**"GO POWER" PROJECT
AUSTIN CHILDREN'S MUSEUM**

FINAL REPORT

**US DEPARTMENT OF ENERGY
OCTOBER, 1993**

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AUSTIN CHILDREN'S MUSEUM
Report on GO POWER Exhibit and Related Activities
October, 1993

Summary

Go Power, was conceived as an interactive exhibit and related set of activities designed to promote in children and families an understanding and appreciation of energy concepts. Planned in 1990, the project culminated its first phase of activities with colorful, interactive exhibit about the pathways and transformations of energy, on display at the Austin Children's Museum between February 5th and June 6th, 1993. The project was supported by the U.S. Department of Energy, the National Science Foundation, the Lower Colorado River Authority and various local foundations and businesses. The following report describes the process, product and outcomes of this project.

Goals:

The exhibit was designed to bridge the gap in young people's energy knowledge by offering children foundations on which to construct more accurate pictures of energy sources, people, pathways, and choices. Goals were:

1. To provide an opportunity to utilize methods of inquiry-based learning and scientific thinking;
2. To help visitors understand the sources of energy through playful and interactive comparisons with personal experiences;
3. To increase knowledge about energy by depicting the route of commercial energy from raw materials to consumption;
4. To increase interest in energy-related scientific fields;
5. To help visitors understand the impact of personal decisions about energy on the future of our planet.

Go Power was planned as a community based learning experience which welcomed students and families and provided easy to use opportunities to exercise and strengthen science thinking skills. For instance, visitors would engage in activities such as creating energy sources and safely manipulating transformers, bulbs, batteries and currents with child sized components. It was intended to create new science education and energy education resources and new linkages between community educators.

Results:

Activities:

Paul Orselli was hired to coordinate all activities of the project. He met with advisors and assembled a broader advisory group of artists, engineers, and educators. Orselli met with students in prek-middle school classrooms to gather information

about basic knowledge and interests regarding energy concepts. He worked with LCRA staff to detail a collaboration plan. LCRA engineers met with staff to discuss their ideas about exhibit content and design. A design team was developed whereby a number of LCRA personnel and independent local artist/engineers began to develop exhibit components. Orselli created a concept draft for critique and began prototyping exhibit components. Ideas were critiqued by advisors, by the Museum's Teen Advisory Committee, and by other staff. An independent team, headed by Museum educator Laura Mueller began to develop activities for a classroom kit based on exhibit content. With assistance from Southwest Educational Development Lab kit activities were developed, prototyped in area classrooms, evaluated and revised, to complete a final kit. Mueller also coordinated development of educator materials to assist teachers planning class visits to the *Go Power* exhibit.

The exhibit was installed in the Austin Children's Museum in January, 1993. During the four months that *Go Power* was on display, the Austin Children's Museum enjoyed its busiest season ever. Each month that the exhibit was open, record breaking crowds were attracted, making *Go Power* our most widely attended exhibit to date. School tours and general attendance for the months of February through May, 1993 was a record 28,040 people. Our Open Door Policy, Tour Scholarship program, and free passes admitted 4,700 of these visitors free of charge.

After the exhibit closed in late May, components were reworked for the traveling edition and all installation materials were developed. In September, 1993 the exhibit was crated and sent to its first traveling venue in Beckley, West Virginia.

Go Power is booked solidly to tour through January, 1996, visiting the Ann Arbor Hands-On Museum; The Youth Museum of Southern West Virginia; The Academy of Sciences in Chicago, IL; the Explorium in Mobile, AL; the Discovery Center in Rockford, IL; the Texarkana Museum; and the Children's Hands On Museum in Tuscaloosa, AL. It is estimated that the exhibit's national tour will be attended by another 200,000 people.

With no other exhibit has the Austin Children's Museum received so much press coverage. Articles about the exhibit appeared in the Austin American Statesman and in Continental Airlines on flight magazine Profiles. The Mayor of Austin, Bruce Todd, declared February 6, 1993 as **Go Power Day** and called on all citizens to join him in visiting and recognizing the importance of the *Go Power* Exhibit.

