
5. environment _____
6. emission _____
7. deforestation _____
8. superconductor _____
9. helioscope _____

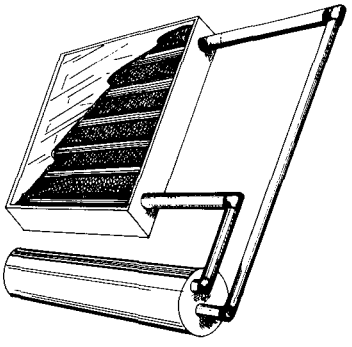
Worksheet 4

Root Words

Our language is made up of many Latin and Greek root words. The root contains a word's basic meaning. Understanding root words will help broaden your vocabulary. Here are a few examples:

duc	=	lead as in conductor
dynam	=	power as in dynamic
gen	=	produce as in generator
insula	=	island as in insulation
port	=	carry as in portable
therm	=	heat as in thermostat
vert	=	turn as in convert
fer	=	bear as in transfer

Read the following passage through to see what it tells you about a solar collector. Some of the words are underlined. In the spaces provided below the passage, write the meaning of the word based on your knowledge of the parts of words. Use a dictionary if you need help.

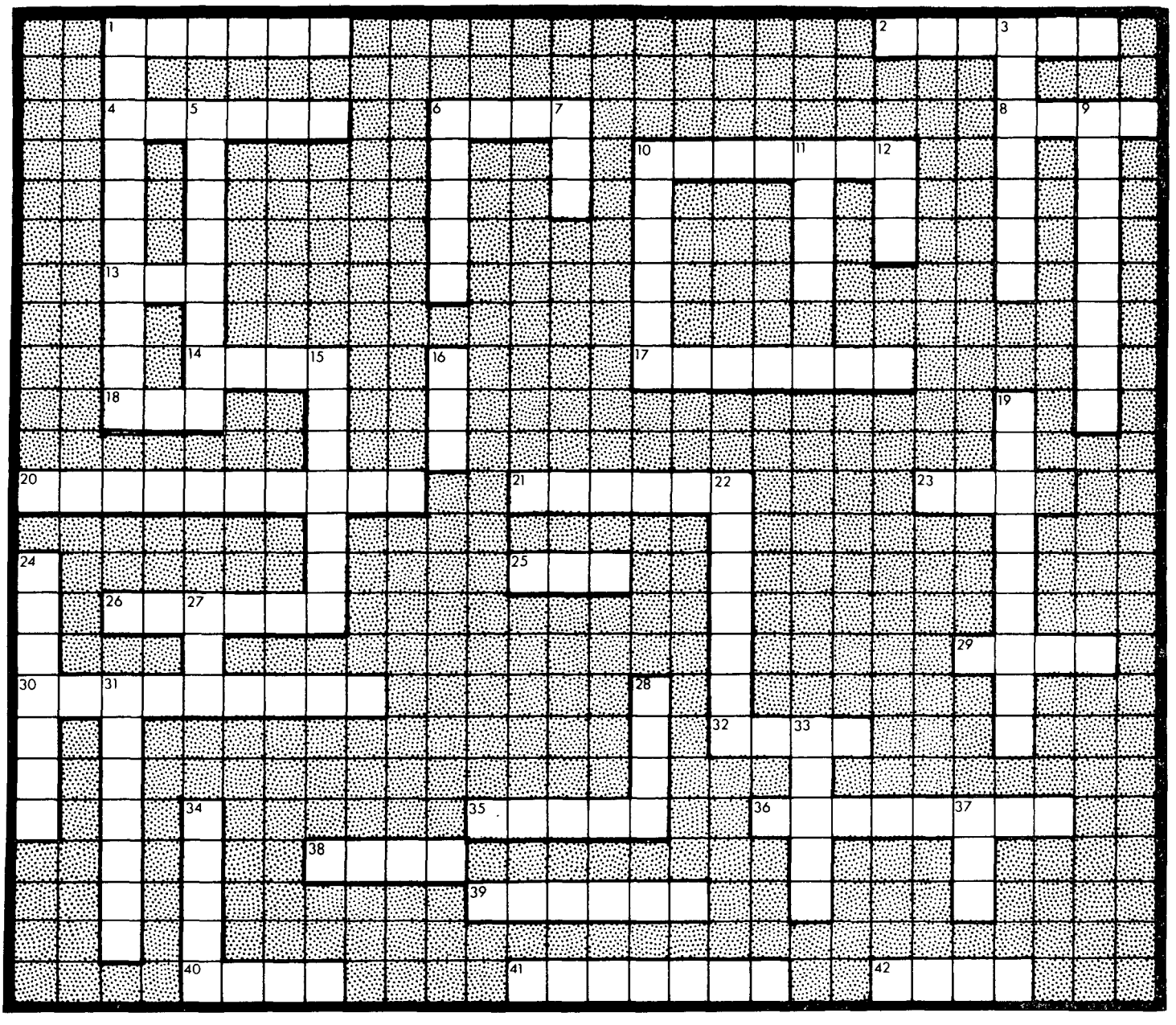


A solar collector is a box that collects solar energy and turns it into heat. Radiation from the sun passes through a transparent material like glass on the top side of the box. Under the glass is a metal absorber plate. When the radiation hits the plate, the plate heats up. The heat would escape, but there is insulation behind the absorber. The insulation, the sides of the box, and the glass trap the heat so the plate gets hotter. Now water passes through pipes in the absorber plate and is heated up. The water transports the heat to an insulated storage tank.

When you want a hot shower, you just draw water from the tank. The sun's radiant energy has been converted to heat for you.

1. collector _____
2. radiation _____
3. transparent _____
4. absorber _____
5. insulation _____
6. transports _____
7. converted _____

Energy Crossword



Across

1. prefix, heat
2. a liquid measure
4. force
6. smoke and fog
8. degassed coal
10. Metric temperature
13. abbr. Second Law Thermodynamics
14. abbr. Organization Petroleum Exporting Countries
17. positively charged core of an atom
18. 7-8-9-__
20. soft coal
21. British word for gasoline
23. 1/10 of a cent
25. black gold
26. a machine that converts energy to motion
29. atomic half-_____
30. flammable liquid
32. opposite of freeze
35. ebbing and flowing
36. two atoms having same number of protons in nucleus
38. carbonized moss
39. left-overs
40. abbr. Ocean Thermal Energy Conversion
41. nuclear reactor
42. thermal

Down

1. temperature device
3. reuse
5. negatively charged particle
6. type of energy
7. petroleum product
9. petroleum distillate
10. organic
11. atoms with positive or negative charge
12. abbr. synthetic natural gas
15. Metric unit of heat energy
16. abbr. magnetohydrodynamic
19. unclean (noun)
22. the lightest metal
24. period of low demand
27. Greek prefix, earth
28. _____gasification
31. #90 on Periodic Table
33. intense beam of light
34. Greek prefix, water
37. abbr. Pounds per Square Inch

Teacher Information

Energy Words

Suggested Grade Level and Discipline

Grades 6-10
Language Arts

Skill Objectives

Defining prefixes, roots, suffixes

Making compound words

Developing an awareness of energy/technical vocabulary

Increasing vocabulary and spelling skills

Recognizing evolution of vocabulary to accommodate technological advances

Major Understandings

Certain prefixes, roots, and suffixes recur in our language.

Scientific/technical vocabulary on energy resources has evolved based on principles of language development.

Background

Many of the words in the English language are derived from combinations of root or base words, prefixes, and suffixes. Most of our prefixes and suffixes come from the Greek or Latin. Many scientific or technical terms used in articles and books on energy employ vocabulary that uses these word parts. Learning them will help students in developing their vocabulary as well as their energy awareness.

Advance Planning

Study the worksheets to determine whether the level of difficulty is appropriate for your students. The first exercises are easy, but the later ones become increasingly difficult.

These activities can be incorporated into most units of study on vocabulary where the skills of prefixes and suffixes are being taught. However, they can be used as a unit within themselves. Have dictionaries available for student use.

Have either xeroxed copies of the activity sheets available for student use or make a transparency of the activity sheet to use as a large group activity.

Suggested Time Allotment

Time will vary depending on whether the teacher is incorporating these activities into a vocabulary unit or using them as a self-contained unit, and depending on whether the activities are done as large group or small group activities.

Suggested Approach

It is recommended that the teacher have introduced and discussed compound words, prefixes, suffixes, and roots previously, since the explanation of these word parts in the activity is very brief.

The various parts of this activity allow for a variety of approaches. They can be done as individual assignments, small group activities, or as a full class lesson. Any given exercise may be distributed as a handout or shown on an overhead.

Since arriving at a correct definition from word parts can be tricky, it is recommended that each exercise be reviewed by the teacher with the whole group. This will help students who are being misled by a too-literal interpretation of some words.

Group review is especially valuable if students are then led to brainstorm other examples of "words made from parts," and perhaps even make up new words for future technologies that they can imagine.

Precautions

The beginning task was geared for low-achievers. It deals with compound words and not the use of prefixes and suffixes. The tasks increase in difficulty.

Points for Discussion

What is a compound word? A prefix? A suffix? A root word?

What are some examples of these <u>not</u> found in the activity?

What other subject areas have developed their own sets of special words?

How do new terms come into our language? What languages aid us in developing new words?

Typical Results

Results will vary depending on the students. In general, students will improve their ability to recognize the meaning of a word and will be more comfortable when reading technical material written on grade level.

Evaluation

Teacher observation throughout the activity offers opportunities for encouragement and evaluation. Since each exercise is short, one exercise can be evaluated while students are working on the next.

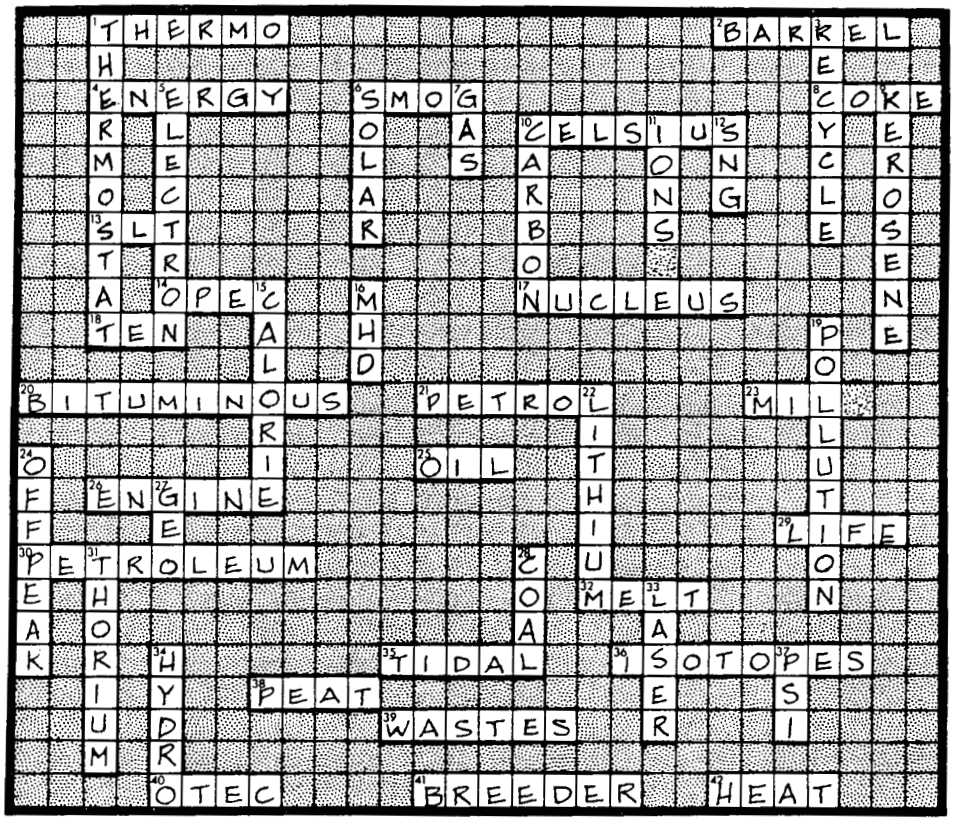
References

Crabbe, David and Richard McBride, eds. The World Energy Book (Cambridge, MA: The MIT Press, 1979).

Fowler, John M. and King C. Kryger. "Alternative Energy Sources: A Glossary of Terms" NSTA Factsheet #18 (DOE Technical Information Center, P.O. Box 62, Oak Ridge, TN 37830)

Hunt, V. Daniel. Energy Dictionary (New York: Van Nostrand Reinhold Company, 1979).

Energy Crossword Key



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Solar Energy Sentence Combining

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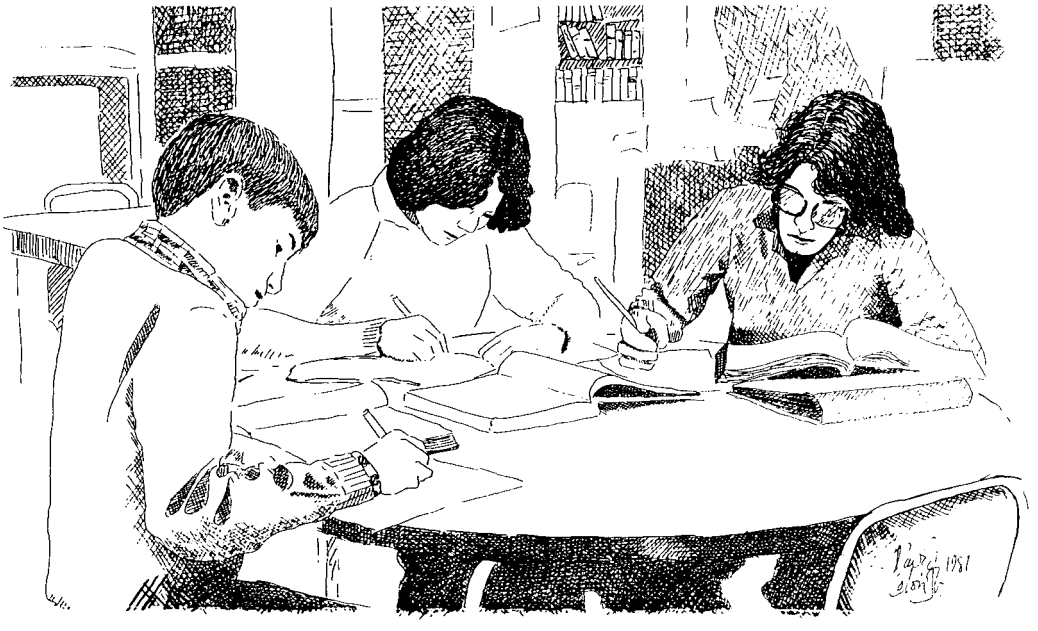


Introduction

On television, in the newspaper, and in schools, energy is one of today's important topics. Perhaps you have already studied energy in some of your courses, and you may have been assigned reports to write on energy topics. In this activity you will be using a technique called "sentence combining" to write about energy.

When you write, you must make choices. The first choice in good writing is to decide what idea you wish to express, and the second choice is to decide how to express your idea fluently and clearly.

A sentence is a group of words joined together to express a main idea. Most of the main ideas in well-written sentences are made up of smaller ideas. If sentences were written so only the smaller ideas were expressed each time, the result would be short, choppy sentences. The following sentences show this kind of choppy writing.

> Kevin built a windmill. The windmill was a scale model. The windmill was for the science fair.

These ideas can be combined in one sentence to form a more fluent expression.

> Kevin built a scale model of a windmill for the science fair.

Here is another example of short, monotonous sentences.

> James Watt invented the engine. The engine was modern. It was a steam engine. The invention was made in 1765.

These ideas can be combined to be less wordy: James Watt invented the modern steam engine in 1765.

Not only does sentence combining improve the fluency of your writing, but it also helps you to express your ideas more clearly.

Objectives

At the completion of this activity, you should be able to

- write more fluently,
- write more mature sentences, and
- express an awareness of alternative energy resources.

Skills and Knowledge You Need

How to write a simple sentence

Materials

pencil or pen

paper or writing folder

sentence combining worksheets

dictionary

Words You'll Learn

photosynthesis, radiant energy, solar cells, passive solar energy, biomass, methanol, ethanol

Procedure

Complete each task as the teacher assigns it.

As you go along, use the dictionary to find the meanings of words you don't understand.

Questions

1. Does a mature writer always use long sentences?
2. Why is it valuable to be able to write both long and short sentences?
3. Where else do people combine ideas (besides in writing)?
4. How do you think people invent ways of using energy?
5. What qualities should a good energy invention have today?

Looking Back

We often feel and think in simple, separate ideas. "There is the sunlight. It is bright. I sit in the sunlight. I feel warm." By combining these fragments of thought and feeling we arrive at more mature statements, conclusions... and questions. "When I sit in the bright sunlight I feel warm. Why is that?"

The energy problems the world faces are not simple yes-or-no, black-or-white problems. By reading and researching, by thinking and combining ideas, we will be able to find workable solutions.

Going Further

Do research for a report on other forms of renewable energy and take notes. (Try passive solar homes, wind energy, hydropower, photovoltaics, geothermal energy, ocean thermal energy.) Write your notes as simple sentences. Then try to combine your simple sentences into more mature sentences for the report.

Worksheet 1

Task 1: **Simple Sentences**

A simple sentence expresses one main idea. Combine the cluster of simple sentences below to form a more developed simple sentence.

1. There is a depletion of resources.
2. The depletion is rapid.
3. The resources are ours.
4. The resources are energy.

Below are two possible ways you might have combined the cluster of four sentences. Do you know other possibilities?

There is a rapid depletion of our energy resources.

(or)

Our energy resources are rapidly being depleted.

Combine the following cluster of sentences to form a more developed simple sentence.

1. Energy travels.
2. The energy is radiant.
3. The energy is from the sun.
4. The travelling is to the earth.
5. The travelling is at a speed.
6. The speed is of 300,000 kilometers per second.

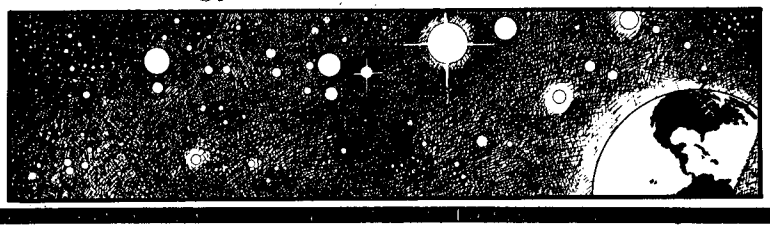
WRITE YOUR SENTENCE.

Below are two possible ways you might have combined the cluster of six sentences. Can you think of another way?

Radiant energy travels from the sun to the earth at a speed of 300,000 kilometers per second.

(or)

At a speed of 300,000 kilometers per second, radiant energy travels from the sun to the earth.



Task 2:

Compound Sentences

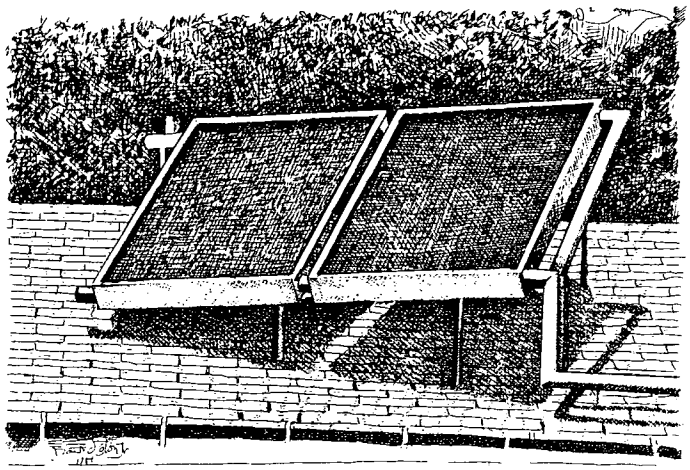
A compound sentence joins two main ideas (independent clauses) together by using connectors (coordinating conjunctions). The six most common coordinating conjunctions are *and*, *but*, *for*, *yet*, *so*, *or*. Combine the clusters of simple sentences to form a compound sentence. The clues (italicized words) on lines four and seven are the coordinating conjunctions to use. In lines eight and nine, the word *SOMETHING* is used only so the simple sentence will make sense. You will insert words from the following sentence to replace *SOMETHING*. Do not include the word *SOMETHING* in your combined idea. *Notice the commas before the coordinating conjunctions.*

1. Homes now heat with sunlight.
2. The heating is of water.
3. The homes are American.
4. The homes are about 35,000 (, *but*)
5. In Israel homes have water heaters.
6. The homes are 200,000.
7. The water heaters are solar. (, *and*)
8. In Japan the figure is *SOMETHING*.
9. The *SOMETHING* is over two million.

WRITE YOUR SENTENCE.

Below is one possible way to combine the nine simple sentences. Can you think of another alternative?

> About 35,000 American homes now heat water with sunlight, but in Israel 200,000 homes have solar water heaters, and in Japan the figure is over two million.



Task 3: **Complex Sentences**

In a sentence containing more than one idea, sometimes one idea is more important than another. The sentence must be arranged so that the more important idea receives the greater emphasis. Such a sentence, containing one main idea (independent clause) and at least one subordinate idea (dependent clause), is called a complex sentence.