Exhibit Components:

Go Power contains several complex elements. A kinetic sculpture includes a photovoltaic panel with three motors, a gear assembly, a Mazda Wankel engine, and a turbine-blower assembly. Unique computer animation and other video materials were transferred to laser disc for use in several components. The exhibit contains a total of four laser disc players and controllers, one VCR, five monitors, and two

Amiga computer platforms. These mechanical and electronic pieces of equipment create interactive environments to expose children to energy topics and to provoke their curiosity. For example, the *Food As Fuel* component involves computer animation to demonstrate the concept that food provides energy (fuel) to the human body. Children pick a type of fuel (orange juice, peanut butter, or cereal), and a type of travel (walking, biking, or powering an auto), and then see on a video monitor the speed and duration of that particular "journey".

The *Go Power* classroom kit contains a Van de Graaf generator, hand held generators, solar cells, videos, and a teachers' handbook for classroom activities. Tested and approved in five Austin area classrooms, the kit joins our collection of seven other Curiosity Kits used by area schools.

Community Involvement:

Go Power was supported by the U.S. Department of Energy, the National Science Foundation, the Lower Colorado River Authority, the Lola Wright Foundation, Southern Union Gas, Southwestern Bell, Advanced Micro Devices, Sematech, the Union Pacific Foundation, Tracor, Radian Corporation, and IBM. Each of these organizations are recognized on the exhibit's entry panel and in the Museum's Newsletter The Magic Window.

Exhibit Developer Paul Orselli worked with many people in the community to develop and produce *Go Power*. Brian Brooker, Brent Ladd, and Dennis Fagan through the advertisement agency GSD & M, worked to produce a pro bono color poster to publicize the exhibit. Vance Sack of Capital Spectrum also assisted with this effort. We hope this poster will be the cornerstone of an ongoing partnership with GSD & M. Employees at LCRA helped in nearly every aspect of *Go Power*. Mike Walker and Walter Reid oversaw the company's efforts. Chris Clymer, Joe Irvin, Marc Koch, and Julian Orosco designed and produced printed materials, including a three color poster. Pat Fries and Richard Gaylord were responsible for video production. A team of seven, Robert Frithiof, J.J. Grigar, Ralph Williams, Jimmy Young, Ronnie Haffelder, Ronnie Wolf, and Terry Case assisted in the construction of the impressive kinetic sculpture. These collaborations provided a great sense of satisfaction and cooperation to everyone involved in the project.

Evaluation:

The evaluation regimen was both formative and summative. As the Exhibit Developer, Paul Orselli was responsible for both of these.

a. Extensive formative evaluation occurred in the year prior to *Go Power's* February 6, 1993 opening date. Orselli worked with evaluators from University of Texas at San Antonio (UTSA) and the Southwest Educational Development Laboratory (SEDL) as well as expert advisors during this phase of the project. The data and information collected focused on the input from preschool and elementary school

students from the Austin area. Five schools were used as data collection sites. The schools and teachers were selected to include a range of age levels, science skill levels, and socio-economic levels. Examples of the information "webs" collected during this process are attached.

Input from the students was collected and collated and the resulting data was used to determine the final message sets and component items for the GO POWER exhibit itself. This was invaluable to the creation of the final working copy of the exhibit.

b. Summative evaluation was planned to assess the impact and use patterns of the exhibit. A number of innovative plans were developed to capture information from teachers, families, and children.

1. Teacher Response Forms

Forms were presented to every teacher who brought a group to the Museum during the *Go Power* exhibit. The teachers were asked a series of questions about the Museum and the exhibit. They were then asked to rate various aspects of the Museum and exhibit, specifically: Content, Program, Staff, and Galleries. Of the small sample returned (15 completed forms) the overall response was very positive.

Teachers mentioned how *Go Power* applied to subjects being taught in their own classrooms. Some teachers also mentioned difficulties they had in receiving Teacher Guides and other pre-visit information. All teachers were happy with the staff, only half the teachers had used the educator's guides prior to their visit. Only one third of the teachers had visited the museum prior to bringing their classes. On a 3-point scale about appropriateness of the exhibit, the Museum received a 3 for all classes about grade 1, and an average of 2 for prek and kindergarten groups. The respondents were again divided into two groups (Kindergarten /Pre-K and Grade 1-4) for the purpose of analysing the data rating each of the four aspects mentioned above. Each aspect was rated on a grade letter scale. The table below shows the numerical results where A=4.0 and F=0.0.

**TEACHER RESPONSES BY GRADE LEVEL
(TABLE 1)**

<u>PRE-K and K (AVERAGE)</u>		<u>1ST - 4TH GRADE (AVERAGE)</u>	
Content	3.30	Content	3.98
Program	3.50	Program	4.00
Staff	3.75	Staff	4.00
Galleries	3.75	Galleries	3.75

2. Visitor Written Comments: Near the entrance of *Go Power*, visitors were invited to comment on the exhibit or make suggestions for improvements. Of the well over 200 legible responses, the vast majority were extremely positive. "Best exhibit ever", "I learned a lot", "I found out some new things about energy" were typical positive comments. The type of specific exhibit components repeatedly mentioned in a positive light were the computer-based components. There were 5 negative, or less than positive, comments. Of these, one comment related to the admission price, and one mentioned a particular component being too high for her 8 year old. The remaining three responses requested more one-on-one interaction with floor staff. A list of comments is attached.

3. Observational Studies. In cooperation with Professor Rich Diem from UT San Antonio an observation tool related to *Go Power* was developed. Approximately 30 hours of observation was performed in all areas of the exhibit during its final month in Austin. In general, the initial analysis of this observational data indicates a positive visitor response and a "user-friendly" exhibit. As shown below, of the six types of selected behaviors being recorded, well over half of the possible interactions were positive use of components. Well over a quarter of possible visitor interactions in any given time period was to return to *Go Power* after visiting other sections of the Museum.

**PERCENT OF POSSIBLE VISITOR RESPONSES
(TABLE 2)**

% RESPONSE (AVERAGE)	VISITOR BEHAVIOR
3	Ignored Exhibit
8	Read Exhibit Labels
35	Manipulated Components
5	Asked Staff Questions
23	Child and Adult Used Component
27	Visitor Returned to GO POWER

4. Drawing review. One activity in the exhibit invites visitors to "design the future at *GO POWER*" providing a context for visitors to think about energy efficient devices. Although many visitors took their drawings with them, a sampling of drawings is attached here to provide a sense of the concentration and issues visitors brought to the task. Visitors created designs of cars, planes, windmills, t-shirts, solar homes, solar hair driers, car maps, camping ovens, etc. A list of design topics is attached.

5. Cross-site evaluation

One of the exhibit components is designed to collect information from each traveling site, to allow us to analyse what visitors know/learn/ and attend to in the computer display. A baseline data set from the Austin part of the tour will be collected in the next few months to provide an opportunity to explore the analysis methods and get a sense of trends.

Conclusions:

The GO POWER exhibit met its goals and is about to embark on the next phase of its adventure: touring the United States. We appreciate the federal support provided to complete this project.

Attachments:

- 1 Component descriptions
- 2 Educator's guide
- 3 Kit guides
- 4 Evaluation materials:
 - formative "webs"
 - teacher feedback
 - family visitor comments
 - Design the future drawings: topic list and samples
- 5 Publicity materials
- 6 Traveling schedule 1993-1996

GO POWER

***Walk through by area**

- **Sources**

Children can convert "people power" into electrical, wind, or water power by cranking, twisting, or pulling the controls of a colorful kinetic sculpture at the entrance of GO POWER.

At the front starting left: the hand impressions activate the blower which spins the wind turbine which light up the LED lights; the pneumatic piston causes the oil well and other gadgets to respond; the hand crank gear mechanically turns the top of the sculpture; turn the Wankel engine; and finally, the second set of hands start the solar panels and the optical spinners.

The large power insulators support the title and credit panel.

Energy investigators journey inside a "simulated slice of earth" to find out what dinosaurs and coal have in common.

SOLAR SUNFLOWER

Most of the Earth's energy comes from the sun.

Some of the sun's light and heat helps plants to grow.

Cells inside green leaves can change light energy into chemical "food" for plants.

Carefully twist the leaves on our "sunflower" to collect light energy for the plant.

OIL PRESSURE

Many scientists believe that oil was formed from the remains of very old ocean plants called plankton.