Combine the clusters of simple sentences below to form a complex sentence. Complex sentences are joined together by the use of connectors (subordinating conjunctions). Following is a list of frequently used subordinating conjunctions: *after*, *although*, *as*, *because*, *since*, *which*, *while*. There are other subordinating conjunctions.

1. The sun is responsible.
2. The responsibility is for photosynthesis. (, *which*)
3. Photosynthesis is a process.
4. It is a process in which plants store energy.
5. The plants are green.
6. The energy is radiant.

WRITE YOUR SENTENCE.

Did your combination read like this?

The sun is responsible for photosynthesis, which is a process of green plants storing radiant energy.

Worksheet 2

Writing a Paragraph

Part 1

Combine the sentences in each cluster to form a single sentence. Add any connecting words you need. Write the combined sentences as a paragraph.

1. Carl Berdahl tested *SOMETHING*.
2. Ray Bartlett tested *SOMETHING*.
3. The *SOMETHING* was an airship.

4. They are from *SOMEWHERE*.
5. The *SOMEWHERE* is Cal-Tech.

6. Their airship is powered.
7. The powering is by solar cells.
8. The cells convert sunlight.
9. The conversion is into energy.

10. The energy runs a motor.
11. The motor flies the ship.

12. The airship travels.
13. The travelling is at three miles per hour.
14. The travelling is on solar power.

15. It uses helium.
16. The using is for lift.

17. The ship is wide.
18. The width is nine feet.
19. It weighs 8.5 pounds.

from Scholastic Science World, Sept. 21, 1978.

WRITE YOUR SENTENCES AND COMBINE THEM IN A PARAGRAPH.

Part 2

Try another paragraph. Combine each cluster to form a single sentence. Write your sentences in paragraph form using any connecting words you need.

1. The solarmobile was built.
2. The building was by the Europeans.

3. It was shown.
4. The showing was the first.
5. The showing was in Sasbach.
6. Sasbach is in West Germany.

7. Cells were mounted.
8. The cells were solar.
9. The mounting was atop *SOMETHING*.
10. The *SOMETHING* was a tricycle.

11. Energy generated electricity.
12. The energy was solar.
13. The generating drove *SOMETHING*.
14. The *SOMETHING* was a motor.
15. The motor was small.

from Scholastic Science World, Oct. 5, 1978.

WRITE YOUR SENTENCES AND COMBINE THEM IN A PARAGRAPH.

Worksheet 3

Extending Paragraphs

After you have combined each cluster in the following task to form simple sentences, you will have the first paragraph of an essay on Greek architecture. When you finish, you are to check with an encyclopedia or other resource book and write another paragraph on solar energy used by the Greeks. Perhaps you might want to check on the cities of Olynthus or Priene. The solar architecture there was extraordinary.

1. Greece is a country.
2. The country is beautiful.
3. It is a country with a past.
4. The past is glorious.

5. The architecture is superb.
6. The architecture is Greek.
7. The architecture is ancient.

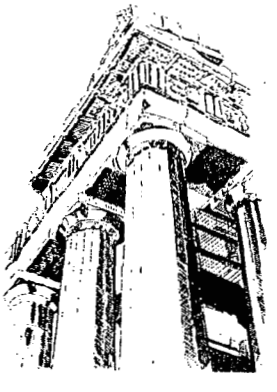
8. The ruins testify.
9. The ruins are of villas.
10. They testify to *SOMETHING*.
11. The *SOMETHING* is the artistry and knowledge.
12. The artistry and knowledge is of the Greeks.

13. Athens produced thinkers.
14. The thinkers were great.
15. Socrates was a thinker.
16. Aristotle was a thinker.

17. Aristotle advocated solar energy.
18. Socrates advocated solar energy.
19. The solar energy was passive.

WRITE YOUR SENTENCES AND COMBINE THEM IN A PARAGRAPH.

WRITE A SECOND PARAGRAPH FROM RESEARCH.



Worksheet 4

Writing a Composition

In the following exercise, you will combine clusters of sentences to form two separate paragraphs. Only the first sentence of the third paragraph is provided. Details and instructions about finishing the essay are at the end of the cluster provided for the beginning of the third paragraph.

Paragraph One

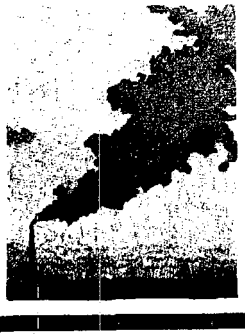
1. Biomass is a resource.
2. The resource is energy.
3. The energy is renewable.

4. It is a process.
5. The process is conversion.

6. Wood and plant matter are converted.
7. Crop residues are converted.
8. Animal wastes are converted.
9. Kelp is converted.
10. The conversion is into energy.

11. *SOMETHING* was estimated.
12. The estimation was in 1979.
13. The estimation was by the Office of Technology Assistance.
14. Ninety percent of energy came from sources.
15. The energy was ours.
16. The sources were nonrenewable.

17. These sources include oil.
18. The oil is domestic and imported.
19. These sources include natural gas.
20. The natural gas is domestic and imported.
21. These sources include coal.
22. The coal is domestic.



23. It is also estimated.
24. By the year 2000, consumption could come from biomass sources.
25. The consumption is in the U.S.
26. The consumption is current.
27. The consumption is of energy.
28. The consumption is fifteen to twenty percent.

29. The U.S. needs independence.
30. The independence is from energy sources.
31. The energy sources are nonrenewable.

32. Processes must be developed.
33. The processes are for conversion.
34. The conversion is of wood.
35. The conversion is of crop residues.
36. The conversion is to energy.
37. The energy is usable.

38. Ways must be developed.
39. The ways are for harvesting.
40. The ways are for collecting.
41. The harvesting and collecting is of these materials.
42. The ways must avoid damage.
43. The damage is to the environment.

Paragraph Two

1. Biomass conversion includes processes.
2. The processes are three.
3. The processes are major.

4. It includes combustion.
5. The combustion is direct.
6. It includes gasification.
7. The gasification is air-blown.

8. These methods are competitive.
9. The competition is with burning.
10. The burning is of fuel oil.

11. Another method is synthesis.
12. The synthesis is of fuel.
13. The fuel is alcohol.

14. This is a conversion.
15. The conversion is from solids.
16. The conversion is to liquids.

17. These liquids are ethanol and methanol.
18. Ethanol is grain alcohol.
19. Methanol is wood alcohol.

20. Methanol can be manufactured.
21. The manufacturing is from wood.
22. The manufacturing is from dry plant material.

23. Ethanol can be manufactured.
24. The manufacturing is from grains.
25. The manufacturing is from sugar crops.
26. The manufacturing is from wastes.
27. The wastes are fermented.

28. Both can be used alone.
29. Both can be blended.
30. The blending is with gasoline.

Paragraph Three

1. Biomass is a source.
2. The source is of energy.
3. The source is promising.
4. The energy is renewable.
5. Using it can create *SOMETHING*.
6. The *SOMETHING* is problems.

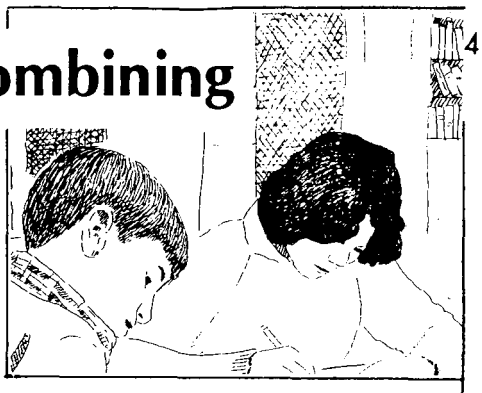
WRITE YOUR SENTENCES AND COMBINE THEM IN PARAGRAPHS.

WRITE YOUR THIRD PARAGRAPH FROM RESEARCH.

Finish this paragraph (and the essay) by writing about some of the problems we must beware of in using biomass as a source of energy.

Teacher Information

Solar Energy Sentence Combining



Suggested Grade Level and Discipline

Grades 7-9
Remedial English
Basic Skills Classes

Skill Objectives

Combining elements from simple sentences into sentences with greater syntactic maturity

Critical reading

Major Understandings

Sentence combining is a way to write longer, more complex sentences.

Basic sentence patterns can be expanded by adding adjectives, adverbs, and phrases.

Writing can be enriched with meaningful comparisons.

Knowledge of renewable energy sources can help to solve our energy problems.

Background

Teachers have been offering lessons in formal grammar for generations. The studies available today indicate that there is little or no correlation between getting good grades on grammar tests and writing well.

Fortunately, we know that content is the principal ingredient of good writing. Teachers reward the students' composition efforts which show good content with the highest grades. We also know that syntactic maturity, or the quality of the sentences, is a major ingredient in good writing. Students can be taught to increase the length and complexity of their sentences by working with Dr. Frank O'Hare's sentence combining activities. Practice for a short time each day, or a regular time each week, has proven to be a good method to employ. Beginning with simple sentences and adding modifiers sets the path for student growth into making their own compound-complex sentences.

These combining activities use solar energy as their theme. Students will be reading factual information and finding new ways to express it in a language appropriate to their level of development.

Advance Planning

You may wish to send for the Dr. O'Hare book Sentence Combining: Improving Student Writing Without Formal Grammar Instruction, an NCTE publication.

Duplicate the materials to be worked through in sequence, or get overhead transparencies, and felt-tip pens if you plan to project the exercises instead of duplicating them.

Suggested Time Allotment

Do the tasks for a short part of each class over several days.

Worksheets 3 and 4 require time for research.

Suggested Approach

Take time, perhaps using an overhead while working through a sample activity, to stress how detailed the work really is. Each kernel sentence, the one that contains the main subject(s) and verb(s), must be identified by reading through the entire group and then deciding. Once the main idea is identified--a fine critical reading activity--it is a step-by-step process of making connections.

Use each task as part of a class period several days in a row. Try to encourage students to use these new patterns in their own writing. Remind them of connecting words and their uses. "Can you think of a word that would connect those two sentences."

Try taking a favorite reading passage of the class and breaking those "professional" sentences down. Use it as a combining activity and then compare it to what the writer decided.

Precautions

Students who have trouble reading need more instruction as to the idea of the exercise and how to use connecting words.

Points for Discussion

What do you suppose a teacher looks for when evaluating your writing?

What decisions does a writer make regarding sentence length and complexity? On what basis?

How many ways can you think of to build a sentence?

Count the number of short sentences in the last paragraph you wrote. How many? How many are long? What does mixing them do for your writing?

How do you think people discovered ways of using solar, wind, biomass, and other forms of energy?

What can you do to conserve energy? What would be the result of these energy-conserving activities?

Typical Results

If this activity is followed by others of a similar nature, you'll notice an increase in the length of the sentences your students will generate. You may be bothered by the imitative nature of these changes, but soon the increased syntactic maturity will take on each writer's own identity.

Evaluation

The students' writing folders could be used for storing the worksheets. Check off each task as it is accomplished.

Create some combining activities and evaluate them with a numerical grade.

Add points to essay grades when longer, better sentences appear.

Make a positive statement on the students' writing when noting increased syntactic maturity.

Modifications

As students grow in skill, give some exercises without supplying connector words.

Work some exercises on the chalkboard or on an overhead, stressing possibility for differences.

References

Daiker, Donald, Andrew Karek, and Max Morenberg. "Sentence-Combining and Syntactic Maturity in Freshman English" (College Composition and Communication, National Council of Teachers of English, 1111 Kenyon Road, Urbana, IL, February 1978).

O'Hare, Frank. Sentence-Combining: Improving Student Writing Without Formal Grammar Instruction (National Council of Teachers of English, 1111 Kenyon Road, Urbana, IL, 1973).

Stotsky, Sandra. "Sentence-Combining as a Curricular Activity: Its Effects on Written Language Development and Reading Comprehension" (Research in the Teaching of English, National Council of Teachers of English, 1111 Kenyon Road, Urbana, IL, Spring 1975).

Writing an Energy Report 5

Introduction

Organizing and classifying information into a coherent report for a specific audience is an important skill. It is useful in both the academic and business world. Informative writing is the kind of writing found in magazines and newspapers, and its purpose is to convey important information to readers who may not have previous knowledge of the subject.

The following activity will give you practice in this kind of writing. In addition you will practice classifying and organizing notes, a useful skill in all your research-related assignments.

The topic of this report-writing exercise is renewable energy--sun, wind, hydropower, wood--forms of energy that constantly renew themselves as they are used. Perhaps this activity will lead you to learn more about renewable energy and the place it may hold in your future.

DRAFT

Objectives

At the completion of this activity, you should be able to

- o identify the main idea of a body of information and list supporting details,
- o generate sentences from phrases,
- o organize a list of notes into a cohesive, informative essay, and
- o recognize vocabulary related to renewable energy.

Skills and Knowledge You Need

Classifying and organizing information

Writing cohesive paragraphs

Connecting related ideas into larger units of thought

Materials

fact sheet

working plan

Words You'll Learn

active solar--collection of solar energy using solar collectors and a mechanical system to store and circulate the energy.

alternative energy sources--sources of energy different from those most used in recent generations. Examples are wind power, geothermal energy, solar energy.

biomass--a volume or amount of plant material in any form: algae, wood, plants, crop residue, animal manure, etc.

fossil fuels--coal, petroleum, and natural gas; this term applies to any fuels formed from the fossil remains of organic materials (plants and animals) that have been buried for millions of years.

hydropower--power from falling water, used for mechanical work or electric generation.

passive solar--collection of solar energy by the house or building itself, without mechanical aids.

renewable energy sources--energy sources that can be replaced or regenerated in a short time. Examples are solar energy, wind, hydropower, wood.

solar energy--the electromagnetic radiation emitted by the sun.

Procedure

Part A:

Learn the vocabulary words and record them in your notebook.

Part B:

1. Read all the information provided on the fact sheet.
2. Group all related information into three groups.
3. Decide on the main idea for each group of related ideas.
4. Fill in the main idea and supporting details for each of the three groups, to complete the working plan. Write complete sentences. (There may be a different number of sentences in each group.)
5. Each of the three groups will be a paragraph in your report. Decide the order of paragraphs and plan of development of your report.
6. Write and revise the report.

Questions

1. Why do we need to explore renewable energy sources?
2. What are some ways you can increase knowledge of renewable energy in your community?
3. What ways does your family consume energy? How do they save energy?

Looking Back

Our nation's energy needs and sources have changed in the last few decades. Awareness of new sources, their advantages and disadvantages, is necessary for responsible consumers if we are to become independent of foreign energy suppliers. Renewable energy is one of the most promising resources for the future.

Going Further

Visit solar homes in your community. Invite an architect to talk to your class about the advantages and disadvantages of solar homes in your area of the country.

Contact your state energy office for free pamphlets and brochures on alternative energy. Make these available in the library for other students.

Conduct a schoolwide survey on energy to find out what information or misinformation people have about energy.

Write "Energygrams" for your school TV station, newspaper, or morning bulletin. Each "Energygram" should state one fact about energy conservation, solar energy, or other energy alternatives that the students in your school seem to be unaware of.

Energy Report
Fact Sheet

The situation You attended a community meeting on the subject of renewable energy sources and took the following notes.

Directions Organize the notes and write a report for your class. Carefully read all the information before you start to write.

Notes

- Renewable energy sources and their advantages
- Wind generators for electricity in windy areas
- Tax credits available for installation of renewable energy systems
- Meeting was on Sun Day, May 3, 1981 at the Town Hall, 7:30 p.m.
- U.S. too dependent on foreign oil supplies
- Passive solar heat = no equipment necessary; building itself collects heat
- Wood burning stoves popular
- Active solar heat = collectors provide hot water or air
- Renewable energy sources: wind, sun, hydro, wood
- Speaker, Dr. John Weaver of the U.S. Department of Energy
- Solar water heaters a practical first step
- Over 1200 people in attendance
- Solar greenhouses good source of passive solar heat
- U.S.--8 million gallons oil per day imported
- Renewable energy sources--popular
- World events affect availability of oil

Your task

To help you organize your report, rearrange the notes using the Working Plan before you start to write your first draft. Be sure to include all the information in the notes. Each idea and supporting detail must be expressed in a complete sentence on the working plan.

Energy Report
Working Plan

Main Idea _____

Supporting details

a.
b.
c.
d.
e.
f.
g.

Main Idea _____

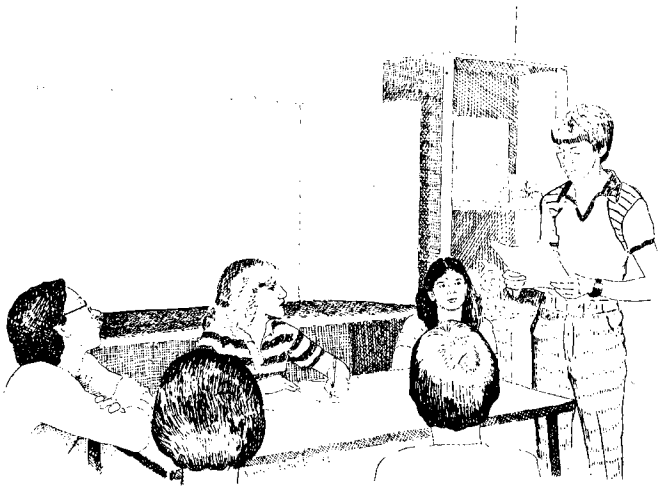
Supporting details

a.
b.
c.
d.
e.
f.
g.

Main Idea _____

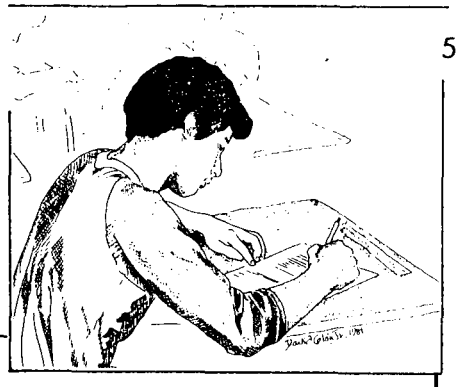
Supporting details

a.
b.
c.
d.
e.
f.
g.



Teacher Information

Writing an Energy Report



Suggested Grade Level and Discipline

Grades 8-12
English
Social Studies

Skill Objectives

Classifying information and grouping associated ideas

Developing sentences from phrases

Organizing and writing a report for a specific audience

Major Understandings

There is a body of vocabulary related to solar energy and other renewable energy sources.

The public needs increased awareness and knowledge of solar energy, energy conservation, and alternative energy sources.

Reports are written by taking notes and then organizing the notes into related categories.

Background

This activity is designed to give students practice in organizing information about alternative energy, especially solar energy, into a written report for a specified audience. Students will need to turn fragments into complete sentences and provide transition from one idea to another. References to passive solar design, solar greenhouses, tax credits, and renewable energy should create curiosity on the part of the student. State energy offices as well as the U.S. Department of Energy have a wealth of free information for consumers. Students might write to these agencies requesting bibliographies and resource materials. These agencies also offer films which provide valuable background information on energy.

Advance Planning

Duplicate Fact Sheet and Working Plan.

Collect brochures, pamphlets, and articles for students to look at before they work on the report.

Suggested Time Allotment

2-3 class periods

Suggested Approach

Prepare a bulletin board of newspaper and magazine clippings about solar homes, solar collectors, and energy awareness in general. Use this as a motivational technique to stimulate discussion about the need for alternative energy sources.

Prior to report writing, invite a local architect, solar engineer, or community resident versed in energy conservation and alternatives to speak to the class. Or show a film on renewable energy.

Vocabulary should be reviewed and discussed with the group as a whole. Organizing and writing the report can be an individual or small group activity. Several different reports could be viewed on the overhead to show organization and stress the validity of different responses.

Points for Discussion

If you could use any form of energy in your home, what would you choose? Why?

What might be the best ways to educate the general public about renewable energy and energy conservation?

Typical Results

Results will vary depending on the ability of the student, and on individual tastes in grouping and presenting the information.

Evaluation

The Working Plan may be checked for main ideas and supporting details.

Letter grades may be assigned to reports based on organization of information, attention to audience, and sentence structure.

Modifications

Organize the report as a class activity using an overhead projector. Then ask students to write their reports independently.

References

State Energy Offices

CAREIRS
Renewable Energy Information
P.O. 1607
Rockville, MD 20850

"National Geographic: A Special Report in the Public Interest - Energy" available from:
National Geographic Society
Dept. 5000
Washington, DC 20036
$1.15 each for 10-99 copies.

"Energy '80" available from:
The Christian Science Monitor
P.O. Box 527, Back Bay Station
Boston, MA 02117
$.60 each for 10-49 copies ($.50 postage and handling).

Solar Age
P.O. Box 4934
Manchester, NH 03108
$20./year

Rodale's New Shelter
33 E. Minor Street
Emmaus, PA 18049
$9./year, $1.50 for single copy

Solar Utilization News
The Alternate Energy Institute
P.O. Box 3100
Estes Park, CO 80517
$10./year

A.T. Times
National Center for Appropriate Technology
P.O. Box 3838
Butte, MT 59701
$10./year

Sun and Shadow: Town Planning

6

Introduction

The sun is our prime source of life, light, and energy, and people are becoming more aware of this fact. As society gradually recognizes the shortages of available/affordable energy from other sources, we begin to feel more appreciative of the gifts of the sun. In the near future all new housing may be required to include some cost-effective solar and energy conservation devices. This art activity is designed to prepare us for our "place in the sun." We will create an ideal, imaginary community where the sun's rays benefit everyone....equally.