The chemical energy that we can get from burning oil today is possible because of the light energy plankton took in from the sun millions of years ago!

Push down on the handle to "speed up time" and change the plankton to oil.

COAL PLANTS

Coal is made up of the decayed remains of plants that were trapped in wet soil.

Can you find tree rings, seed pods, and other plant cells inside these thin slices of coal?

People who study the earth often call coal "fossil sunshine", to remind us that the energy trapped in the plants that make up coal came from the sun.

GAS PIPES

Sometimes dead plants underground can form a natural gas called methane.

Even though natural gas has been found all over the world, there are often clues that show likely or unlikely places where gas may be.

Carefully push the "gas pipes" into the holes marked with clues. If a blue gas flame pops up, you've discovered a likely natural gas well.

•People

Children will feel as though they have entered the control room of a power plant and are ready to try on the jobs of "energy people", the workers involved in different aspects of the energy stream. Electronically "ask questions" of the energy people who actually design, build and repair the many parts of the energy pathways that we use everyday. Get a grip on some energy concepts by trying out actual "tools of the trade" used by energy people. Find out what's what with a kilowatt and how to rate a generator.

VIDEO (outside of the generator)

Meet the people who work in a power plant.

GENERATOR

Spinning a magnet near a coil of wire will produce or "generate" an electric current. Spin the magnet top and slide it into the center of the wire coil. What happens to the red and green lights on the side of the coil?

Power plant generators also use moving magnets inside of coils of wire. Usually water or steam is used to spin the magnets inside these huge generators.

VIDEO (inside of the generator)

Find out how a generator works.

TRANSFORMERS

The word transform means "change". Electrical transformers can change the force (voltage) and amount (current) of electricity moving through an electrical system.

Electrical transformers are usually made up of coils of wire.

Electricity moves from one coil to another, and the voltage and current coming out of the transformer changes.

One reason we use transformers is to change the higher voltages in power lines to the lower voltages that power lights and appliances in our homes.

Try using these transformers to make your own changes by connecting them to the electric power supply and the light-up meter.

• Pathways

Simulated power lines lead into the Pathways section of GO POWER. Become an energy investigator and follow the paths of electricity, natural gas, and alternative energy sources through the walls, floors and appliances of the simulated kitchen. Discover that meters measure dollars as well as power and that food energy in kitchen cupboards can serve as fuel for cars and appliances as well as the human body.

ELECTRIC METER

Electric meters measure how much electricity is being used inside of a house or building. Since we pay electricity bills, electric meters also measure money. This electric meter is connected to two lights and switches. Every time the silver and black wheel moves, both electricity and money are being measured. Why do you think people ask you to turn off a light if you are not using it?

GAS METER

Meters, like gas meters, often measure things we normally can't see or touch. Look carefully at this see-through model of a gas meter. Small containers inside the meter fill with gas and make the numbers on the front of the meter move. These numbers show how much gas was used inside of the building the meter is connected to.

VIDEO: FOOD AS FUEL

GIANT CIRCUIT [BATTERY, SWITCH, METER, L.E.D.]

Battery: source of energy

Switch: mechanism that controls the flow of electrons or current

Meter: measures the use of current (electrons)

L.E.D.: receiver of electrons

Pretend you have become very small and very fast. So small that you can fit inside an electrical wire. So fast you can move more quickly than a racing car or a rocket ship. You have become an electron!

When electrons move through a circle or "circuit" of wire, we call that electricity.

Now start at the battery, try on an "ELECTRON" tag, and take a walk around our giant circuit.

VIDEO: SOLVE ENERGY CHOICES

• Choices

Leaving the kitchen, via a larger than life electrical circuit and meter, brings you into the choices section of the exhibit. Working within the setting of an energy research and development laboratory, uncover the many choices available in the production and utilization of energy. Try a computer simulation to find out what might happen if, for example, you caused all electrical production plants to run on solar power instead of fossil fuels. Try your hand at assembling new energy products at the Tinker's Workbench or change your bright ideas into design plans inside the Information Station.

TINKER' S WORKBENCH

Use the hand generators and other energy sources to power buzzers, bulbs and propellers.

DESIGN TABLE

Design the future of Go Power.

INFORMATION STATION

Resource books and Videos are housed within the futuristic structure of Kevlar plastic (the same material they use to make Stealth Bombers).

Be sure to ask "open-ended" questions of the tour visitors. "What would happen if..." "Why does..." "What do you think..." "Where does..." "When you do this, what..." It's OK not to know all the answers. Discovery is half the fun.

GO POWER FLOOR PLAN EXAMPLE

- A. KINETIC SCULPTURE
- B. SLICE OF EARTH "ARCHWAY"
- C. STRATA SECTION: COAL, OIL, GAS
- D. "ENERGY PEOPLE" MEDIA UNIT
- E. GENERATOR MOCK-UP
- F. HOUSE BACKDROP: FOOD AS FUEL, METERS
- G. GIANT ELECTRICAL CIRCUIT
- H. "CHOICES" MEDIA UNIT
- I. "FUTURE ENERGY" TABLE
- J. INFORMATION STATION

NOTE: 1/8 inch = 1 foot scale

(Final version 8/92)

GO POWER INVENTORY

(BY AREA)

SOURCES:

Kinetic Sculpture:

- 1 base with hand piece- 104" X 34" X 40" (approximate)
- 1 base with hand piece - 84" X 44" X 40 " (approximate)
- 1 base with crank component - 60" X 50" X 50" (approximate)
- 1 bell (top)
- 1 floor jack

- 1 Rock arch

Title Panel:

- 1 title panel - 60" X 31"
- large base with 2 insulators - 56" X 37" X 27"
- 1 brace

Sun, Oil Coal, Natural Gas Component:

- 1 floor base - 97" X 38" X 6"
- 1 wall
- 1 solar sunflower - 50" X 26" X 12"
- 1 yellow clip light w/ adapter
- 1 strata table top - 48" X 49" X 6"
- 4 table legs
- 1 oil drum with light box 48" X 26" diameter
- 4 coal samples in boxes secured to table
- 5 "sliced" coal sections between plex
- 3 gas pipes (with flames)

PEOPLE:

Generator Kiosk:

- generator kiosk 73" X 48" X 43"
- 2 generator walls -75" X 74" X 6"
- 2 generator "wings" - 72" X 12" X 1"
- 1 LCRA generator sign - 44" X 15" X 1"
- 2 tables (labeled A and B)
- 2 TV monitors

- 1 Sony VCR with VHS tape (generator)
- 1 Laser disk player with 1 laser disk (energy people)
- 1 Laser disk controller
- 1 large smiling face transformer
- 3 small smiling face transformers
- 1 spinning magnet component

- 1 large insulator with base
- 1 pair of electrical gloves (attached)

PATHWAYS:

House:

- 1 base 97" X 38" X 6"
- 1 wall 77" X 84" X 6"
- 1 fence 34" X 25" X 1"
- 1 "electric" pole
- 1 transformer (actual size)
- 1 food as fuel upper cabinet
- 1 food as fuel lower cabinet 29" X 44" X 24"
- 1 TV monitor
- 1 laser disk player with laser disk
- 1 light meter
- 1 gas meter with pipe braces

Giant Circuit:

- Giant Battery
- Giant Switch
- Meter
- L.E.D.
- 7 electron tags

CHOICES:

Choices video:

- TV Monitor
- 1 Laser disk player with laser disk
- 1 Amiga 2000 computer
- 1 video cabinet 54" X 34" X 34"

Tinker Workbench:

- 1 table "B" 31" X 84" X 25.5"
- 3 wood blocks with light bulbs
- 2 wood blocks with fans
- 2 wood blocks with buzzers
- 7 hand generators
- 1 power supply
- 1 toolbox containing:
 - Wire cutters
 - straight screwdriver
 - phillips screwdriver
 - pliers
 - extra ring tongues
 - solderless banana plugs (red and black)- male
 - solderless banana plugs (yellow)-female
 - 10 gauge wire
 - screws with nuts
 - spare connectors
 - brass screws
 - spare leads
 - propellers
 - buzzers

Design Table:

- 1 table "A" 31" X 84" X 25.5"
- Red laminated backboard
- 1 master copy of "I helped design the future at GO POWER"
- 2 pencil holders (considered a consumable)
- 2 acrylic paper trays (considered a consumable)
- misc. design stencils and rulers (considered a consumable)