DRAFT

Objectives

At the completion of this activity, you should be able to

- construct three-dimensional geometric forms of rigid paper,
- use an architect's scale to build them,
- combine the building shapes into solar-type houses,
- discover how sunlight and shadow affect solar town planning, and
- collaborate with your classmates to plan a solar town.

Skills and Knowledge You Need

Common sense, trial and error, problem solving

Measuring, ruling, cutting, scoring, folding, and gluing

Familiarity with architects' scales (x inches = x feet)

Materials

for your house:

pencil, eraser, scissors or Exacto knife, steel edge protractor, T-square (optional), graph paper, ruler or architect's scale ruler

oak tag or one-ply bristol board

rubber cement

for your town:

card table or flat surface accessible from four sides

portable electric or battery flood lamp, with or without reflector, mounted on a stand or tripod

extension cords

for both:

drafting tape

black marker

green sponges, toothpicks, and plastecine (optional, for making trees)

Words You'll Learn

solar access
solar rights

Procedure

1. Imagine a house you would like to live in.

2. Study the drawings on Worksheet 1, page 6. These are typical buildings representative of current styles in solar architecture.

3. With the others in the class, establish a scale (say, 1 inch equals 10 feet) which everyone will use.

4. Choose a set of shapes that would make an interesting house.

5. Carefully follow the step-by-step diagrams on Worksheet 2, to build each component of your house. Be sure to write your full name on the underside of each geometric form.

6. Assemble and glue your components firmly in place to make your house.

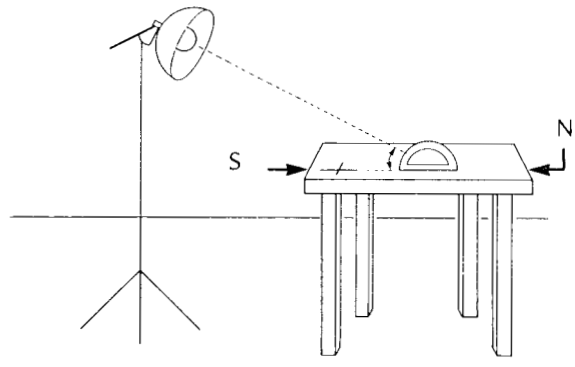
7. Next, prepare your table for setting up a model town. This will be a committee project.

8. You'll do some simple calculations to set up your lamp. The sun is lowest in the sky in December. Your teacher will tell you what your latitude is. Subtract your latitude from 90°. Take the answer and subtract 23°. This tells you the angle of noonday sunlight in December.

   Set up the lamp so that it is at that angle in relation to the center of the table top.

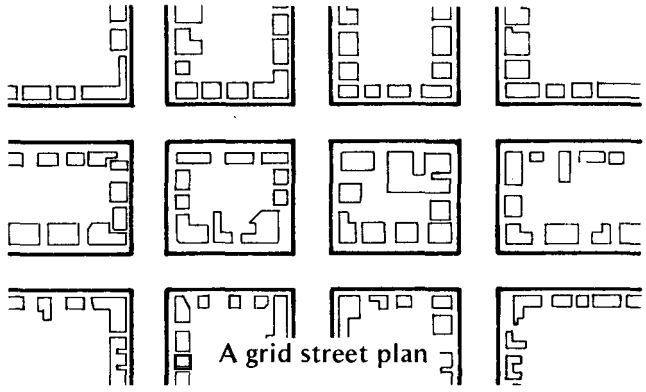
   Your lamp now represents the sun in the southern sky at midday in December.

Setting up the lamp



9. Cover the table top with a sheet of paper. Tape it down. Mark a compass on one corner of the sheet to show north and south. South should be directly toward the lamp. Don't move the table!

10. Take your houses and line them up on the table according to a grid street plan, like the diagram below. Have straight streets, rectangular blocks, and houses side-by-side around the block all facing the street, to simulate a traditional town. Don't fasten the houses to the table yet.


A grid street plan

11. Do all the houses get full sunlight? Where are the shadows? Would there be problems with shadows in the morning or afternoon?

12. Consider the "builder's rule of thumb": to avoid casting a shadow from one house onto another, the distance between adjacent houses should be twice the height of the taller house.

13. Rearrange the town so that each occupant enjoys the maximum advantages of sunlight without shadows. Allow each person to decide which side of the house should face the sun. If you wish to experiment further, add greenery and hills.

14. After everyone agrees that her/his house is in the best possible location, glue the houses into final position. Draw in the streets of your model solar town.

Questions

1. Why was the lamp supposed to be set at the angle of the sun in the December sky?

2. What problems arise to prevent the ideal arrangement of houses to take advantage of the sun?

3. From what you've learned in this activity, what do you think the terms "solar access" and "solar rights" mean?

4. What can be done to ensure that everyone's "solar rights" are protected?

5. If every house has plenty of space to avoid shadowing, does this create other problems? (transportation, power lines, etc.)

6. Why are artists and architects likely to be aware of the sun's attributes before the general population?

7. In what ways can you control how the sun affects your personal life?

8. Why should today's teenagers be more concerned than their parents are about solar energy?

Looking Back

In early times, towns were often built with the sun in mind. Today, because of central heating and artificial light, many communities are laid out with no concern for sunlight at all. As energy becomes more expensive, however, this trend will reverse itself. Town planners, architects, builders, landscapers, and interior decorators will all become more aware of where the sun is in the sky, and how its energy can be used to light and heat the spaces we live in.

Going Further

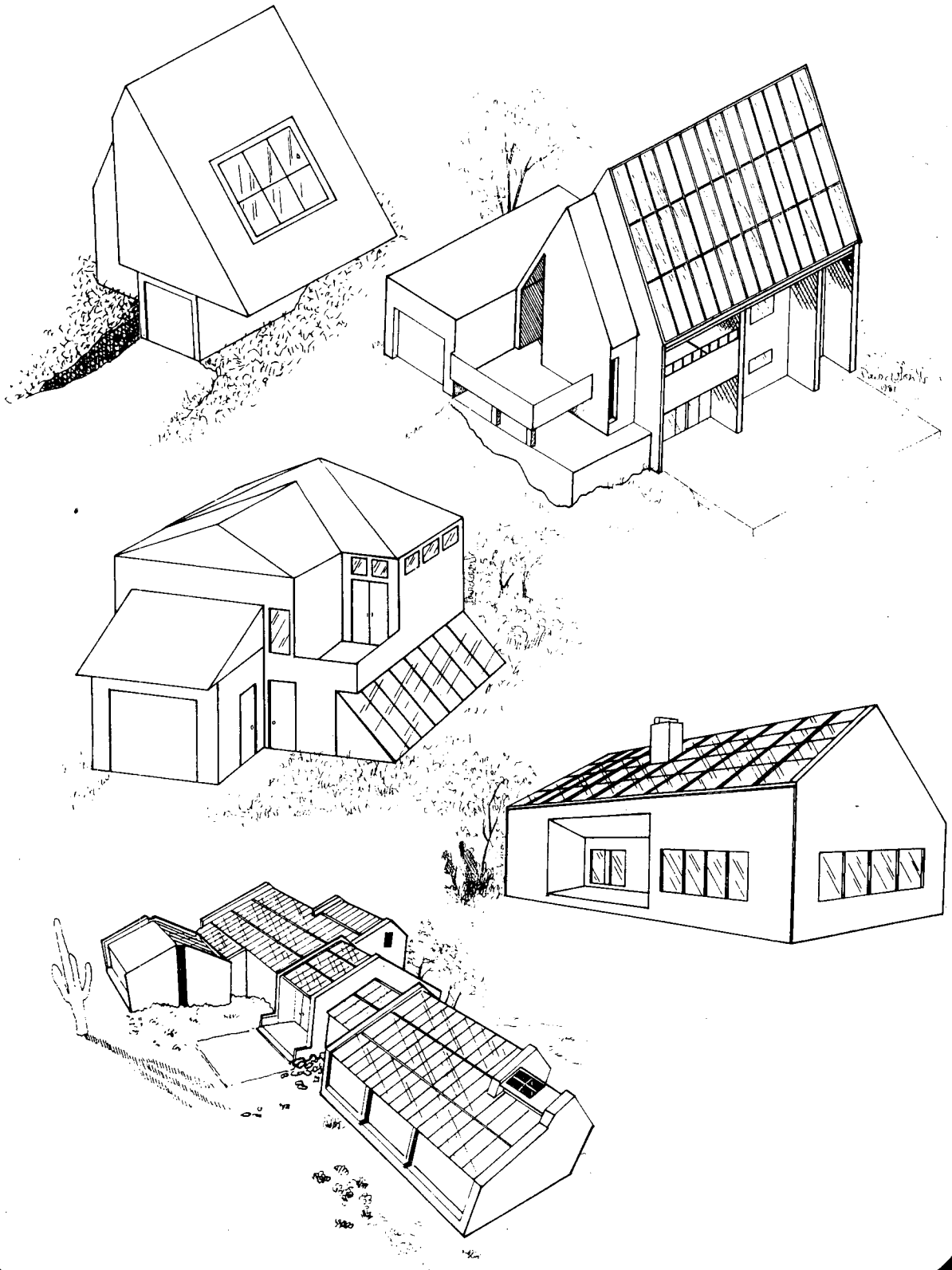
Unlike a real-life situation, the ideal model town is laid out on an absolutely flat surface, minus hills, valleys, trees, or shrubs. Obviously, all these factors exist everywhere, and alter the amount of sun and shadow. Two experiments may be conducted to prove this. To observe the effect of greenery, trees may be made out of sponges and toothpicks. They may be placed near houses in wads of soft clay. The rule of thumb about shadows cast by trees is: an object shadows an area to its north for a distance of three-quarters its height. Is this true in December? To observe the effect of variations of terrain, areas of the town may be raised by inserting books or boxes underneath the grid, to simulate hills or plateaus.

Also consider the effect of trees and shrubs as an energy conservation measure. Place trees and shrubs on the windward (usually west and north) sides of buildings to serve as windbreaks, which slow the winter winds and reduce heat loss from buildings. Consider whether these windbreaks will affect the solar access of other buildings.

Share your discoveries with your schoolmates. Find out if there is space in the library, lobby, lunchroom to exhibit your town. Be sure to list all the contributors and to write narrative exhibition cards which help viewers understand how you approach the coming Solar Age.

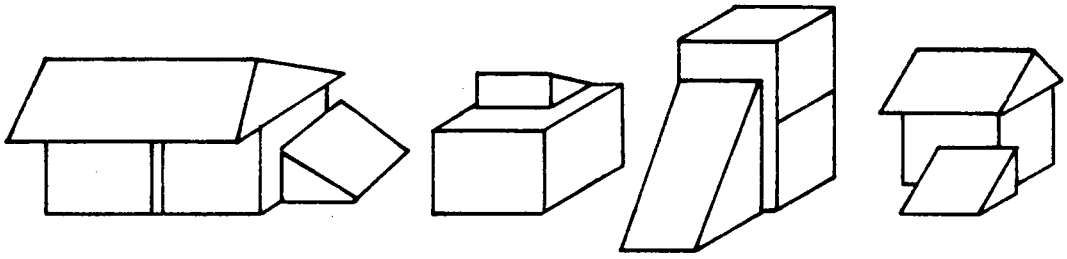
Worksheet 1

Solar Architecture Today



Worksheet 2

Typical Building Shapes in Solar Architecture



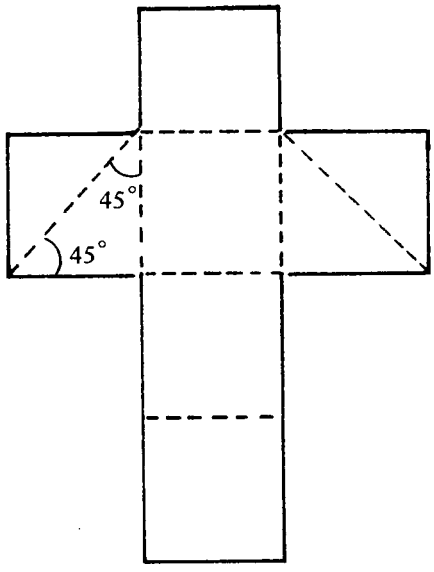
Directions for making shapes

1. Enlarge or reduce pattern to scale you want.
2. Cut as shown.
3. Score, then fold, on dotted lines.
4. Glue finished shape.
5. Write your name on underside.

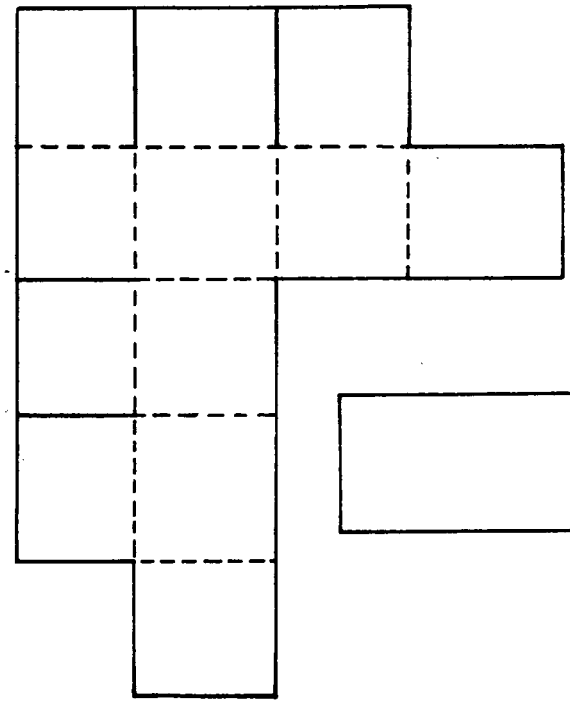
——— = cut

- - - - - = score and fold

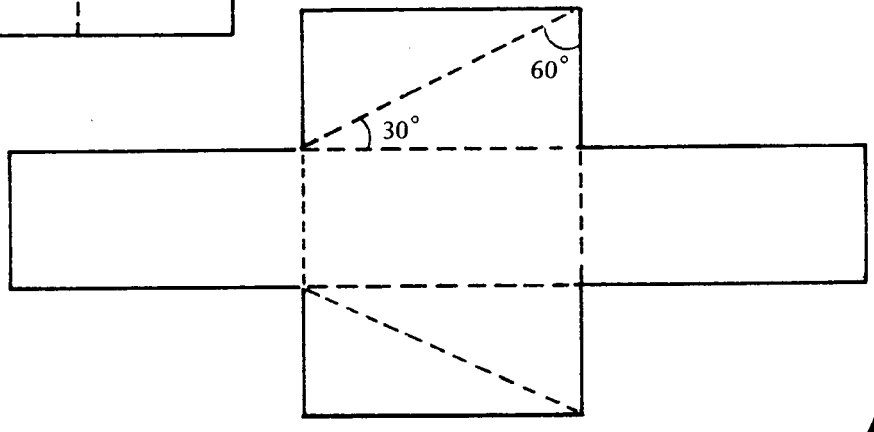
45° pyramid



cube

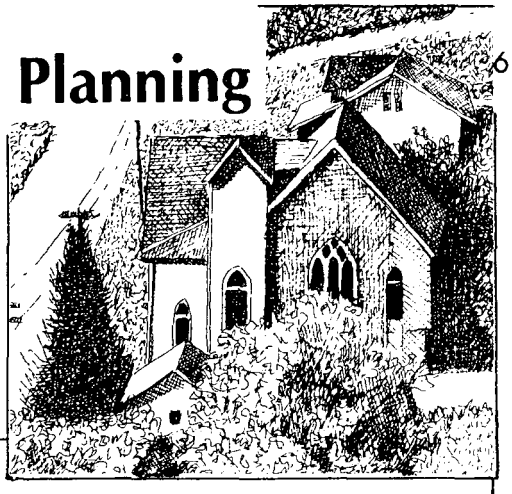


30°-60° pyramid



Teacher Information

Sun and Shadow: Town Planning



Suggested Grade Level and Discipline

Grades 9 to 12
Fine and Applied Arts
Architecture design (3-D, industrial, environmental), urban planning
Photography
Sculpture

Skill Objectives

Bending, folding, scoring, cutting, gluing rigid paper

Assembling, arranging

Measuring, scaling, comparing, observing

Major Understandings

Geometric forms can be constructed of rigid paper.

The sun's angle changes through the year.

Planning is required if human structures are to take full advantage of the sun's heat and light.

Background

Forward-looking art teachers (just as teachers of the physical and social sciences) strive to alert teenagers to environment/energy issues. This activity develops both aesthetic awareness and practical judgments necessary for coping with contemporary solar concerns. Looking at the cube and the pyramid as typical building shapes of solar architecture opens young minds to design options and energy choices. Students are prepared for their "place in the sun," in keeping with one probable architectural trend of the next decade.

Many solar homes today look contemporary or even futuristic. On the other hand, many solar homes are quite traditional looking. A New England saltbox, facing south, can be a solar home.

The important features of a solar home are:

unobstructed southern exposure from 9:00 A.M. to 3:00 P.M., and

a bank of windows or solar collectors on the south side.

Inside, these houses store solar energy as heat in columns of water, beds of sand or rock, or brick or stone walls and floors. This kind of "storage mass" stores the heat at sunny times and radiates heat slowly at night and on cloudy days.

Besides solar collection and storage, solar houses usually have something to temper the heat in summer: awnings, deciduous trees, or a roof overhang that blocks the rays of the high summer sun.

Advance Planning

Duplicate the needed quantity of worksheets.

Clear sufficient unencumbered space to hold a table accessible from all four sides, with an electric outlet nearby.

If a display of the model town is to be installed, planning for this should be initiated at the same time as the class project. In this way, the explanatory exhibition labels, photography for press releases, and guest lecturers (local solar architects, environmentalists, government representatives) can be scheduled to coincide with the "hands-on" activities in the classroom.

Suggested Time Allotment

Allow two to four lessons for the demonstration, discussion and construction of the building shapes. The preparation of the traditional town plan and the solar town should be scheduled for an additional two to four lessons.

Suggested Approach

Some teachers may prefer to introduce this lesson with a prerequisite activity for all students: constructing a six-sided cube of paper.

Prepare students for the idea of solar homes. Show slides of solar houses: Frank Lloyd Wright and contemporary designers.

Discuss the main concepts of solar design:

(1) Why is an unobstructed southern exposure important?

(2) What about trees and shrubs? (Deciduous vs. coniferous.)

(3) What about zoning: setback and height requirements?

(4) Active solar and passive solar: how do their requirements compare?

(5) How do urban settings lend themselves to solar? Rural settings?

(6) What about summer? Can houses be naturally cooled?

When students work on geometric shapes to form houses, encourage combination and recombination of shapes. Remind students that the perfect solar home has yet to be designed.

If possible, permit each student the individual opportunity to manipulate the light and observe, at first hand, how the shadows are created. This will guarantee a meaningful learning experience far beyond merely witnessing the phenomenon.

If the class is large, assign one group to calculate the proper light angle and rig the light, another group to arrange the grid street plan, and a third group to arrange the "solar town."

Precautions

Without prior discussion of the demands of solar design, this activity will be meaningless.

Don't assume that this activity is irrelevant to urban students. Once the basic concepts are learned, they can be applied to the more difficult problem of solar access in the city.

Points for Discussion

How does solar energy heat and light a house?

What materials should be used in a house to take advantage of solar energy?

How do different climates place different demands on solar design?

If communities depended on solar energy, what effects would it have on lifestyles, aesthetics, laws, design, etc.?

Evaluation

Observe students' grasp of basic solar siting principles.

Discuss local dwellings and nearby communities. See whether students are able to apply what they've learned.

Assess how well each student constructed the geometric forms.

Modifications

Invite an architect to discuss solar design.

Show one of the many films on solar houses. (See bibliography.)

Have students design and construct a model solar city neighborhood (apartment buildings, townhouses, stores, office buildings, and green space). This will be a more challenging activity.

References

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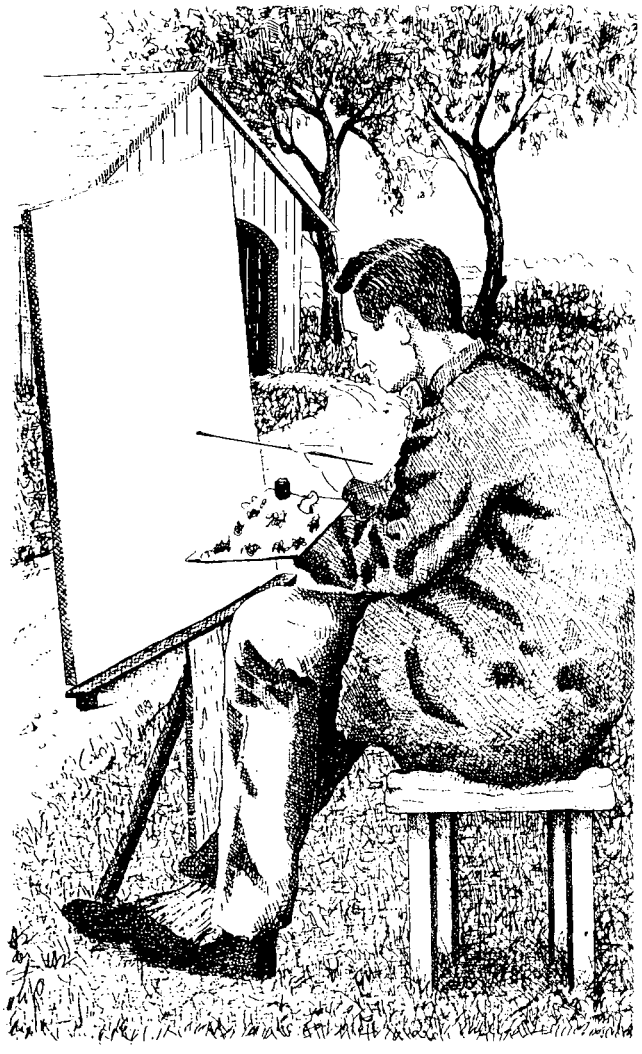
Sunlight and the Impressionists

7



Introduction

Just at the end of the 19th century, in Paris, a group of painters altered the direction of art history. These artists became dissatisfied with the traditional mode of pictorial painting which the general public accepted. Courageously, they challenged public taste. In opposition to the accepted academic style, these revolutionary artists brought their easels out of their studios and set them up under the open sky. In the French countryside, along river banks, in meadows and gardens, the "pleine aire" artists let the sun shine on their work.

In this activity, you will experience the startling effect of sunlight on paint. You will sketch an outdoor scene. Then, following the manner of the Impressionists, you will mix and apply the colors. Actually, you will approach this experiment in the way that was perfected by Claude Monet (1840-1903) and Alfred Sisley (1839-1899).

DRAFT

Objectives

At the completion of this activity you should be able to

- o create a painting in the Impressionist style,
- o apply the optical mixture method, using only pure colors like those of the solar spectrum, and
- o analyze Impressionist techniques - palette, brush strokes, composition--and appreciate their place in modern art.

Skills and Knowledge You Need

Knowledge of the theory of the color wheel

Mixing colors

Simple sketching

Handling brush and tempera paint

Materials

pencil and eraser

soft hair watercolor brushes

two water jars (one for rinsing brushes, the other for diluting paint)

rags, paper towel, blotter, or sponges

white paper, approximately 9" x 12"; thick, absorbent (uncoated), rough textured

a portable, rigid work surface (masonite, 3-ply cardboard, or drawing board)

drafting tape

muffin pan or ice cube tray for a paint dispenser

tempera paint--yellow, red, and blue ONLY

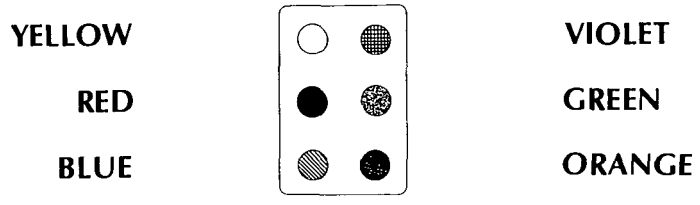
Procedure

1. Tightly tape the paper on all four edges to the work surface.

2. Fill three sections of one side of the paint dispenser with one teaspoonful of each of the three primary spectrum colors: yellow, red, and blue.

3. Use three sections of the other side of the paint dispenser to mix each of the three secondary colors: violet (equal parts of red and blue), green (equal parts of blue and yellow), and orange (equal parts of yellow and red).

   Your finished paint dispenser should be arranged like this



   with complementary colors side-by-side.

4. Carry your easel, paint dispenser, water jars, brushes, and accessories to an unshadowed outdoor location. You will better observe the effects of sunlight if you can pick a clear day. Naturally, atmospheric conditions such as fog, the time of day, and the season of the year determine the quality of light. The quality of light, in turn, dramatically alters colors. Consider, too, that the position of the sun in the sky controls the shadows.

5. Dip a clean sponge or rag into the clear water and saturate the entire painting area. This step prepares the paper to receive your colors. Set aside to dry.

6. While you are waiting for your "canvas" to dry, select the scene you will paint. Keep it simple. Decide on a foreground, middle ground, and background. One single interesting item is usually preferable to a clutter of objects.

7. Very loosely, in pencil, mark off the main features of the scene. Omit all detail and texture. Your preliminary drawing should be pale enough to be covered with a single coat of tempera paint.

8. Now you are ready to apply paint to your drawing. The following hints will help you achieve the fresh look the Impressionists aimed for:

   a. Work from light to dark. First apply the light tones, then the middle colors. The darks come last. Use these sparingly.

   b. Apply color with staccato, comma-shaped strokes. (,,,). Never lay down a solid, flat wash of color.

   c. Place the short strokes side by side. For instance, the appearance of a field of grass is created by putting strokes of yellow next to strokes of blue. The viewer's eye will blend the colors optically. An illusion of green grass will emerge. If you want the

grass to be delicate, young, yellowish, then place yellow strokes next to green strokes, for a yellow-green impression.

d. Black is rarely used. We never really see black objects as pure black. However, you can accomplish dark accents and shadows by overlapping strokes of complementary colors. (The complementary colors are opposite each other in the color wheel.) Therefore,

violet over yellow, green over red, orange over blue, and vice versa.

e. To intensify color, outline or underline a stroke with a thin line of its complementary.

f. Opaque white paint is discouraged. Untouched areas of paper or canvas convey the transparency of light. Fewer strokes, placed further apart, suggest lighter colors.

g. The Impressionists captured the sparkling essence of unpolluted environments in a natural, candid way. WE, TOO, ARE STRIVING FOR LUMINOUS SPONTANEITY.

Questions

1. What is the optical mixture method? How did you create different colors from your primary colors?

2. What techniques did you use to create your "Impressionist" painting?

3. Compare your painting to a typical example of Impressionist art. What similarities do you see? What differences? How might you improve your technique?

4. How did your painting use sunlight or show its effects?

5. What aspects of your painting are particularly pleasing to you? What aspects don't you like?

Looking Back

In this activity we reenacted a painting process that revolutionized art. Many artists contributed their personal discoveries and their individual points of view to the development of Impressionism. Although they were scorned and ridiculed, they clung to the belief that they must faithfully record what they saw...and, that looking at the world in the bright light of the sun is exhilarating.

Claude Monet, for instance, preferred to rely exclusively on his reaction to nature, rather than study the past, as did most artists of his time. In his search for the

absolute truth, he was especially intrigued by water because in it, light moves. The "Father of Impressionism" wrote to a friend, in 1890, "...I am working away: I am set on a series of different effects (haystacks), but at this time of year, the sun goes down so quickly that I cannot follow it...I am working at a desperately slow pace, but the further I go, the more I see that I have to work a lot in order to manage to convey what I am seeking: 'instantaneity,' above all, the envelopment, the same light spread over everywhere."[1]

Going Further

Paint the same scene in a series that shows changing light and shadow as time passes. Monet's famous Cathedral and Haystack series can serve as examples.

Paint the same scene as you imagine it would look in the changing seasons: autumn, winter, spring, summer.

Visit a museum and discuss the characteristics of three Impressionists.

Read the biography of one Impressionist. How did (or did not) his personal life affect his art work?

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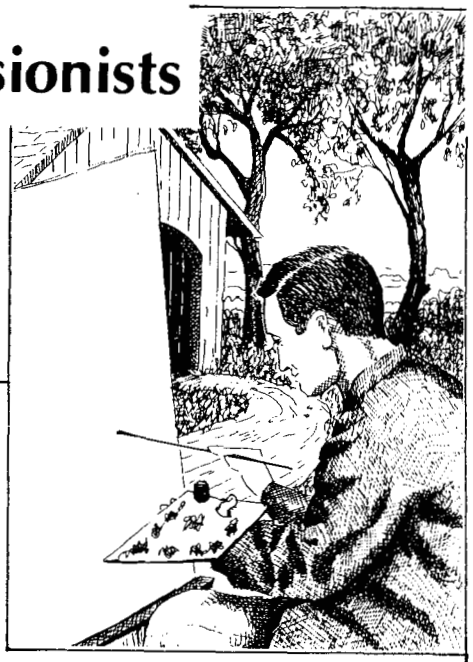
1. Linda Nochlin, Impressionism and Post Impressionism, Sources and Documents p.34, Claude Monet, letters to Gustave Geffrey (N.J.: Prentice Hall, Inc. 1966).

Teacher Information

Sunlight and the Impressionists



Suggested Grade Level and Discipline

Grades 9-12
Art Appreciation
Humanities
Studio Painting

Skill Objectives

Creating a painting at an outdoor site

Following instructions

Mixing colors, manipulating paint

Developing aesthetic awareness and critical judgment

Major Understandings

In carefully structured, developmental painting such as this, the artworks that result look very much like each other. This is precisely why everyone recognizes Impressionist painting!

Viewers (consumers) are more likely to comprehend the relative contribution of Impressionism in the stream of twentieth century art if they have a "hands on" experience with its prime ingredient--pure color.

The sun was a motivating force behind an important development in art history--Impressionism.

Just as physical and social scientists investigate means to improve our earthly condition via solar energy, artists explore the sun for ways to enhance our visual perception of the world around us.

Background

Manet, Pissaro, Renoir, Sisley and the other Impressionists shaped art history, perhaps because they were eye-witness to cultural and social breakthroughs, pointing towards greater personal freedom. Darwin published The Origin of Species in 1859, Lincoln delivered The Emancipation Proclamation in 1863, Marx published Das Kapital in 1867, and Ibsen discussed the emancipation of women in The Doll's House, 1879. Scientific progress was just as rapid. Lister introduced antiseptic surgery in 1865, the Atlantic cable was laid in 1866, Bell invented the telephone in 1876, and Edison patented the phonograph (1878) and the electric light bulb (1879).

One hundred years later, mankind stands on the threshold of monumental decisions. How should we manage our dwindling resources? How can

we sustain a life of quality in the face of increasing energy shortages and public apathy? These questions concern everyone, students, scientists, and artists alike. Perhaps the current generation will be another time of important breakthroughs, like the Age of the Impressionists.

Advance Planning

Color theory can either be introduced concurrent to this activity or, if time allows, can be taught as a separate unit, beforehand. Precut circles of chrome paper: yellow, orange, red, violet, blue, blue green, green, yellow green. Paste them in a circle, and rule in the two triangles connecting the primaries and the secondaries.

Look for a place near the school where students can paint their pictures.

Assemble the needed materials.

This activity can be adapted to advanced students. The medium can be changed to oil paint or pastel, instead of the tempera paint.

Suggested Time Allotment

This activity can be conducted in as little as two days or can be sustained for four weeks. Auxiliary films, filmstrips, visits to museums or galleries, research lessons in the library can provide substantive study skills and a sound body of knowledge. If, as explained in the Going Further section, students continue the color experimentation in a series of paintings as the sun moves across the sky, or as seasonal conditions affect light and color, the activity can take several more weeks.

Suggested Approach

Show slides or filmstrips (see References) to help students see the departure that Impressionism was from the prevailing artistic style of the time. Give students the opportunity to examine a print of an Impressionist painting close up, so that they can see and appreciate the effect of the technique.

Discuss how the word "impressionist" might be interpreted, and what it implies about the effect for which these artists were striving.

Give students the opportunity to look around and consider various possibilities before each selects his/her subject.

In collaboration with the school librarian, who may gather and display volumes about Impressionists, an exhibition of the outcomes from this activity could be mounted in the school library.

Precautions

If students will be painting on private land, obtain permission from the property owner.

Points for Discussion

How successful did the student feel in using this technique? Did he/she feel that it made him more observant and objective, or less so?

What discoveries were made about combining colors? About representing planes and shapes?

What special challenges does working in natural daylight present? What are the advantages?

What are the differences between the Salon-approved, academic painting and the Impressionists', at the end of the nineteenth century?

Why is Impressionist painting so much more popular today than it was at the time when it was introduced?

Do you think that contemporary artists are returning indoors, to work within the confines of their studios? Substantiate your answer with names of artists and explain why you think they have taken this action.

Typical Results

The Impressionists' use of color and brush technique will appeal to some students but not to others.

Evaluation

Look for evidence of understanding of the Impressionist technique, and experimentation with the effect of colors.

Modifications

Introduce works by other artists who were preoccupied with the effect of light: The Luminists, Op Artists, etc. Discuss the similarities and differences.

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A Solar Photo Essay 8

Introduction

Throughout history, man's culture has been influenced by the sun and its mysteries. Humanity's dependence on the powers of the sun and the sun's influence on man's environment have caused whole civilizations to both fear and worship the sun. Temples were built in honor of the sun-god, to whom people prayed and offered sacrifices. These offerings were made to the sun in return for the sun's protection of families, fields, and homes.

Symbols for the sun were as varied as the cultures that created them. Many graphic designs for the sun are to be found in art and architecture, and are repeated throughout all periods of history. Often the graphic representations of the sun in architecture were functional as well as decorative.

In this activity you will be exploring architectural design where you live to find evidence of the sun-design. Certain patterns and designs you discover will be easily recognizable as "sun" shapes. Others, however, will have their own subtle or obvious variations in form, color, texture, and materials. You will be recording these details with a camera, and will produce a photographic essay showing symbols and designs related to the sun.

DRAFT

Objectives

At the completion of this activity you should be able to

- recognize sun graphics in architecture,
- produce a "photo essay" of your prints to exemplify the use of sun graphics in architecture, and
- define a number of architectural terms.

Skills and Knowledge You Need

Using a 35mm camera

Developing and printing black and white film

Selecting good quality prints

Materials

35mm camera

2 or 3 rolls of Plus-X or Tri-X film

darkroom facilities

art materials

dictionary, encyclopedia, and introductory architecture books

Words You'll Learn

pediment	capital	gargoyle	return
sill	plinth	bulkhead	reveal
gutter	facade	fenestra	reredos
riser	lintel	eaves	arch
tread	cornice	gable	clerestory
coping	brace	Doric	bannister
spindle	balustrade	Roman	Gothic
Ionic	Corinthian	solarium	gazebo
conservatory		skylight	trellis

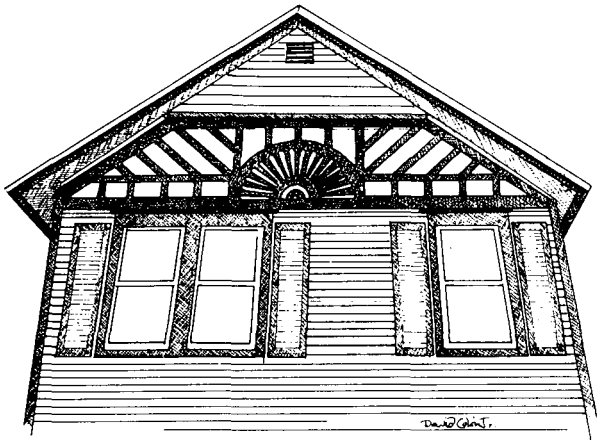
Procedure

1. Look up the vocabulary words and find illustrations for these terms. Doing this will give you a better idea of where to look on a building for decorative and structural places that might make use of sun designs.

2. Choose an area of your city, village, or town in which there is a concentration of buildings, including commercial, residential, and institutional. Generally speaking, it will be the public buildings which possess the richest

sources and examples of architectural detail, as well as the older, more historic houses in your area. Don't overlook the little corners of private homes where some imaginative carpenter or craftsman might have exercised his creativity.

3. Camera in hand, walk the area, looking carefully and patiently for the sun design elements you're seeking. A casual glance will not usually reveal the treasure you are searching for. You must scan slowly, covering the whole surface area of the building you're observing.



4. When you see the sun appearing in some architectural detail, take a picture of it. Remember that you can photograph someone's house, but you can't enter his property without permission.

Caution: Don't trespass. Get permission to enter private property. Usually, if you explain your project, homeowners will be pleased to let you proceed.

5. Take notes on all your pictures. Include the location of the building and the owner's name (if possible), the architectural style, and the placement, detail, and function of the design.

6. Develop your film, make a contact print, and decide which photographs, or parts of photographs, will become a part of your photo essay.

7. Arrange and mount your photos in an appropriate sequence, with the written information for each. Display the results.

Questions

1. What did you photograph that was functional as well as decorative?

2. Did you see sun designs being used to disguise the true function of part of a building? Give examples.

3. How did designs on different kinds of buildings differ?

4. What kinds of building materials are used in the sun designs?

5. What periods of architecture show the greatest use of decorative detail? The least? What periods seemed to make the greatest use of sun designs? The least?

Looking Back

You have seen how universal symbols (such as the sun) can serve functional and decorative roles in architecture and design. What other evidence of sun influence in our society and culture can you record photographically? Reexamine your original photographs of sun designs and find another way of presenting your "essay." Once you're aware of the sun's influence in art and society, you'll begin to see it everywhere!

Going Further

Create a collection of photos of modern commercial art (signs, billboards, magazine ads) that depict the sun. Note similarities and differences between modern use of the sun in commercial art and earlier architectural uses.

Make a presentation to a class (social studies, for example, if you're in English, or vice versa) of your photo essay, with comments.

Using your photographs and sketches from them, design a solar home, showing particularly how you might use sun designs in your building.

Consider what might account for the many and varied representations of the sun. Write an essay telling what must be considered by an artist depicting the sun.

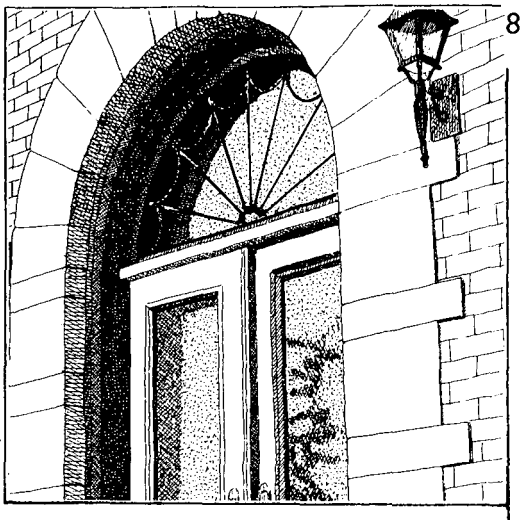
Suppose you must design (or select) the representation of the sun which will emblazon all the solar energy publications for your state's energy department. What will it look like? Draw it, write about it, and justify your choice.

Teacher Information

A Solar Photo Essay

Suggested Grade Level and Discipline

Grades 8-12
Photography
Industrial Arts
Social Studies
Art
Humanities
Architectural Design



Skill Objectives

Improving visual awareness

Recognizing architectural detail and design

Becoming aware of the use of universal symbols in design

Defining architectural terms

Photographing architectural design

Major Understandings

Architectural terminology is a useful language used by the initiated.

Layout and design are important aspects of a good photographic essay.

Sun symbols are many and varied and appear in the architectural design of many periods.

Background

All periods of architecture employ basic design structures symbolic of recurring forms in nature. The sun is one of the most prevalent of these forms, and is used both subtly and obviously in both primitive and sophisticated architecture. Awareness of these details and appreciation of their influence should increase interest in the preservation and rebirth of these designs, as the sun and solar power again become an influence on our culture. A photographic essay serves as a visual portfolio of the importance of the sun in our society and its effect on art and architecture.

You and your students should have a working knowledge of darkroom procedure. However, film can always be sent out for development, and the lack of darkroom facilities should not deter you from trying this activity.

Advance Planning

Obtain needed quantities of film.

Ready the darkroom.

Assemble dictionaries, encyclopedias, and architecture books which explain and illustrate the architectural terms.

If students will be using cameras from the school supply, plan a schedule to avoid conflicts and give each student ample camera time.

Scout your locality for neighborhoods that offer rich architectural detail and variety.

Suggested Time Allotment

1 period to introduce activity and assign equipment

1-2 periods for vocabulary work and discussion of terms

3-4 days to explore site and take photos

10 days to develop, print, and mount photos

Suggested Approach

Discuss with the class certain popular images and symbols that recur frequently in architecture. Perhaps they can think of examples from public buildings.

Introduce the idea that the sun is one such popular motif. Perhaps show a few slides of the very diverse settings in which this motif occurs: fanlights over doors, ornamental stonecarving on public buildings, brick or tile design on factories and warehouses, etc. This would be an effective way to introduce the unit and begin to focus students' attention on the designs as well as on the vocabulary necessary to narrate their presentations.

The students should be encouraged to explore all types of architecture in their immediate area. A walking tour can be an alternative if a certain neighborhood is rich in period architecture.

The students should photographically record and isolate repeated and similar symbols or images that they discover in the architecture available to them. Notes should be made referring to placement, detail, and function.

Finished prints should then be arranged in a graphically attractive manner.

Precautions

Concern for private property should be discussed, as well as ways of approaching property owners to get their cooperation. Supervision of excursions should be provided when possible.

Caution students on the handling of borrowed cameras.

Points for Discussion

Does the type of design used to depict the sun indicate the artist/society's viewpoint?

What similarities in design have you discovered?

How are these symbols functional as well as decorative?

Which period of architecture used the symbol for the sun most prevalently?

Why do you suppose the influence of this design was so strong?

Typical Results

Finished photo essays will vary, depending on the geographic locations available to the students. Generally, the photos should depict the more universally used solar designs from different periods of architecture.

Evaluation

Evaluation could take the form of a teacher-student discussion, in which the teacher should be alert to the student's ability to incorporate the terminology introduced into his explanation and presentation of his photographs.