Information Station:

- 2 video kiosks 48"X 25" X 25"
- 2 TV monitors
- 2 Amiga 2000 computers
- 1 laser disk player
- 1 line stabilizer
- 1 keyboard
- 1 mouse
- 4 "wings"
- 1 tabletop - approximately 60" diameter

- 1 small tabletop insert
- 1 black tube fitting
- 2 acrylic bookshelves 22" X 14" X 7"

MISC:

- 1 toolbox containing:
 - 1 8" Stanley adjustable wrench
 - 2 15/16 Husky wrenches
 - 1 pair red-handled pliers
 - 1 Phillips screwdriver
 - 2 adjustable socket wrenches
- 1 extra cool white fluorescent light (oil squish)
- 1 extra black light lamp (tinker table)
- 1 extra red siren
- 6 ton #5443 vehicle stand (to assist with kinetic sculpture set-up)
- 2 4-wheelers
- 1 installation and use manual
- 4 heavy laminated energy posters 24" X 36" (consumable)
- 8 energy books: (consumable)

Energy for Planet Earth, Readings from Scientific America Magazine, 1991, W.H. Freeman and Comp.

Facts on Future Energy Possibilities, Hugh Johnstone, 1990 Franklin Watts

Energy Projects for Young Scientists, Robert Gardner, 1987, Franklin Watts

The Story of Electricity, George deLucenay Leon, Dover Publication, Inc.

Facts on Water, Wind and Solar Power, Guy Arnold, 1990, Franklin Watts

Getting Started in Electronics, Forrest M. Mims, III.

Electricity, Eyewitness Science, 1992, Dorling Kindersley, Inc.

Force and Motion, Eyewitness Science, 1992, Dorling Kindersley, Inc.

SOS Planet Earth Power Failure, Mary O Neill, Troll Associates

Facts on Fossil Fuels, Clint Twist, 1990, Franklin Watts

THE AUSTIN CHILDREN'S MUSEUM
presents

**An Interactive Exhibit about Energy Pathways
and
Transformations**

**An Educator's Guide:
Pre-Kindergarten through Sixth Grade**

1501 W Fifth Street
Austin, Tx 78703
(512) 472-2499

Go Power

An Introduction

GO POWER is an interactive exhibit about energy pathways and transformations developed by the Austin Children's Museum under a grant from the U.S. Department of Energy.

The components present a logical progression of activities and concepts from basic sources of energy (SOURCES), to a major site of energy conversion (the Power Plant setting of PEOPLE), to the household consumer (PATHWAYS), and finally to a place where research and development of future energy sources occurs (CHOICES). This "Pathway" mirrors the path energy follows in the "real world" and GO POWER aims to express this to the visitor.

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Museum Mission and Educational Philosophy:

The mission of the Austin Children's Museum is to provide innovative museum exhibits, programs and resources which encourage curiosity, creativity, appreciation of the world around, and learning for all children, their families, and those who work with children.

The Museum accomplishes this through the use of multidisciplinary approaches, emphasizing personal involvement, focusing on themes of *how different people live, the human experience, and everyday science and technology*, designed to motivate participants to develop skills and attitudes to meet challenges of a dynamic and diverse world.

Preparing For A Successful Museum Tour

Use of the Educators Guide:

This guide has been developed to enhance the educational value and enjoyment of a school group's visit to the **GO POWER** exhibit and to assist the teacher in preparing students for the Museum tour. The guide provides questions, ideas, information, activities and resources that correlate **GO POWER** with the essential elements required for each grade level. The pre-activity suggestions are designed to prepare students for the exhibit and to maximize their ability to participate in the exhibit activities and more fully understand the tour information. The post-activities provide follow-up activities which enable students to integrate their Museum experience with the classroom curriculum. Many of the activities in this Guide were adapted from activities produced by the National Energy Foundation.

Teacher's Pre-Visit Pass:

Teachers are encouraged to take advantage of the **PRE-VISIT PASS**. With the complimentary pass, teachers may visit the Museum before they bring their classes. A pre-visit allows teachers time to familiarize themselves with the exhibit content, try out the activities and read the background information presented in the wall graphics and labels.