In an art/photography/industrial arts class, the entire project is a measure (perhaps a term project or practical exam) of the students' growth in photographic and darkroom skills as well as layout and design.

Modifications

Discussion and study of ancient cultures and architecture and modern commercial art should reveal a strong influence of the sun's use in design and function.

Combining a photo essay with collections of myths and folklore (sun-oriented) should spark an interest in the study of man's historic preoccupation with the sun and its mysteries.

Further exploration into sun dials and similar aesthetic and scientific equipment should be encouraged.

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An International Sun Collage

9

Introduction

In some very old English poetry, the sun was called the "day's eye," no doubt a reference to the way the sun "looks" down on us, and at the same time provides us light by which we see. This graceful figure of speech became associated with a common wildflower, the daisy, with its yellow center surrounded by "rays" of white petals. The progression from DAYESEYE, to DAY'S EYE, to DAISY, is one of those curious movements of language that demonstrates one small way that the sun has influenced our own way of speaking.

All languages have their own special ways of symbolizing the sun, and in this activity you will be exploring some of the foreign words and symbols which refer to the sun and which show how deeply the sun has penetrated the languages of mankind.

Not only will you become acquainted with some new English words, but you will see words from unfamiliar alphabets and from other kinds of systems for denoting language. In the course of your explorations, we hope you will find a symbol that is particularly pleasing to your eye, because it is out of one of these symbols for the sun that you will create a collage that expresses what the sun means to you.

DRAFT

Objectives

At the completion of this activity you should be able to

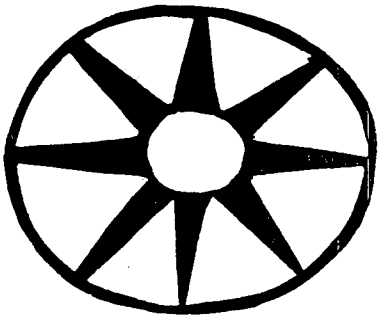
- recognize foreign words and phrases which mean "sun,"
- identify root words for sun in our own language,
- complete a collage using elements of color, composition, and central theme, and
- express visually sun-related words from other languages, as part of your collage.

Skills and Knowledge You Need

Using the library

Planning and making collages

Sketching as an aid to remembering



Materials

construction paper

scissors

white glue or paste

pencil or crayon

notebook

Procedure

1. Study Worksheet 1: Words Meaning Sun and Ideograms for Sun. Select three of these words or ideograms, and using a separate sheet of construction paper for each one, recreate the word or ideogram in your own style. Repeat the design as many times and in as many ways as it takes to fill the sheet of paper (probably a 9"x12" would be an appropriate size). See illustrations A and B, Worksheet 2: Planning and Assembling Your Collage.

2. Go to the library, or some place where there is an ample selection of art books (the big, heavy kind with lots of illustrations), and look through them for examples of ways in which artists have pictured the sun. Keep a paper or notebook handy for sketching these ideas for your own use. Try to find at least ten different examples, copy them as carefully as you can (but don't trace them), and you will have a collection of ideas to take back to your classroom for use in creating your collage.

3. Back at the drawing board, select one of your sketches of the sun, and enlarge it to fill a new piece of construction paper. Try to keep your design simple and with as few lines as possible. See illustration C, Worksheet 2.

4. Select one of the words or ideograms you've worked on, and use it to fill the spaces inside your sun sketch enlargement. See illustration D, Worksheet 2.

5. Using construction paper in warm colors (shades of red, yellow, and orange), cut out the shapes suggested by your sun sketch. Also cut out your sun words or ideograms. Combine these shapes by overlapping them, underlapping them, always making sure that they at least touch each other. Arrange and rearrange the words, shapes, and colors until you have a design you like for your final sun collage. Glue or paste your arrangement of cutouts to a larger piece of construction paper.

Questions

1. Why does the sun figure so prominently in art?

2. You looked at many representations of the sun in your library research. What are some of the similarities among the different works of art you examined, in the way they showed the sun? What differences were there?

3. Is the sun used as the subject for commercial art today? What examples can you think of?

4. What English words related to the sun can you think of? Which other languages do they come from?

Looking Back

The sun is one thing which is common to the experience of every human being, and yet every human being expresses this experience uniquely in art. To some the sun is an awesome and fearful power, to others it is representative of recreation and fun, while still others see it as the source of the earth's fertility and fruitfulness.

In this activity you have used words, symbols, shapes, and color to create a collage that dramatically expresses feelings about the sun.

Going Further

What symbols can you create to picture the sun and all the ideas the word implies to you?

Choose a foreign phrase or word, and graphically represent the idea it expresses to you.

Make a list of sun-related words and phrases in the English language, and trace the origin of the root word.

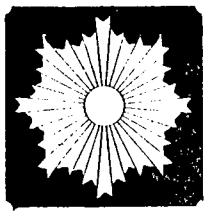
Using "found" objects or natural materials, create another collage expressing some feeling you have personally about the sun and its effect on you.

Create crossword puzzles using foreign idioms, phrases, or symbols influenced by sun words.

Create "logos" for sun-powered (solar energy) products, corporations, or ideas, using your newly acquired sun vocabulary.

Worksheet 1

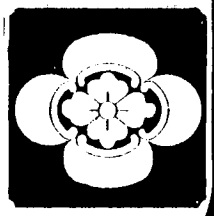
Words Meaning Sun



Hebrew	shimshon	שמש
Latin	sol	
Greek	helios	ΗΛΙΟΣ
German	die Sonne	
Spanish	sol	
French	soleil	
Italian	sol	
Zulu	ilanga	
Chinese	tài yáng	太陽
Russian	solnsye	СОЛНЦЕ
Irish	grian	GRIAN

Ideograms for Sun

Early pictograph		sun, day, time
Assyrian		sun, day
Sumerian		sun, day
Chinese		sun
Ancient Chinese		sun
Early hieroglyphics		sun
Arapaho		sun



Worksheet 2

Planning and Assembling Your Collage

Illustration A

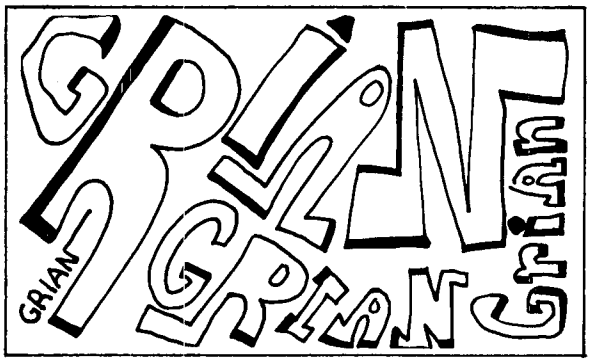


Illustration B

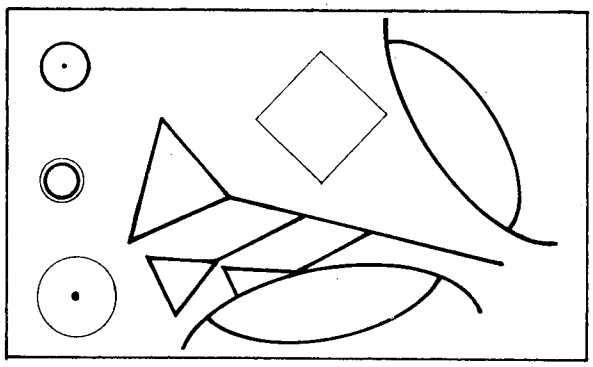


Illustration C

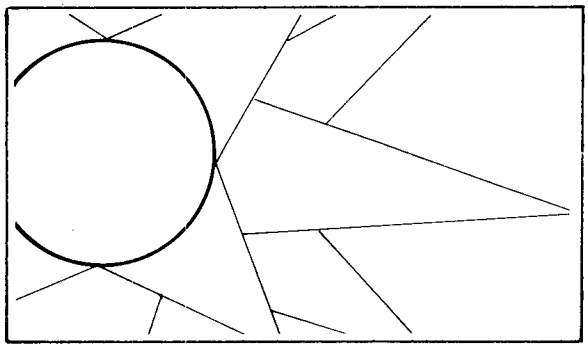
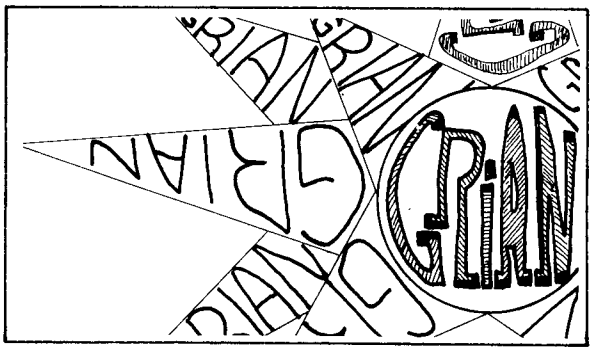
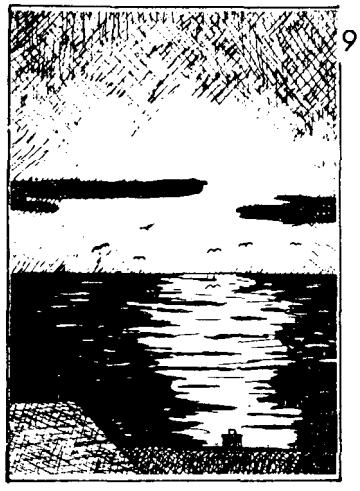


Illustration D



Teacher Information

An International Sun Collage



Suggested Grade Level and Discipline

Grades 7-12
Art
English or Language Arts
Foreign Languages

Skill Objectives

Creating a collage

Sketching as an aid to remembering another artist's work

Making a graphic representation

Major Understandings

Different languages have different words for the sun, and English has borrowed some of these words.

Words and images can be combined to create a dramatic design.

To produce such a design requires experimentation and planning with color, pattern, texture, etc.

Background

All languages have words or symbols for the sun. But English is especially fortunate in having been "cross-pollinated," linguistically speaking, by sun vocabulary from other languages both ancient and modern. A simple dictionary search will equip you with ample examples to share with your class. **Begin with words having the root sol- and helio-, and** you will have a good foundation.

Advance Planning

Look through the art books available to your students, so that you can point them in the direction of artists who portray the sun in their works.

Duplicate the worksheets, and assemble the needed materials.

Suggested Time Allotment

3-5 class periods

Suggested Approach

Introduce the collage technique. The procedure outlined in the student guide should be sufficient as a guide for the teacher as well. If collage has been done before, a review of the basic techniques will be helpful. Emphasize the method of overlapping shapes which visually express related ideas.

Emphasize the universality of the selected words and symbols, universality in the sense that everyone on earth has to deal with the sun both literally and visually.

Precautions

Encourage creativity and originality.

Allow ample time for experimenting with designs.

Points for Discussion

Which foreign sun words have found their way into our own language and culture?

How many words can you think of that use roots or prefixes taken from words learned in this activity?

In terms of sun words, which foreign language has been the greatest influence on our own?

Is the sun particularly prominent in the works of one artist or one period in art history?

Do portrayals of the sun more often express feelings of fear, awe, security, or love?

Typical Results

Since this activity is an individually directed and motivated creative experience, the results will and should vary. The final result should be that each student will have successfully depicted foreign words and symbols for the sun in a collage motif employing the basic elements of design, graphics, color, and composition.

Evaluation

Collages should be of a singular theme, original, and graphically balanced. Colors should be related to the abstract suggested by the sun-related language.

Modifications

Visit a museum or art gallery to observe contemporary artists' expressions of the sun.

Use the sun collages to generate ideas for a larger work of art, perhaps a group project such as a mural or wall collage.

References

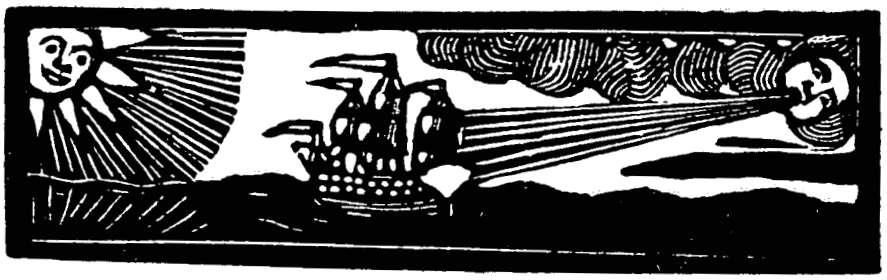
Frazer, Sir James George. The New Golden Bough (Garden City, NY: Doubleday & Company, Inc. - Anchor, 1961).

Hutton, Helen. The Technique of Collage (New York: Watson-Guptill Publications, 1968).

Janis, Harriet and Rudi Blesh. Collage: Personalities, Concepts, Techniques (New York: Chilton Company, Book Division, 1962).

Jung, Carl G., ed. Man and His Symbols (Garden City, NY: Doubleday & Company, Inc. - Anchor, 1964).

Lom, Josephine. Collage (New York: Arco Publishing Company, Inc., 1975).



Making a Sundial 10

Introduction

Have you ever seen a sundial set in a garden at a park or historic site? Perhaps you've wondered how sundials originated, and how to tell time by "reading" one. Sundials are an ancient and interesting combination of beauty and usefulness. Today, when interest is directed toward the sun as a source of energy in a world facing severe energy shortages, we will focus on the sun's pervading power by constructing a sundial for the school grounds as a creative arts activity.

DRAFT

Objectives

At the completion of this activity, you should be able to

- o explain how an art object reflects the culture of its time,
- o follow directions to design, create, and install a simple sundial, and
- o design a dial face, including a hand-lettered motto.

Skills and Knowledge You Need

Tracing, lettering, and crafting

Materials

tracing paper, sharp-pointed pencil, ruler, compass, protractor

complete set-up for whatever craft is to be used in the clockface: mosaic tile, etched glass or metal, ceramic, clay, stone, etc.

sheet metal such as aluminum, 1/16" thick

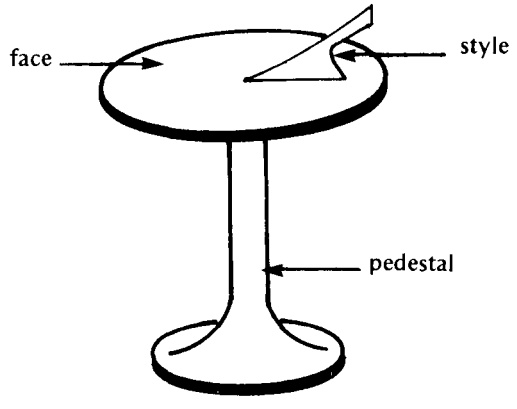
Procedure

1. Select an outdoor location suited for the installation of a sundial. Find a clear space, visible to many people, where the sun shines, without obstructions or shadows for most of the day. You may want to call for the expertise of local craftsmen, architects, horologists, and/or astronomers to advise you on the best location for your sundial. If you prefer, you might get permission to install a sundial in a neighborhood park, or, even in your own backyard.

Caution: Be sure to obtain written permission from the proper school and/or civic authorities before you start.

2. Read "Making a Sundial," the reading on pages 5 and 6.

3. Now you are ready to begin preliminary drawings. You need to design a style, a face, and a pedestal.



4. The step-by-step instructions in the reading will bring you to the final drawing. This may be influenced by the materials you chose to use in the actual construction of the sundial.

5. The choice of craft material and process will depend on what is available in your school, and on the severity of the weather conditions in your geographic location. The writer of "Making a Sundial" used wood but you can use any of a variety of materials that withstand outdoor weather. Select a craft technique that is available to you in your school:

   mosaic tiles (set in concrete)

   metal plate such as aluminum, brass, or copper (engrave, etch)

   glass or transparent acrylic (engrave or etch)

   glass (reverse painting on under-surface)

   clay, ceramic (low relief, glazed)

   slate or stone (carve or etch)

6. Sundials traditionally carry a message. Sometimes in Latin, often serious, sometimes humorous, the motto conveys a universal story. Here are a few copied from antique sundials:

   Life's but a shadow, man's but dust;
   This dial says, die we all must.

   Let others tell of storms and showers,
   I'll only count your sunny hours.

   So rolls the sun,
   so wears the day,
   and measures out
   life's painful way.

   Amidst the flowers Time wanes away
   I tell the hours As flowers decay.

   A clock the time may wrongly tell.
   I, never, if the sun shine well.

   My promise is solely to follow the sun
   and point the course his chariot doth run.

   While ye have light, believe in the light.

   Time is the chrysalis of eternity.

Pick the motto you like, or compose your own. Experiment with various alphabets and type faces, in a variety of positions and sizes, to present the message and the numbers on the face in the most attractive way.

7. After every student has completed a comprehensive sketch of the dial and the motto, the group should vote for the most aesthetically pleasing design or designs for the school grounds.

8. Now construct the sundial, install it in the chosen location, and follow the instructions in the reading for "setting" it.

Questions

1. Is it important to know the exact time? Why or why not?

2. Why do you think people in ancient times invented the sundial? What does it show about what was happening in their societies?

3. Can you think of a completely different kind of structure or invention that could be used to tell time with the sun?

4. Why would the construction of a sundial require cooperation between art and science?

Looking Back

In modern life we can become very cut off from nature. Our cars and houses shelter us completely, so that we almost ignore sun and rain, day and night, winter and summer. Sometimes, though, nature can't be ignored, especially when we want to use it in some way. With today's energy problems we have to look for help from natural forms of energy like sun and wind. A sundial is a pleasant reminder to us that the sun is a reliable source of energy that won't run out.

Going Further

Make a calligraphy collection of sundial mottoes.

Do a photo essay on sundials and weathervanes, which can also be fine works of art. Look in parks, on public buildings, church steeples, museums, etc.

Making a Sundial

Excerpted from "Making a Sundial" by John Horst. Reprinted by permission from Blair & Ketchum's Country Journal. Copyright March 1980 Country Journal Publishing Co., Inc. All Rights Reserved.

Making a sundial is easy. It has only two parts, the style (also known as the gnomon), which casts the shadow, and the clock face, which has the time markings. With a little care you can produce a curio that will tell time reasonably accurately, within ten minutes, all year long.

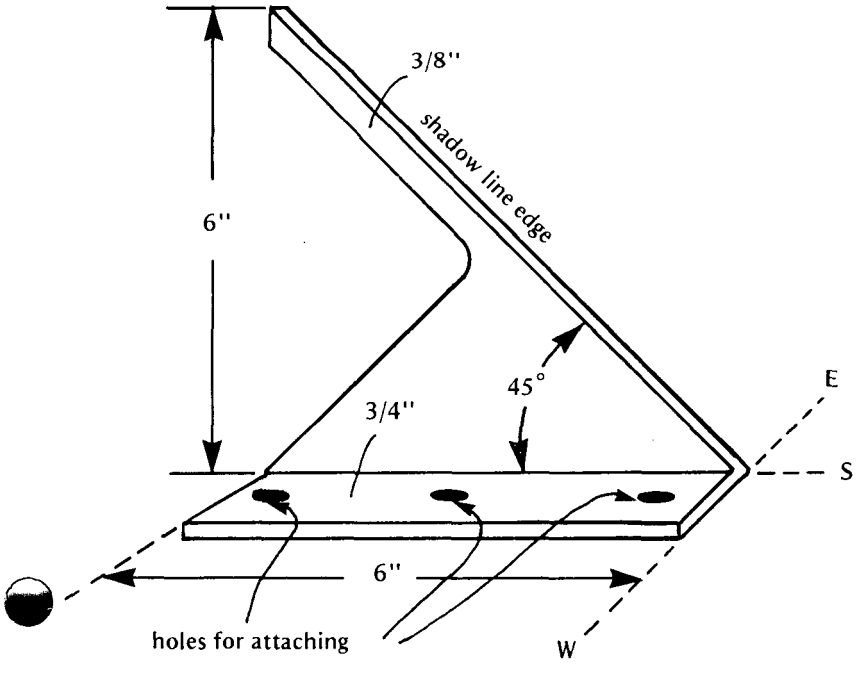
The Style

Make the style from a piece of sheet metal thick enough to resist bending, yet flexible enough to permit bending to form the base that attaches to the clock face.

The important things to remember about the style are: First, the shadow-line edge should be at 45 degrees to the clock face in the north-south direction and at 90 degrees to the clock face in the east-west direction (see Figure 1). A north-south angle of 45 degrees is a good compromise angle for any location in the continental United States. If you live in Alaska the angle should be 60 degrees.

Second, the shadow-line cast by the style should be thin enough to make a readable line, yet the edge should be sturdy enough to resist bending by wind and the weather. (See Figure 1).

Figure 1



The Face

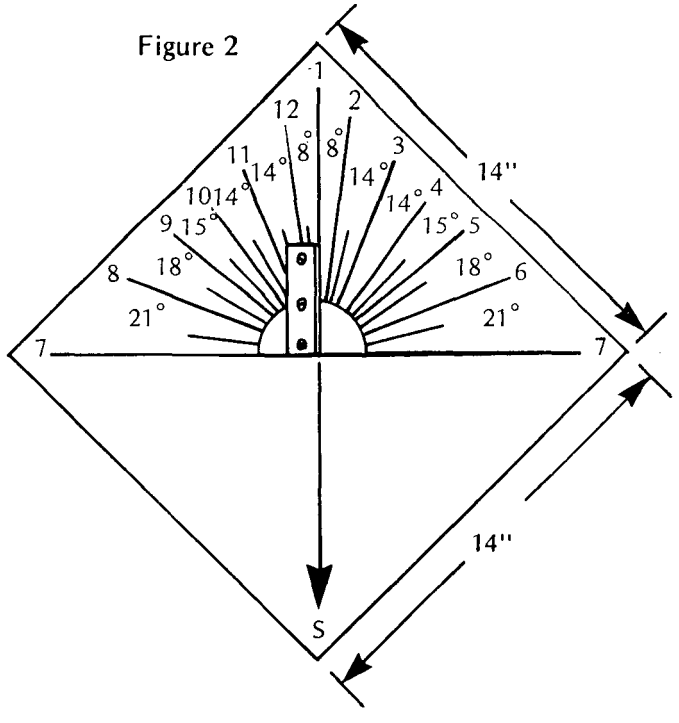
The clock face can be any flat surface. I used two square pieces of 5/8 inch exterior-grade plywood glued together to make one solid piece 1¼ inches thick and 14 inches on a side. The double thickness made for a sturdy face that had enough weight to set firmly on the stand even in windy weather. You can just as easily make it round or any shape that strikes your fancy. A friend made one using a slice from a maple log he was cutting up for firewood.

The important things about the face are the spacing of the time marks and their orientation to the sun.

Calibrating the Face

Start by laying out two lines at right angles, crossing where the 45-degree shadow-line edge of the style will meet the clock face when the style is installed. These two lines will be your north-south and east-west orientation lines.

Figure 2

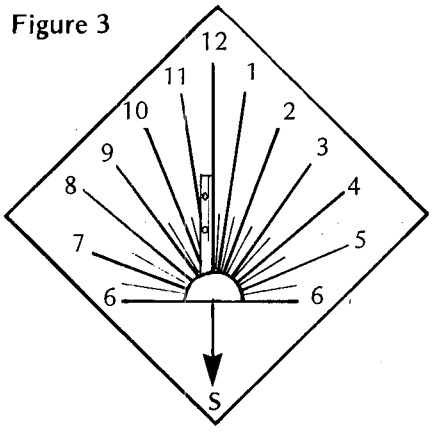


Now divide the space between east, north, and west into wedge-shaped segments using the angle measurements shown in Figure 2.

The line dividing each segment will stand for an hour. Divide the space between each pair of hour lines in half, and you have the half-hour lines. A simple protractor will be accurate enough to establish the degree angles at the "point" of each segment. To make your solar clock for daylight saving time (Figure 2), label the line pointing west "7", the next hour line "8", and so forth. The 1 P.M. line will also be the north indicating line. The 7 P.M. line will coincide with the east indicator.

For standard time (Figure 3), start with 6 on the west line. Noon will be on the north line and east will be 6 P.M.

Figure 3



A good way to have a clock that is good all year is to paint standard-time markings on one side and daylight-saving-time markings on the other. When the time to set the clock forward or back arrives, you simply remove the style, flip the clock face over, replace the style, and realign the face with the sun.

After the clock-face markings are painted on and dry, you are almost finished.

Attach the style as shown in Figure 2. The 45-degree shadow-line edge should slope down toward and meet the clock face exactly where the east-west and north-south lines intersect. The rest of the style should be perpendicular to the face along the north line.

Now set the clock face on a suitable base in a sunny spot. Anything that provides steady support will do. Level the face in all directions using a carpenter's level or a pan of water.

Setting Your Sun Clock

The next step requires a little preliminary explanation. The sun is always due south at midday (noon, standard time or 1 P.M. daylight saving time) if you live precisely on the eastern edge of a time zone, any time zone. If you live on the western edge of a time zone, midday by the sun comes at 11 A.M., standard time (noon, daylight saving time). If you live in the middle of a time zone it comes at 11:30 A.M.

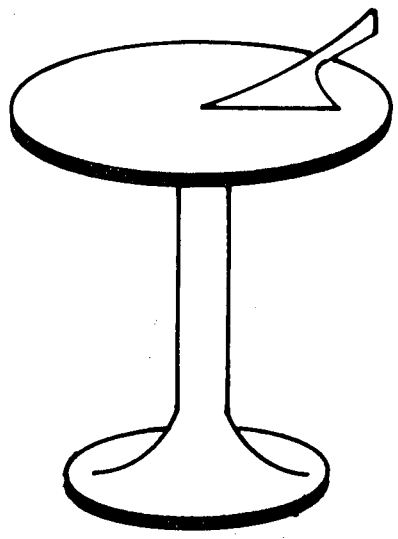
Now, back to our sundial. To obtain the most accurate reading, set your sun clock at midday, sun time. Here is what to do.

If you live in the eastern quarter of a time zone, Boston, Chicago, or Spokane, for example, at the stroke of noon standard time (1 P.M. daylight saving) on a sunny day, rotate the sundial on its base so the style shadow-line indicates 12 o'clock (or 1 P.M. daylight saving time).

If you live in the middle of a time zone, say Pittsburgh or Denver, follow exactly the same procedure, but set it at 11:30 A.M. standard time. If you live in the western quarter of your time zone, set it at 11 A.M. standard time (or noon, daylight saving time).

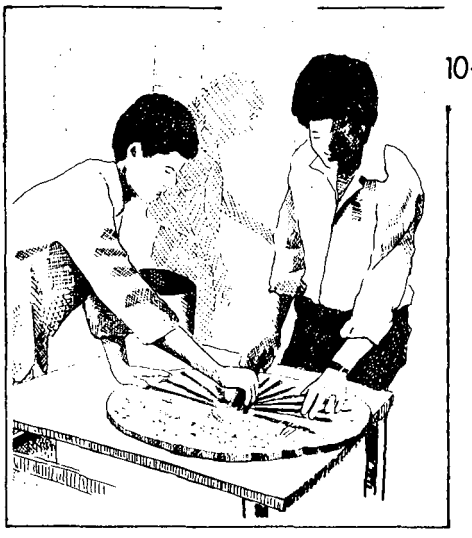
You can set the clock at any other time of day, but the approximations used to compute the style angle will complicate things.

You now have your very own energy-saving, perpetual, solar-powered clock. Enjoy it.



Teacher Information

Making a Sundial



Suggested Grade Level and Discipline

Grades 9-12
Studio art
Art history
Applied crafts, calligraphy, ceramics, design, drawing, graphics, sculpture

Skill Objectives

Practicing a given craft

Applying a craft technique to the making of a functional object

Integrating a well-rendered, hand-lettered message within the boundaries of the dial surface

Major Understandings

Artists and scientists are interdependent, and the sun has sustained importance to both groups.

Words and design can be rendered as a harmonious unit.

Background

The Bible mentions the Dial of Ahaz, which may have been constructed in ancient Babylonia as far back as the eighth century B.C. In the fourth century B.C., the Greeks observed the position of the shadow cast by a gnomon (a vertical pole on a horizontal, graduated plate) in the sunshine to tell time. Some historians believe that the Egyptians built the pyramids to mark the progress of the seasons by the shadows cast on the desert sands. Throughout human history, every civilization has relied on the sun to learn the time of day and the season of the year.

Because the sundial measures the apparent motion of the sun across the sky we call this local sun time or apparent time. On the other hand, a clock records accumulated equal units of time. We call this mean time. Although the earth turns on its axis approximately once every twenty-four hours, its yearly path around the sun is irregular. Scientists developed a table which gives data to correct these irregularities. This table is known as "The Equation of Time" and it is available in most of the books listed in the bibliography. There are several kinds of time and those whose curiosity is aroused can investigate this by referring to books in the bibliography. In fact, sun time and mean time are equal only four days of the year.

For dial makers who are interested in the science of gnomonics, ample information is readily available in most libraries. For our purpose, in this classroom project, the simplified instructions and the

sample dial on pages 5-6 should be adequate for the students' immediate needs. Historically, a sundial is a combination of aesthetics, craftsmanship, and science.

Whether we think of a sundial as a scientific instrument or as a beautiful art object, when the sundial is installed in an open, outdoor space it becomes an eloquent reminder of how man turns to the sun to measure the span of his days and his years. In the twenty-first century, man may also turn to the sun to ensure the quality of his life.

Advance Planning

Inform students of this culminating activity when they are introduced to a craft process that will later on evolve into the making of the sundial. It is up to the teacher to identify the craft most readily available to make the dial: a low relief plaque in glazed clay, an etching on a metal plate, a reverse painting on glass or acrylic, a mosaic in tile or any other stable, rugged material that can withstand the weather.

Assemble all needed materials.

It may be possible to elicit the assistance of a horologist, astronomer, architect, landscape gardener, or other local craftsman with some experience of sundials.

Suggested Time Allotment

2 weeks or more, at the discretion of the teacher

Suggested Approach

Introduce the activity with a discussion of nature, and natural, renewable forms of energy.

Discuss how every person's lifestyle, whether consciously or not, is attuned to the sun's hours and seasons.

Allow time for design experimentation.

If possible, team with the English/language arts teacher on the activity of writing messages and mottoes for the sundial face.

Go over the reading as a group, with explanation of calibrating the face and "setting" the sundial.

Conduct open, joint discussion to determine which design to use and where to install it. Encourage community attention.

Install the sundial on the ground or on a pedestal, in an easily accessible location, with ceremony and dignity to give honor to the craft that produced it and to the school community.

Precautions

It may be advisable for students to complete an introductory project in the craft process before they embark on the sundial.

Be sure the students obtain written permission from the proper school and/or civic authorities before they start.

Points for Discussion

How did the function of the sundial determine its form?

How do the standards by which we evaluate good sculpture apply to the sundial installation?

Compare the advantages and disadvantages of a sundial with those of a watch.

In the 21st century, some jobs will become vital to society's welfare. What do you think the role of urban planners, architects, environmental designers, artists, craftsmen, sculptors will be?

In which daily endeavors are artists dependent on scientists or vice versa? Predict how and why emphasis on the sun as source of heat, energy, and light will alter this interdependence in the future.

Typical Results

Where students have sufficient experience in a craft, they will work independently to produce a satisfactory project. Group instruction is needed to calibrate the dial and "set" the sundial.

Evaluation

Observe skill with a practiced craft and originality and balance in the design. If students team, observe the contribution of each to the project.

Modifications

For a smaller-scale project, allow students to design and create "windowsill sundials"--indoor projects for a south-facing window.

Use a large object (flagpole, goalposts, etc.) as the basis of a grand-scale sundial sculpture or landscape: a temporary or permanent work of art.

Discuss how science and art related in the past, and how they relate today. How does each stimulate the other? Study people who embodied this cross-fertilization: DaVinci, John James Audubon, Samuel F.B. Morse.

References

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Guye, Samuel and Henri Michel. Time and Space: Measuring Instruments from the 15th to the 19th Century (New York: Praeger Publishers, 1971).

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Michel, Henri. Scientific Instruments in Art and History (New York: Viking Press, 1967).

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Improvising from an Energy Circle

11

Introduction

Must you have sheet music in front of you before you can play an instrument? Of course not! You can play from memory, make up music as you go along, or get the feeling of what you want to play from a picture, a story, or from watching something happening.

In this activity you will make up music from a graph. This graph is a renewable energy graph. It shows where our energy could come from in the year 2000. All the kinds of energy you see on this graph are called renewable energy. That means that when you use them they replace themselves in a fairly short time, so you don't run out of energy. In one way or another, they all come from the sun. You'll be learning what the different words mean. You'll make up music about them. Then you'll write down the music using your own set of symbols so that you can remember, practice, and improve your sun energy composition.

DRAFT

Objectives

At the completion of this activity you should be able to

- o draw, color, and arrange sections for an energy circle graph,
- o select musical instruments and arrange sounds to create a musical composition from the graph,
- o write the composition in your own musical symbols, and
- o perform the composition.

Skills and Knowledge You Need

Some experience with reading and playing music from symbols

Some experience with classroom musical instruments

Drawing, coloring

Materials

paper (large - about 3' x 3')

yardsticks, rulers, and protractors

markers, crayons, and colored pencils

Sun Energy Graph

timer (to measure seconds)

tape recorder

classroom instruments:
mallets: marimbas, xylophone, glockenspiel, vibes
percussion: snare, bass, timpani, tambourine, latin percussion
also any strings, woodwind, and brass

Words You'll Learn

biomass energy--energy from plant matter which can be processed to produce liquid, gas, or solid fuels.

hydropower--energy from falling water which drives turbines to produce electricity.

ocean thermal power--energy produced by the differences between warm surface waters and cold deeper waters in the ocean. These differences can be used in a heat pump to produce electricity.

photovoltaic cell electricity--power from silicon cells which produce an electric current when exposed to light.

solar heat--energy for heating obtained by allowing sunlight to pass through glass and heat a storage material.
solar thermal power--power from concentrating sunlight with reflectors to produce high temperatures.
wind power--energy from windmills which can be used to generate electricity.

Procedure

Making Your Graph

1. Split up into small groups (4-5 people). Each group is responsible for drawing and coloring one graph, creating a composition, and performing the piece.

2. Select one large sheet of paper, markers, crayons, straight edges, and a protractor for your group.

3. Reproduce the Sun Energy Graph on your large sheet.

4. Color, design, and illustrate your circle with energy and solar themes. Use your imagination. Leave the outer circle to write your music in.

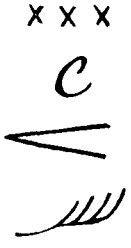
Writing Your Composition

5. Each person should select an instrument to play. Assign one person to be conductor/timekeeper.

6. Use the percentages on your graph for timing: for example, 9 seconds of music for wind power, 31 seconds for solar heat.

7. Decide what instruments and what sounds you want to use to express the kind of energy in each part of the graph. (For example, you might want to use violins for wind, drums for hydropower.) Experiment to see how suitable your choices are.

8. Pick symbols or marks to remind you of the sounds you plan to use. For example, here are some symbols that could be used.



= short notes

= C chord

= gradually getting louder

= glissando up 4 notes

Different instruments may need different symbols.

9. Use the Graphic Notation Sheet to write down everything you have decided. List the parts of the graph, the time each part will be played, the instruments that will play for each part, and the symbols to show what each instrument should play.

Playing Your Composition

10. Practice the composition section by section, and then put the whole thing together. The conductor should keep track of the time and point out who plays in each section. Start at any point on the circle. Each instrument or group of instruments plays until the conductor/timekeeper indicates the beginning of a new section.

11. Rehearse, perform,and tape record each composition.

12. Listen to each tape.

13. Discuss and refine your composition. Add to the notation.

14. Draw the notation for each section in the outer circle on your large graph.

Questions

1. Which part of your composition is most suited to the form of energy it is trying to express?

2. Which group's composition is the best overall? Why?

3. By listening to your tape or another group's tape, can you match up and compare each musical section with the appropriate energy source?

4. How can each small group make their sounds more cohesive?

Looking Back

Each sun energy graph composition was written using the graphic notation technique. The class assignment included drawing a graph, choosing and arranging instruments, and composing and playing the piece.

In creating this composition, you did several very creative things. You drew and illustrated a graph about energy. You made original music about the graph. You invented symbols to write down that music. And in performing your composition you used the energy of music to express the renewable energy of the sun.

Going Further

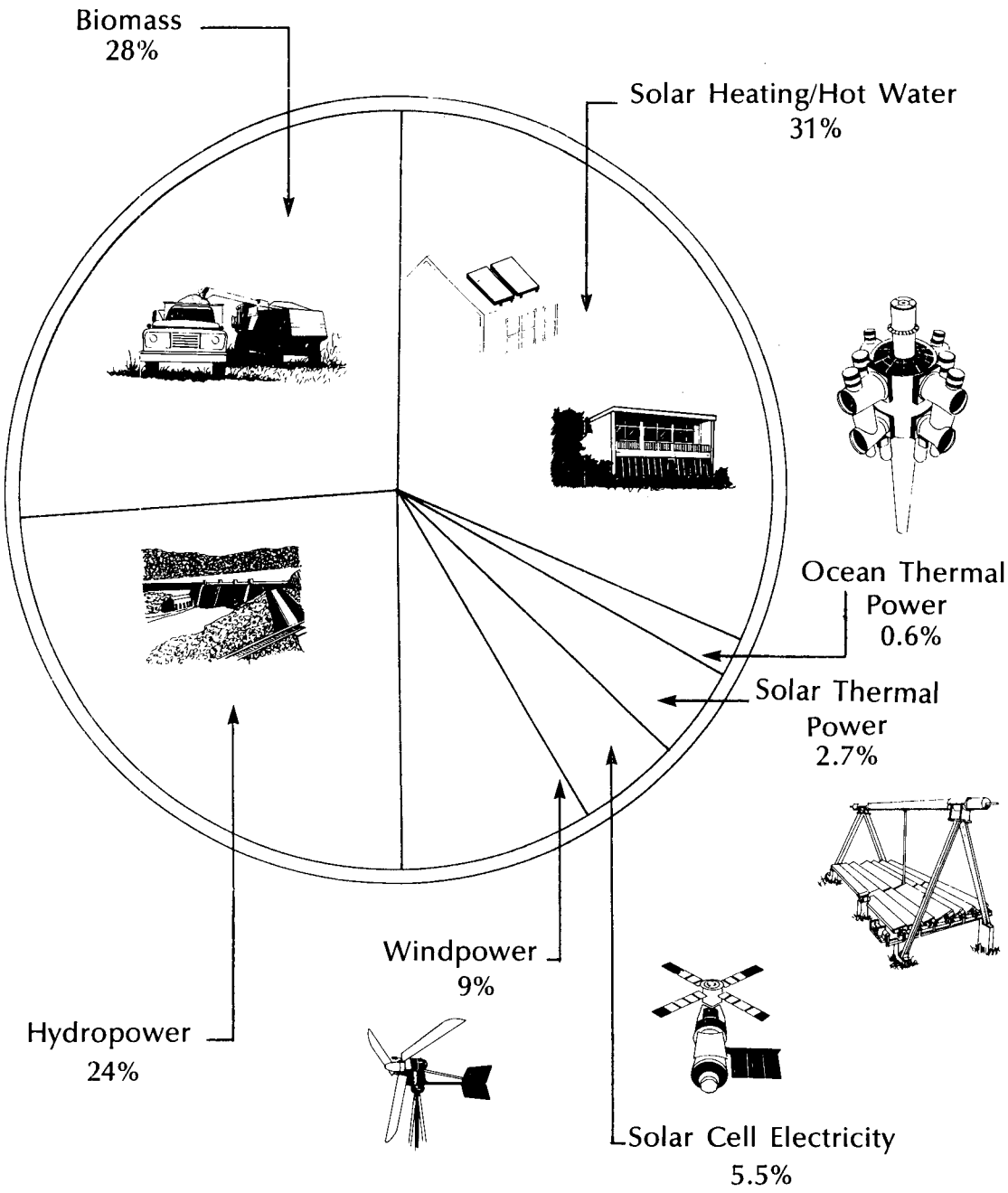
Find graphs of other sources of energy and compose a graphic piece using the figures on the graph.

Try using other media with your composition (opaque projectors, overhead projectors with transparencies, slides, dance, pantomime.)

Sun Energy Graph

A Budget for Renewable Energy for the Year 2000

from The Energy Puzzle
Alliance to Save Energy, Washington, D.C.



Graphic Notation Sheet

Sun Energy Graph Composition

Group Members _____ _____

_____ _____

_____ _____

_____ _____

_____ _____

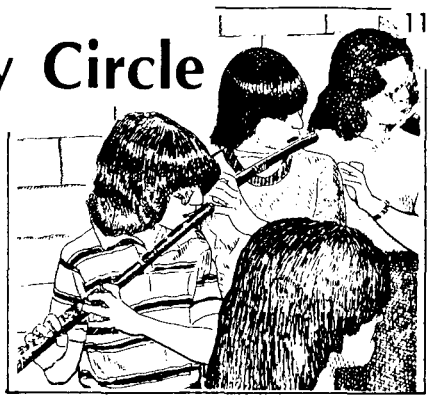
_____ _____

Key to Symbols _____

Section of Graph	Time	Instruments	Notation

Teacher Information

Improvising from an Energy Circle



Suggested Grade Level and Discipline

Music, Grades 6-8

Skill Objectives

Drawing and coloring a circle graph

Composing, rehearsing, and performing music to express a circle graph

Listening to and evaluating compositions

Discussing musical arrangements

Major Understandings

Information in one form can be transferred to another form.

Improvised musical sections can be arranged to increase the dramatic and subtle aspects of a composition.

Symbols are arbitrary and can express anything the user wants them to.

Background

People have invented many ways of recording information and communicating it to others. We have writing, pictures, photographs, charts, graphs, recordings, and so on. Musicians have musical notation.

During the 1950's, some musical composers began to feel that traditional musical notation would not serve their needs or allow them to express themselves freely. Their imaginations stretched beyond the well-known kinds of harmony, rhythm, instrumental arrangement, and so on. To express their compositions, they wanted a new kind of notation, and they invented one!

Instead of the familiar staff, with notes and rests and written directions

they invented symbols like these, symbols that represented the kinds of sounds they wanted.

Each composition would have its own set of symbols invented by the composer. The symbols are defined in a key--like the key to a road map.