Correlation with Essential Elements:

The content and activities in **GO POWER** address classroom curricula associated with the following Essential Elements as outlined by the Texas Education Agency for Kindergarten through sixth grade:

- **Science**

1. Manipulative lab skills (K-6th)
2. The use of skills in acquiring data through the senses. (K-6th)
3. Experience in oral and written communication of data. (K-6th)
4. The use of skills in drawing logical inferences, predicting outcomes and forming generalized statements. (4th-6th)
5. Experience in skills relating objects and events to other objects and events. (4th-6th)

- **Health**

1. Recognizing and avoiding hazards in the environment. (K-6th)

Overview of Museum Exhibits

Go Power Exhibit:

- **Sources**

Children can convert "people power" into electrical, wind, or water power by cranking, twisting, or pulling the controls of a colorful kinetic sculpture at the entrance of GO POWER. Energy investigators will journey inside a "simulated slice of earth" to find out what dinosaurs and coal have in common and how satellites in space can help find oil underground.

- **People**

Children will feel as though they have entered the control room of a power plant and are ready to try on the jobs of "energy people", the workers involved in different aspects of the energy stream. Electronically "ask questions" of the energy people who actually design, build and repair the many parts of the energy pathways that we use everyday. Get a grip on some energy concepts by trying out actual "tools of the trade" used by energy people. Find out what's what with a kilowatt and how to rate a generator.

- **Pathways**

Simulated power lines lead into the Pathways section of GO POWER. Become an energy investigator and follow the paths of electricity, natural gas, and alternative energy sources through the walls, floors and appliances of the simulated kitchen. Discover that meters measure dollars as well as power and that food energy in kitchen cupboards can serve as fuel for lights and appliances as well as the human body.

- **Choices**

Leaving the kitchen, via a larger than life electrical circuit and meter, brings you into the choices section of the exhibit. Working within the setting of an energy research and development laboratory, uncover the many choices available in the production and utilization of energy. Try a computer simulation to find out what might happen if, for example, you caused all electrical production plants to run on solar power instead of fossil fuels. Try your hand at assembling new energy products at the Tinker's Workbench or change your bright ideas into design plans inside the Information Station.

Other Museum Exhibits:

- **HealthLab**

The HealthLab gallery presents information related to human biology and health. Meet STUFFEE- a seven foot doll that has blue hair and is filled with colorful reproductions of the lungs, heart, stomach, and other organs that teach children how our bodies work.

- **Creation Station**

We provide glue, tape, scissors, crayons, and recycled materials. Children use their imagination to create and invent.

- **Whole Foods Market**

This gallery is a miniature market complete with cash register, assorted grocery items and aprons with job descriptions. Children can pretend to be a manager, bagger, shopper, cashier or stocker.

Pre-Visit Activity Ideas

To the Teacher: These activities are designed to prepare students for the GO POWER exhibit and to maximize their ability to participate in the exhibit activities.

- **Watts Happening:** What happens when you turn on the light switch? Electricity is always on the move but from where? Trace electricity from the lights in your classroom back to the source. It ends at the light, comes through the switch . . . and where from there? You might want to ask the school custodian to help trace it through the school. Find a way to share your discoveries with the class. You may want to take a fieldtrip to the place where it all begins.

At the Museum: Take your class to the simulated kitchen. Turn on a light or an appliance. Next, have the children trace the pathway of electricity back to its original source. Walk your students through the Museum as you trace the path of electricity through the house, wires, electric meter, transformers and finally to the power plant. Have your children discover how electricity is produced by exploring the power plant. Next, follow the pathway of energy to its source along the simulated pipeline. What sources can be changed to generate electricity? Where do these sources come from? What is the ultimate source of energy?