X X X = short notes

C = C chord

< = gradually getting louder

= glissando up 4 notes

The performers have a general guideline to follow, but have a lot of freedom within those guidelines to express themselves.

This way of writing down music is called "graphic composition." It's called graphic because it is more picture-like than traditional musical notation.

One exciting facet of this type of notation is that it helps to establish links with other forms of communication. In this activity, students will study a graph about energy. They will plan a composition which communicates something about these graphs, design a system of notation to represent the sounds of the composition, record the composition in notation, and then practice and refine it.

Advance Planning

Look over the graph supplied with the activity and familiarize yourself with the vocabulary and the procedure.

Gather any materials needed.

Duplicate the graph and the notation sheet or enlarge them with an overhead or opaque projector.

Suggested Time Allotment

5 class periods

(Perhaps spend one day leading into the activity and playing or talking through an example, and one day arranging, drawing, and coloring the graph. Allow two days for playing, rehearsing, and taping the pieces. One-half class period can be spent summarizing.)

Suggested Approach

Give an introduction or review of graphic notation techniques for reading, playing, and writing. Suggest the various things that can be expressed with musical symbols: pitch, loudness, number and rhythm of notes, arrangement and harmony.

Introduce or review the playing of classroom instruments.

Read through the introduction to the activity, and go over the new vocabulary.

Explain how graphic notation will work with this project.

Run through a short example from the graph to illustrate the activity to the class.

Stress the need for diverse instruments in each small group.

Read through the procedure with the class.

Precautions

If the class or the classroom setting doesn't lend itself to several small groups working independently and simultaneously, make the activity one large group composition, with each small group doing just one section, and the graphic notation written on the board.

Make sure the procedure is clearly understood before the groups begin work.

Each group should always play as musically as possible; this should be stressed. Class members are functioning as composers and performers of music.

Points for Discussion

Why is graphic notation sometimes used in place of standard musical notation?

What are the advantages of standard musical notation?

Are there other groups and professions that have their own "shorthand"?

Typical Results

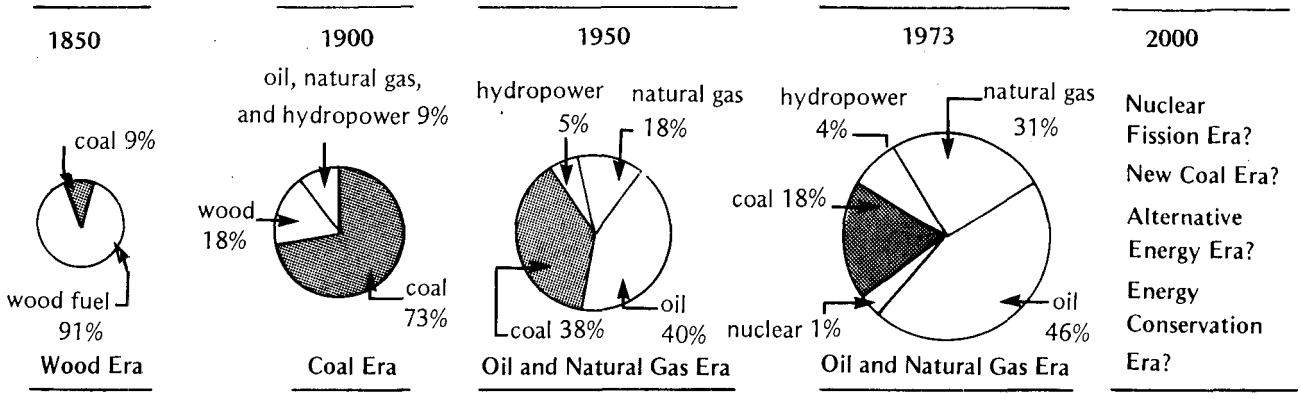
The pieces will be arranged, basically, to the students' liking. One composition may be very improvisatory and atonal, while another may follow a more traditional sound, say a 12-bar blues improvisation. Each group must decide upon its own degree of structure.

Evaluation

Observe students' abilities to improvise music from ideas, and to refine their improvisations.

Modifications

Use the other circle graphs below to produce the movements of an energy symphony, culminating in the year 2000.



from Living in the Environment, 3rd edition by G. Tyler Miller
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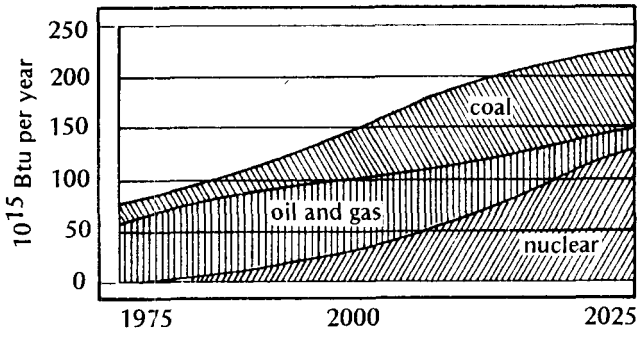
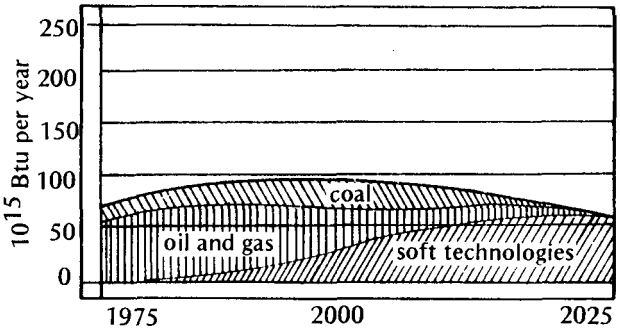
Have students consider ways to express line or bar graphs (like those below) or other visual material in musical terms.

An Illustrative Schematic Future for U.S. Gross Primary Energy Use



An Alternate Illustrative Future for U.S. Gross Primary Energy Use



from Soft Energy Paths, © 1977, Friends of the Earth International.
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Rather than using classroom instruments, have students bring in "found" or homemade instruments to use in creating their compositions.

References

Brindle, Reginald Smith. The New Music: the Avant-Garde since 1945 (London: Oxford University Press, 1975).

Paynter, John and Peter Aston. Sound and Silence: Classroom Projects in Creative Music (New York: Cambridge University Press, 1970).

Sadie, Stanley, ed. The New Grove Dictionary of Music and Musicians (Grove's Dictionaries of Music, Inc., 1283 National Press Bldg., Washington, DC 20045)

Schafer, R. Murray. Creative Music Education (New York: Schirmer Books, 1976).

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Sun Poems and Music 12

Introduction

Composers often use poetry as the source of themes around which they compose their works of music. In addition to popular songs--which have always relied on poetry and lyrics--many symphonic works also incorporate poetry into their thematic development. Beethoven's Ninth Symphony has the "Ode to Joy" as its last movement and has been nicknamed the "Choral Symphony." Russian composer Dmitri Shostakovich set eleven poems to music and bound them together in his Symphony No. 14 for Soprano, Bass, and Orchestra written in 1969.

In contemporary pop songs the lyrics will often carry a message. Lennon and McCartney's "Yesterday," Simon and Garfunkle's "My Little Town," and Janis Ian's "At 17" are examples of this. In this activity the "message" you are setting out to deliver is that energy exists in nature in the sun, the wind, falling water, and growing plants, and that we can use that energy to make our lives better.

The poet and composer are both creators and builders. The poet uses words and their rhythms and accents while the composer uses pitches, dynamics, rhythms, textures, and harmony. We all are capable of creating word combinations and playing and writing music, especially when we are surrounded by poetry and music every day.

DRAFT

Objectives

At the completion of this activity you should be able to

- find or write a poem which uses energy in nature (sun, wind, falling water, or growing plants) as its theme,
- select words from the poem that suggest sounds,
- identify, organize, and list musical sounds to dramatize the poem, and
- perform the piece with reader and instrumental ensemble.

Skills and Knowledge You Need

Researching sources for an appropriate poem (or writing a poem)

Playing classroom instruments

Arranging musical sounds to complement verse

Materials

poem

classroom instruments: mallets, drums, springs, woodwind, gong, chimes, brass

Procedure

1. Study the worksheet with the Sample Plan for a Poem Composition. You will be making a similar plan with a poem of your choice.

2. Write or select a poem which has a theme related to nature's energy:

   sun
   wind
   rain
   plants
   falling water
   heat
   rivers
   the seasons

   Choose a poem that makes you feel that you could draw a picture or write a piece of music to describe what the poem is talking about.

3. Read through the poem and decide whether you really like it.

4. Now go through the poem and underline those words in the poem which suggest appropriate sounds.
For example:

> Beams of sun
> Touch the flowers
> ---Bloom
> Wheat stalks reach up
> Grass grows greener
> As drops of dew melt away.

5. Take this underlined version to your teacher, who will make copies for the class to select the class poem for instrumentation.

6. Once a poem has been selected, write it on your worksheet in the space marked "Your Poem." Discuss with a partner (or three or four of you together) the various instrumental sounds which can be used to enhance the poem. Focus your discussion around the inherent qualities of the music. Think of

   pitch and range--do you want the notes to be high or low or in between?

   dynamics--what degree of louds and softs do you want?

   texture--what organization and arrangement of sounds do you have in mind?

   melody--what tune do you want? How alike or different do you want your phrases?

   harmony--what combination of musical tones sounding together do you have in mind?

   rhythm--how even or uneven do you want your long-short beat?

   silence--can it be used for effect?

   instrumentation--do certain instruments convey certain feelings or images?

7. Read the poem over several times in your group. Work through the entire piece, adding music at certain cue words. Add the cue words, instruments, and sounds to your worksheet.

8. Assign instruments and set up.

9. Read through the piece several times more, adding music either before, after, or while the cue words are spoken.

10. Rehearse the piece.

11. Tape record the piece and play it back.

12. Have the class evaluate each group's piece and make suggestions for improvement.

Questions

1. Are there ways to elicit unusual or unexpected sounds from your instruments in order to add color to the piece? How?

2. Are there other, different ways to play music for the cue words?

3. What sound-word combinations were particularly effective? Why?

4. Can you make a chant, or ostinato, out of the energy words in the song to add harmonic and rhythmic accompaniment to the melody?

Looking Back

Combining music and poetry often leads to a very dramatic multi-media presentation. By carefully choosing instruments and arranging sound combinations, the music and verse can be made very complementary. Composers of all eras have added music to verse as a means of expressing themselves.

This activity has involved selecting or writing a poem and coloring the verse with musical sounds. You identified the important ideas and feelings in the poem and orchestrated them to produce a composition.

Going Further

Graphically notate the piece.

Use a longer folk tale, myth, or story as a source for a multimedia presentation.

Form a whole "symphony" of 3 or 4 movements grouped together.

Create visual effects or images to create an environment (use projectors, etc.) for presentation.

Draw a picture to describe the poem.

Write a piece of program music to accompany a story, painting, place, or event which is meaningful to an energy-conscious person.

Worksheet

Sample Plan for a Poem Composition

Poem

BEAMS OF SUN
TOUCH THE FLOWERS
——— BLOOM

WHEAT STALKS REACH UP
GREEN GROWS GREENER
AS DROPS OF DEW MELT AWAY

Composition

Cue	Instrument	Sound
"BEAMS"	CYMBAL	ROLL WITH SOFT MALLETS SOFT
"BLOOM"	GUITAR	C CHORD
"REACH UP"	W.W.	B♭ ARPEGGIO
"GROWS"	XYLO	GLISSANDO UP-4x's
"DROPS"	GLOCK	TWINKLING VERY HIGH
"MELT AWAY"	GLOCK	SLOWLY "TWINKLE" AWAY

Your Plan for a Poem Composition

Your Poem

Your Composition

Cue	Instrument	Sound

Teacher Information

Sun Poems and Music

Suggested Grade Level and Discipline

Grades 6-10
Poetry, creative writing, music

Skill Objectives

Researching and selecting or writing appropriate poetry

Orchestrating cue words with instrumental sounds

Discussing alternative ways of orchestrating

Listening to and evaluating orchestration

Major Understandings

If you know the basic elements and structure of music you can create original compositions.

One type of composition takes themes from poems and uses the theme and words of the poem to determine instrumentation, pitch, rhythm, etc.

Poems about energy in nature (sun, wind, falling water, growing plants) make good subjects for this type of composition.

Background

Music really never tells the listener what inspired it because musical sounds do not have the accuracy of meaning that words do. Music must rely on tone to suggest a mood or feelings. The composer suggests his feelings by relying on dynamics, form, harmony, melody, rhythm, tempo.

Some of the most dramatic musical experiences combine words and music. From baroque cantatas to rock operas, musicians have used words to inspire their compositions. In the process, the verbal message is absorbed into the total musical creation.

Advance Planning

Check with English/Language Arts teachers for referral to sources of poetry and/or an approach to having the class write verses of their own.

Get a recording of Peter and the Wolf, The Sorcerer's Apprentice (with narration), Carnival of Animals, La Mer, Grand Canyon Suite, or a similar piece of program music.

Review instruments and sounds with students.

Suggested Time Allotment

One or two class periods to select and read poems (Original writing may take longer.)

One period to choose the class poem and discuss instrumentation in small groups

Two periods for each group to rehearse and record their composition

One period for the class to listen to and discuss tapes of each group

Suggested Approach

Play one of the recordings (Peter and the Wolf, The Sorcerer's Apprentice, La Mer, etc.) for the students to help them grasp the nature of program music. Introduce the notion that poetry is often given more expression by being set to music.

Have the librarian give a book talk or read some poetry aloud to the students, focussing on those that lend themselves to choral reading. Show students Granger's Index to Poetry with its thematic listings. Leave several poetry books around for student browsing.

Make the final selection of one poem a class decision--as much as possible.

Read the final selection aloud to class (repeat once or twice to familiarize students with work). Elicit responses for music.

Help groups set up instruments, and work through the piece. The musicians should respond or react to the previously decided upon "cue words."

Discuss each group's approach to the composition with the larger group.

Precautions

Guide students toward relatively short poems for the first attempt.

Points for Discussion

Was the piece effective? If so, why? If not, how can we make it so? (What makes music effective? What is effective?)

Define program music. Listen to a recording of Danse Macabre. Is this program music? What are its identifying features?

Identify some ways the composer has at his disposal to create a mood or atmosphere that he finds necessary for his piece.

After listening to several programmatic pieces, can you identify the nonmusical idea (the person, place, poem, or event) that the composer had in mind?

Does the composer use his musical materials to tell the listener what inspired his composition?

Evaluation

Participation at the various stages of the activity could be a criterion for evaluation. Skill in identifying key words in the poems and suggesting appropriate instrumentation could also be observed.

Modifications

The activity can be done as two separate classroom projects--English specialist works with his/her class on poetry assignment; at completion turns verses over to music teacher--or as a team-teaching project.

Finished composition is then presented in a show or concert.

References

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Sun Sounds: Program Music

13

Introduction

A composer's music may often be inspired by a story, folk tale, myth, work of art, film, or current event. A piece derived from a source such as this is called PROGRAM MUSIC.

Think of the music you've heard that reminds you of horses galloping or even the steady clip-clop of a donkey's hooves. These are samples of program music. Vivaldi's "The Four Seasons," Moussorgsky's "Pictures at an Exhibition," Ravel's "Mother Goose Suite," Stravinsky's "Rites of Spring," Colgrass's "As Quiet as a . . ." are examples of some works that have been inspired by words or pictures.

What kind of music do you think of when you think of the sun? In this activity you will be considering how the sun looks and how it makes you feel. Then you will be translating those sights and feelings into musical sounds.

How can what we see remind us of a sound we've heard? How can a sound remind us of something we've seen? Our complicated sense system records its impressions in a central memory bank. They mix, blend, and resurface--often as pictures with sound; sometimes as a feeling. You can record your various sense impressions of the sun as sun sounds.

DRAFT

Objectives

At the completion of this activity you should be able to

- o select the theme for a program composition,
- o develop the elements of your theme and translate the written elements to music,
- o organize and arrange the music to form a composition, and
- o create, rehearse, and perform a composition inspired by personal experiences.

Skills and Knowledge You Need

Group discussion and decision-making

Playing classroom instruments (xylophones, marimbas, hand drums, guitar), also strings, brass, or woodwind

Improvising, arranging music, and following a conductor

Materials

classroom instruments

tape recorder

pictures and photographs showing the sun, or sun-filled settings

program composition worksheets

Procedure

1. Find pictures suggesting the sun, sunlight, and objects and activities you associate with the sun.

2. Study the pictures and consider your own feelings and ideas about the sun.

3. Study Worksheet 1 showing two sample program compositions. Then turn to Worksheet 2.

4. With your classmates, choose a solar theme: for example, Sun Power, The sun brings spring, Sun fun, etc. List your theme in column A, Theme.

5. Discuss the feelings, words, and ideas you associate with your theme. Pick the ones you want to use in your composition. List them in column B, Elements.

6. Choose the instruments you will use to express the feelings you have listed. List the instruments in column C, Instruments.

7. Now work out in detail the notes and sounds you want from each instrument for the element it is supposed to express. List the sounds in column D, Musical Sounds.

8. Set up classroom instruments and have everyone choose an instrument from the worksheet plan.

9. Choose a conductor who "leads" the music group through the sounds listed in the plan.

10. Practice the piece.

11. Discuss how the piece suggests the feelings you want to express. Refine parts of the piece.

12. Tape record the piece.

13. Listen to the recording and make improvements.

Questions

1. Are certain instruments more effective in playing certain musical sounds? List examples.

2. What are some of the qualities that make a theme or composition exceptional?

3. What sounds or instruments make you think of hot, scorching July days? How about windy, frigid February nights?

4. If you were feeling especially sad, what kind of day would you expect it to be? What season? What sounds would you use to express it?

5. Can you explain how the same sound can be both dark and light at the same time?

Looking Back

Composers of all eras have called upon programmatic sources as inspiration for their works. Certain combinations of words and music seem to work together especially well. Descriptive adjectives are particularly useful.

This class activity called for focussing on a solar topic or theme and breaking it down into individual elements--the feelings and ideas you associate with that theme. As with any activity, the more rehearsal a piece gets the more it can be refined.

The sun is an interesting theme for a piece of program music, especially since today's energy situation is making people more aware of the sun as a natural, rhythmic energy source in our lives.

Going Further

Listen to the musical selections discussed in the introduction to this activity.

Find and listen to other pieces of programmatic music.

Notate your composition graphically.

Perform the composition but use different instruments to play the same sounds.

Find a poster that makes you feel good on a bad day. Orchestrate your feelings about the poster. Think of your song when you need a lift.

Worksheet 1

Sample Plans for Two Program Compositions

Theme	Elements	Instruments	Musical Sounds
A	B	C	D
OCEAN	Floating	Guitar	G Major chords
	Flow	Clock	Glissando
	Calm	Vibes	Play soft and slow
	Storm	Drums	Play loud and rough
	Plants	Mallets	Play a C Major scale
	Dark	Piano	Clusters on piano bass
	Light	Piano	High notes on piano
FALL	Colors	All	Each play any 4 notes
	Sun through trees	Glockenspiel	High twinkling notes: fast to slow
	Plants growing	All	Go up scale
	Sunlight	Piano	High Major chords
	Wind	Drums	Rolls-louds/softs

Worksheet 2

Your Plan for a Program Composition

Theme	Elements	Instruments	Musical Sounds
A	B	C	D

Teacher Information

Sun Sounds: Program Music

Suggested Grade Level and Discipline

Grades 6-8
Music: Structured atonal improvisation
Original composition

Skill Objectives

Deciding on a theme for a composition

Identifying and listing feelings evoked by this theme

Selecting rhythms, harmonies, etc. to communicate feelings

Playing classroom musical instruments

Participating in class discussions

Major Understandings

The sun is a natural phenomenon easily portrayed by music.

From one point of view musical instruments function as sound effects for life.

Some instruments are designed specifically for making sound effects (temple block, anvil, slapsticks, woodblocks).

Background

Programmatic music can convey the sound of thunder, the trilling of a bird, or the crackle of an autumn fire. Descriptive music is skillful and amusing, arising when the imagination of the composer is stimulated by some experience, firsthand or vicarious.

While the music generated by pictures, stories, and events may sometimes be questioned by purists, students respond readily to both the notion of program music and the obvious message it brings. The purpose of this lesson is to combine the experience of the sun as an energy source with this joyful experience of music.

Advance Planning

Duplicate the worksheet.

Organize chart on board, overhead transparency, etc.

Set up classroom instruments.

Gather several varied pieces of program music.

Amass a class resource table of pictures, stories, magazines, etc. focussing on the solar theme. Have students bring from home, the library, or their other classes solar energy theme pictures, photos, stories, etc.

Suggested Time Allotment

One period to discuss and listen to program music

One period to introduce and select pictures which focus on solar energy, and to develop the program chart

One period to rehearse and record

One period to listen to and revise the composition

Suggested Approach

Introduce and explain program music and how it will be used in this class project. Play recorded examples, perhaps "Whistle A Happy Tune" from The King and I, "The Donkey Serenade" from Grand Canyon Suite, Gershwin's American in Paris, etc. The Pathétique and Pastorales may serve for more initiated audiences.

While playing the program pieces, ask students first to envision, then perhaps to draw or select from the resources, a pictorial representation of the music. A slide presentation may be in order.

Work on the solar theme, eliciting suggestions from the class. List ideas on a chart similar to the worksheet. What sounds could be played that would represent each idea or feeling?

Work through some basic conductor's hand signals to cue instrumentalists.

Points for Discussion

In what ways is the sun depicted in the music played in class?

Which instruments remind you of particular solar themes?

How does your mood determine the kind of music you like to hear? Do you prefer happy music when you are sad, or do you like quiet mood music then?

The theme of energy based on the sun can be positive, that is, offering only good to mankind. Can you think of times when the sun has done damage? What changes would you have to make in instrumentation to show this new emphasis?

Typical Results

See the sample compositions on the student worksheet for typical student-written pieces.

The length of the piece, dynamics, ranges, entrances, and exits are determined by the conductor.

Evaluation

Classes could evaluate each other's compositions. The evaluation could be purely affective. It might be evaluated with an "applause meter" agreed upon by the class.

Give each student a blank worksheet and have him/her select a new theme and create a program composition.

Modifications

Make an improvisational symphony that depicts the energy history of society: muscle power, wood, coal, oil, electricity, nuclear, and the future.

A group of students could band together and do a dramatic interpretation of the music of another group, showing the theme as clearly as possible.

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An Energy Glossary

a

active solar energy system: a system which requires external mechanical power (motors, pumps, valves, etc.) to operate the system and to transfer the collected solar energy from the collector to storage or to distribute it throughout the living units. Active systems can provide space heating and cooling, domestic hot water, and/or steam for industrial use.

air pollution: the presence of contaminants (natural or manmade) in the air to such a degree that the normal self-cleaning or dispersive ability of the atmosphere cannot cope with them.

alcohol fuels: primarily grain alcohol (ethanol) and wood alcohol (methanol) which have been used for decades in some European cars and in race cars. Cheap and easy availability of gasoline in the past made them uneconomical. Engine modifications will be necessary if these liquid fuels are to be put into widespread use, but small amounts of ethanol (up to 10% mixture with gasoline, as in gasohol) can be used in most cars without alterations. Alcohol fuels can be made from a variety of materials including crop surpluses, lumber wastes, municipal sewage, and garbage.

b

backup energy system: an energy system using conventional fuels to supply all the heating and domestic hot water during any period when the solar energy system is not operating.

barrel: a liquid volume equal to 42 gallons or 159 liters. One barrel of crude oil has about the same heat energy as 350 pounds of bituminous coal, 5.8×10^9 joules or 5.5×10^6 Btu or 1.39×10^6 kcal.

bioconversion: a general term describing the conversion of one form of energy into another by living organisms. Examples are production of wood and sugars by green plants, production of alcohols and natural gases by microorganisms acting on organic materials, and transfer of energy in food chains.

biofuels: renewable energy sources produced by or from green plants. Examples are grain alcohol, wood, methane from anaerobic digesters, and all foods.

biomass: a volume or amount of plant material in any form: algae, wood, plants, crop residue, animal manure, etc.

breeder reactor: a more complex nuclear reactor than ones now in commercial use, a breeder converts non-fissionable uranium or thorium to nuclear fuel. Conventional nuclear reactors depend on fission of an uncommon form of uranium, U_{235}, which comprises less than 1% of uranium ore. To extend the use of uranium, breeder reactors may be able to change more abundant forms of uranium into fissionable elements. Higher operating risks, engineering problems, and waste disposal considerations have been factors in slow development of breeder technology.

c

coal: solid fuel formed by the decomposition of plants buried deep under the earth's surface. A group of naturally occurring, carbon and hydrogen-rich substances are called "coal". Various types are ranked by the percentage of carbon in dried samples or by the caloric value of moist ones. From least to most carbon-rich, the coal group includes peat, lignite, sub-bituminous and bituminous coals, and anthracite.

collector: any of a wide variety of devices (flat-plate, concentrating, vacuum tube, greenhouse, etc.) which collect solar radiation and convert it to heat.

compost: a mixture of decomposing plant refuse, manure, etc. used for fertilizing and conditioning the soil.

concentrator: a reflector or lens designed to focus a large amount of sunlight into a small area thus increasing the intensity of the energy collected. In wind terminology, a device or structure that increases the speed of the wind.

conservation: making the best use of natural resources by reducing waste, improving efficiency, and slowing the rate of consumption.

d

deciduous: describes trees and shrubbery that lose their leaves during the fall season of each year and produce new foliage in the spring.

direct solar gain: a type of passive solar heating system in which solar radiation passes through the south-facing living space before being stored in the thermal mass.

e

energy: the ability to do work or make things move; the application of a force through a distance. Energy exists in a variety of forms (electrical, kinetic or motion, gravitational, light, atomic, chemical, heat) and can be converted from one to another. Common units are calories, joules, Btu, and kilowatt-hours.

energy transition: a time in history when there is a significant change in the mix of energy resources on which people depend. An example is the transition in the U.S. from use of coal and wood primarily (as in 1900) to widespread use of gas and petroleum, in addition to coal, by 1950. Another example is the entry of nuclear power generation on the commercial scene and its increased contribution to total energy needs, up from 1% in 1973 to 4% in 1979. If the future brings greater reliance on renewable resources and less dependency on fossil fuels, OR if fission/fusion processes generate the major share of commercial electricity, either of these scenarios would be another "energy transition".

environment: the sum of all external conditions and influences affecting the life, development, and ultimately the survival of an organism.

evaporation: the change from liquid to gas which requires extraordinary absorption of heat by the material undergoing this phase change. Liquid water, for example, absorbs 540 extra calories per gram at 100° C as is vaporizes. This heat will be released again if the water vapor condenses.

f

flat plate collector: an enclosed, glazed panel containing a dark absorbing surface that converts sunlight to heat without the aid of a reflecting surface to concentrate the rays. The collector transfers its heat to a circulating fluid.

fossil fuels: coal, petroleum, and natural gas; this term applies to any fuels formed from the fossil remains of organic materials (plants and animals) that have been buried for millions of years. The ultimate source of energy for those plants and animals was the sun.

g

gasohol: a fuel mixture composed of 90% unleaded gasoline and 10% ethanol (ethyl or grain alcohol).

generator: a device that converts heat or mechanical energy into electrical energy.

geothermal energy: heat trapped in the interior of the earth is called geothermal energy. Boreholes into the crust show an average temperature increase of 1° C for every 30 meters of depth, or about 100° F per mile. Geothermal heat is believed to come from the decay of radioactive materials deep in the earth as well as from friction of rock movements, tidal forces, and perhaps other sources. This heat keeps great quantities of buried rock molten and hot. Some of this energy escapes at the surface as hot water. Geothermal energy is available in four forms: dry steam, wet steam, hot rocks, and hot water.

h

heat: energy that flows between a system and its surroundings because of a temperature difference between them. Heat results from the motion of molecules of matter. Also, the word heat is often used to refer to the energy contained in a sample of matter (for example, kilocalories per unit of food).

hydroelectric plant: an electric power plant in which the energy of falling water is converted into electrical energy by a turbine generator.

i

insolation: the energy received by earth from the sun, a contraction of the three words: incoming solar radiation. The total daily insolation is the equivalent of about 4.2 quadrillion kilowatt-hours. Local insolation depends on the position of the earth in its orbit, the thickness and transparency of the atmosphere, the inclination of the intercepting surface to the sun's rays, and the solar constant. Weather bureaus now keep insolation data or "sunshine statistics."

insulation: material with high resistance (R-value) to heat flow. Some commonly used materials for home insulation are fiberglass, cellulose, rock wool, and styrofoam.

m

methane gas: a colorless, flammable, gaseous hydrocarbon, emitted by marshes and by dumps undergoing decomposition; can also be manufactured from crude petroleum or other organic materials.

n

natural gas: a mixture of gaseous hydrocarbons occurring naturally in certain rocks. There are several kinds of gas trapped in porous rocks underground. One of these "natural gases" is methane, used as a commercial fuel. Petroleum deposits always include some methane, but natural gas deposits are not always accompanied by petroleum. Natural gas is commonly sold to individuals in hundreds of cubic feet (CCF), the unit appearing on household utility bills. One CCF of commercial methane has about 25,000 kilocalories, the equivalent of 8 pounds of coal or 0.7 gallons of crude oil. (See also: methane.)

nonrenewable resources: energy resources that are not being replaced during the time span of human history. Examples are coal, oil, natural gas, and uranium.

nuclear energy: energy from radioactive decay or from fission or fusion reactions. In a controlled situation it can be used to produce electricity.

nuclear reactor: a device in which a fission chain reaction can be initiated, maintained, and controlled.

o

ocean thermal energy conversion (OTEC): an energy technology in which the temperature difference (between cold deep water and the warm surface water 2,000 feet above it) in tropical oceans is used to generate electricity.

oil shale: a sedimentary rock containing solid organic matter (kerogen) that yields substantial amounts of oil when heated to high temperatures.

p

passive solar energy system: an assembly of natural and architectural components which converts solar energy into usable or storable thermal energy (heat) without mechanical power. Current passive solar energy systems often include fans, however.

peat: accumulated plant remains that decayed in a swamp, becoming a loosely packed mass of carbon-rich materials. It is usually brown, porous, and fibrous; has a high water content; and leaves much ash when burned. Nevertheless it is a valuable fuel. The U.S.S.R. has generated electricity from peat since 1914 and now has many peat-fueled power stations.

petrochemicals: chemicals removed from crude oil at the refinery and used to make a wide range of products such as plastics, synthetic fibers, detergents, and drugs.

petroleum: an oily, flammable liquid that may vary from almost colorless to black and that occurs in many places in the upper strata of the earth. It is a complex mixture of hydrocarbons and is the raw material for many products including gasoline, kerosene, lubricants, and waxes.

photosynthesis: green plants' process of using solar energy to convert simple molecules into complex ones with high potential energy. Carbon dioxide and water are combined, in the presence of sunlight and chlorophyll, into carbohydrates such as sugars, starches, oils, and cellulose.

photovoltaic cell: a device which converts solar energy directly into electricity. Sunlight striking certain materials (silicon is most common) causes the release of electrons. The migration of these released electrons produces an electrical current. The conversion process is called the photovoltaic effect.

power: the rate at which work is performed. It is measured as units of energy per unit of time, for example: calories per second, watts (joules per second), or horsepower (foot-pounds per second).

r

radiation: the method by which heat is transferred through open space. About 60% of the heat transferred to a room from a wood stove is by radiation. Sunlight travels to us by radiation through space at "the speed of light," 299,728 kilometers per second.

reclamation: the process of replacing the soil, clay, and rocks removed earlier to expose coal or oil shale for strip mining; compacting and contouring the site; and replanting it to restore its appearance and reduce erosion and drainage of waste materials.

renewable resources: materials that are recycled by natural processes within a relatively brief span of time (a human lifetime). Fresh water, wind, sunshine, and trees are some examples of resources that replace or recycle themselves within human time frames.

retrofit: to modify an existing building by adding a solar heating or cooling system or insulation to improve its energy efficiency.

R-value: the resistance to heat flow, reciprocal of U-value. The higher the R-value, the greater the insulating efficiency of the material. R-values are commonly stated per inch of building material. R-values are additive--thicker material or a combination of materials means increased resistance to heat flow. Some typical R-values per inch of material are 6.25 for polyurethane foam, 3.17 for fiberglass batts, 1.25 for fir and pine wood, 0.18 for plaster, and 0.08 for concrete.

S

solar access or solar rights: the right to receive direct sunlight without interference. The protection of solar access is a legal issue.

solar cell: see photovoltaic cell.

solar energy: the electromagnetic radiation emitted by the sun. The earth receives about $4,200 \times 10^{15}$ kilowatt-hours of solar radiation per day.

solar furnace: a device using mirror reflectors or lenses to produce very high temperatures at a focal point or "hot spot." Small backyard furnaces generate temperatures as high as 1,100 degrees Celsius; the largest solar furnace in the world reaches 3,100 degrees Celsius.

storage: the device or medium that absorbs collected heat and stores it for later use.

sunspace: a living space enclosed by glazing; a sunroom or greenhouse.

t

thermal storage: a system which uses brick, rocks, concrete, water walls, salt ponds, eutectic salts, or other materials to store heat energy. Thermal storage is especially desirable for solar-heated homes.

w

watt: a unit of measure for electrical power equal to the transfer of one joule of energy per second. The watt is the unit of power most often associated with electricity and is determined by multiplying required volts by required amperes. One horsepower = 746 watts.

WECS (wind energy conversion system): a system which converts mechanical energy from the wind to electricity, heat, or fuel which is used directly or stored.

windbreak: a dense row of trees, or a fence or other barrier that interrupts and changes the local path of the wind.

windmill: a machine run on energy generated by wind blowing against blades or slats.

wind turbine generator: see WECS.

Agreement on Guidelines for Classroom Copying

in Not-for-Profit Educational Institutions with Respect to Books and Periodicals

The purpose of the following guidelines is to state the minimum and not the maximum standards of educational fair use under Section 107 of H.R. 2223. The parties agree that the conditions determining the extent of permissible copying for educational purposes may change in the future; that certain types of copying permitted under these guidelines may not be permissible in the future; and conversely that in the future other types of copying not permitted under these guidelines may be permissible under revised guidelines.

Moreover, the following statement of guidelines is not intended to limit the types of copying permitted under the standards of fair use under judicial decision and which are stated in Section 107 of the Copyright Revision Bill. There may be instances in which copying which does not fall within the guidelines stated below may nonetheless be permitted under the criteria of fair use.

Guidelines

I. *Single Copying for Teachers*

A single copy may be made of any of the following by or for a teacher at his or her individual request for his or her scholarly research or use in teaching or preparation to teach a class:

A. A chapter from a book;
B. An article from a periodical or newspaper;
C. A short story, short essay or short poem, whether or not from a collective work;
D. A chart, graph, diagram, drawing, cartoon or picture from a book, periodical, or newspaper;

II. *Multiple Copies for Classroom Use*

Multiple copies (not to exceed in any event more than one copy per pupil in a course) may be made by or for the teacher giving the course for classroom use or discussion; *provided that:*

A. The copying meets the tests of brevity and spontaneity as defined below; *and,*
B. Meets the cumulative effect test as defined below; *and,*
C. Each copy includes a notice of copyright

Definitions

Brevity

(i) Poetry: (a) A complete poem if less than 250 words and if printed on not more than two pages or, (b) from a longer poem, an excerpt of not more than 250 words.

* *(ii)* Prose: (a) Either a complete article, story or essay of less than 2,500 words, or (b) an excerpt from any prose work of not more than 1,000 words or 10% of the work, whichever is less, but in any event a minimum of 500 words.

Each of the numerical limits stated in "i" and "ii" above may be expanded to permit the completion of an unfinished line of a poem or of an unfinished prose paragraph.

(iii) Illustration: One chart, graph, diagram, drawing, cartoon or picture per book or per periodical issue.

(iv) "Special" works: Certain works in poetry, prose or in "poetic prose" which often combine language with illustrations and which are intended sometimes for children and at other times for a more general audience fall short of 2,500 words in their entirety. Paragraph "ii" above notwithstanding such "special works" may not be reproduced in their entirety; however, an excerpt comprising not more than two of the published pages of such special work and containing not more than 10% of the words found in the text thereof, may be reproduced.

Spontaneity

(i) The copying is at the instance and inspiration of the individual teacher, and,

* *(ii)* The inspiration and decision to use the work and the moment of its use for maximum teaching effectiveness are so close in time that it would be unreasonable to expect a timely reply to a request for permission.

Cumulative Effect

* *(i)* The copying of the material is for only one course in the school in which the copies are made.

* *(ii)* Not more than one short poem, article, story, essay or two excerpts may be copied from the same author, nor more than three from the same collective work or periodical volume during one class term.

* *(iii)* There shall not be more than nine instances of such multiple copying for one course during one class term.

* The limitations stated in "ii" and "iii" above shall not apply to current news periodicals and newspapers and current news sections of other periodicals.

III. *Prohibitions as to I and II Above*

Notwithstanding any of the above, the following shall be prohibited:

* (A) Copying shall not be used to create or to replace or substitute for anthologies, compilations or collective works. Such replacement or substitution may occur whether copies of various works or excerpts therefrom are accumulated or reproduced and used separately.

* (B) There shall be no copying of or from works intended to be "consumable" in the course of study or of teaching. These include workbooks, exercises, standardized tests and test booklets and answer sheets and like consumable material.

(C) Copying shall not:

(a) substitute for the purchase of books, publishers' reprints or periodicals;

(b) be directed by higher authority;

(c) be repeated with respect to the same item by the same teacher from term to term.

(D) No charge shall be made to the student beyond the actual cost of the photocopying.

Metric Conversion Table

Unit of Measure	English Unit	→ Multiply By ← Divide By	Metric Unit	Symbol
Length	inches	2.54	centimeters	cm
	feet	30.0	centimeters	cm
	feet	0.3	meters	m
	yards	0.91	meters	m
	miles	1.61	kilometers	km
Area	square inches	6.5	square centimeters	cm^2
	square feet	0.09	square meters	m^2
	square yards	0.8	square meters	m^2
Mass (Weight)	ounces	28	grams	g
	pounds	0.45	kilograms	kg
Volume	gallons	3.8	liters	l
	cubic feet	0.03	cubic meters	m^3
Temperature	degrees Fahrenheit	→5/9 (after subtracting 32) ← 5/9 plus 32	degrees Celsius	^oC
Heat	Btu	252	calories	c
Speed	miles per hour	1.61	kilometers per hour	km/hr

Energy Units

barrel: a liquid volume equal to 42 gallons or 159 liters. One barrel of crude oil has about the same heat energy as 350 pounds of bituminous coal, 5.8×10^9 joules or 5.5×10^6 Btu or 1.39×10^6 kcal.

Btu: British thermal unit, a unit for measuring heat; a Btu is the quantity of heat necessary to raise the temperature of one pound of water one degree Fahrenheit, about one-fourth of a kilocalorie (252 calories).

calorie(also: gram calorie): a metric unit of heat energy; the amount of heat needed to raise the temperature of one gram of water one degree Celsius. It equals 0.0039 Btu. One thousand calories make one kilocalorie (kcal), sometimes called a Calorie or food Calorie.

kilowatt: a measure of power, usually electrical power or heat flow; equal to 1,000 watts or 3,413 Btu per hour.

kilowatt-hour: the amount of energy equivalent to one kilowatt of power being used for one hour; equals 3,413 Btu, or about 860 kcal.

watt: a unit of measure for electrical power equal to the transfer of one joule of energy per second. The watt is the unit of power most often associated with electricity and is determiend by multiplying required volts by required amperes. One horsepower = 746 watts.

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Association Films, Inc.
866 Third Avenue, New York, NY 10022
(Lends 16mm movies free of charge)

Your local gas or electric utility

Library Filmstrip Center
3033 Aloma, Wichita, KS 67211
(Color and sound filmstrips with cassettes on solar energy)

Modern Talking Picture Service
200 L Street NW, Washington, DC 20036; 16 Spear Street, San Francisco, CA 94105 (A selection of free films on energy-related topics produced by major industries)

New York State Alliance to Save Energy, Inc.
36 West 44th Street, Room 709, New York, NY 10036
Energy On Film (a convenient digest of over 160 energy-related films available from various sources)

Solar Energy Institute of America
P.O. Box 6068, Washington, DC 20005
(35mm slides on all aspects of solar energy @ $1.00 each)

Solar Lobby
1001 Connecticut Avenue, N.W., Suite 510, Washington, DC 20036
Solar Energy Education Bibliography (comprehensive energy A-V listing)

Your State Energy Office

3-M Company
Visual Products Division, 3-M Center, St. Paul, MN 55101
(Energy films)

Total Environmental Action
Church Hill, Harrisville, NH 03450
(Solar slides)

U.S. Department of Energy Film Library
P.O. Box 62, Oak Ridge, TN 37830
(Provides teachers with an annotated brochure on free energy films)

Zomeworks Corp.
Box 712, Albuquerque, NM 87103
(Solar slides)

Organizations and Agencies

American Forest Institute
1619 Massachusetts Avenue, N.W., Washington, DC 20036

American Section of the International Solar Energy Society
American Technological University, P.O. Box 1416, Killeen, TX 76541

Center for Renewable Resources
1001 Connecticut Avenue, NW, Suite 510, Washington, DC 20036

Citizens' Energy Project
1110 6th Street, N.W., #300, Washington, DC 20001

Consumer Action Now
355 Lexington Avenue, 16th Floor, New York, NY 10017

Your local Cooperative Extension Office

League of Women Voters of the United States
1730 M Street, N.W., Washington, DC 20036

The National Center for Appropriate Technology
Box 3838, Butte, MT 59701

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1412 16th Street, N.W., Washington, DC 20036

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36 West 44th Street, Room 709, New York, NY 10036

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Information Services, 1050 Mills Tower, San Francisco, CA 94104

Solar Lobby
1001 Connecticut Avenue, S.W., Suite 510, Washington, DC 20036

Your State Energy Office

Superintendent of Documents
U.S. Government Printing Office, Washington, DC 20402

U.S. Department of Energy
Technical Information Center, P.O. Box 62, Oak Ridge, TN 37830

VITA (Volunteers in Technical Assistance)
3706 Rhode Island Avenue, Mount Rainier, MD 20822

Worldwatch Institute
1776 Massachusetts Avenue, N.W., Washington, DC 20036