- **Energy Source Who Am I?:** Make energy source cards by writing sources of energy and their meanings on 3"x 5" cards. For younger children you may want to use pictures or choose the sources you know your children will be able to identify. You can duplicate each source of energy to have enough for a class of 32. You may wish to preview the list of sources and discuss with students before beginning the activity or you may wish to add or delete words depending on your class.

wind	coal	electricity	natural gas	nuclear	geothermal
food	chemical	mechanical	solar	hydroelectric	wood

Explain the rules of the activity: Children may ask only three questions per person. The questions can be answered only **yes** or **no**. Next, place the cards on the backs of all the children with tape or pins. Allow them to ask their questions to each other. If anyone identifies their energy source, they can continue to answer questions until all the children have guessed their energy source. For younger children instead of giving each child a source card, select one child and place a source card on his/her back. Have the other children give clues until the energy source is identified. After 20 minutes, stop the activity and have the students place their card on their chest. Then have them group themselves according to a similar energy source. Have each group explain how they have grouped themselves. Finalize the activity by going over each energy source with the children.

- **Name an Energy Source:** Have the children use their name - first, last or both - to make a list of energy users that begin with the letters in their name. Example: Television Oven Motorcycle

- **Make An Energy Calendar:** Develop a classroom energy calendar for each day of the month or for one day a week. Have all the children in the class input their ideas. Ideas could include:

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Count the number of lights on in your house when you go to bed.	Brush your teeth using only 1/2 cup of water.	Count the number of hours your TV was on in your home.	How many times did you take a trip in a car? How could you reduce?	Take a quick shower rather than a bath.

- **Energy Users:** Have the children think about the rooms in their house: the kitchen, the bedroom, the bathroom, the living room. Next, have them divide a piece of paper into four sections and list the things in each room that use energy. For younger children have them draw pictures or cut out magazine pictures of energy users in their home. Which room has the most energy users? Which room has the least amount of energy users? Classify the energy users according to the source of energy they use or what the energy users do (i.e., heat, provide light, etc.). How can we reduce the number of energy users in our homes?

- **High and Low Voltage Demonstration:** Fill a plastic dish detergent bottle with water to demonstrate high and low voltage of electricity. A soft squeeze is equivalent to low voltage which travels short distance. A hard squeeze is equivalent to higher voltage which travels a longer distance.

At the Museum: Take your children to the GO POWER exhibit power plant. Discuss how voltage is the "pressure" that pushes electricity through the wires. Remind them of the high and low voltage demonstration. Next, show them the transformer on the pole and the transformer in the power plant. Ask them if they have ever seen a transformer in their neighborhood. Explain that a transformer lowers and raises the voltage of electricity. Why do we need to raise and lower the voltage of electricity?

- **Concentration:** Make game cards for words children may encounter in the exhibit (See vocabulary list). Write the word on one card and a picture or definition on the other card depending on the age of the group. To play, mix up cards and place them face down on the table. Take turns choosing two cards to try to make a match (word to meaning match). The person with the most cards after all of the matches have been made wins. Until meanings are somewhat firmed, the game can be played with the cards face up.

- **The Sun's Energy:** Have a discussion with the students about the sources of energy that get their energy directly or indirectly from the sun. You might include some examples: coal, oil, natural gas, water power, wind energy, gasoline and wood. Explain that fossil fuels (coal, oil and natural gas) come from animals and plants that have been buried underground for millions of years. The weight from the ground created pressure and heat which changed the animals and plants into fossil fuels. Help the students trace the energy sources back to the sun. Afterwards, have the students create suns that are stuffed with paper. To make the suns give each student a piece of butcher paper or newsprint. Instruct the students to fold the paper in half and to paint a or draw a large sun on either side of the fold. Encourage creativity! On the rays of the sun have the students print or draw the ways we get energy from the sun. Staple the sun together across the side and top and stuff with old newspaper. Complete stapling and decorate the room with the suns by hanging them from the ceiling.

- **Meter Man:** Teach your children how to read an electric meter. At the top of an electric meter you will find four dials that record the number of kilowatt hours. The dials look like watch faces lined in a row (every other dial moves counter-clockwise). The reading for this meter would be 6064.

Notice that when the pointer is between two numbers, you should record the lower of the two numbers. When the pointer seems to be directly on a number, look at the dial on the right; if the pointer on that dial has passed "0", then write down the number the pointer seems to be on; if that pointer has not passed "0", then write down the previous (lower) number on the dial. Have the children read their electric meter everyday for a week to determine their weekly electric use. After the children have read their electric meter for a week, have them try to conserve electricity for a week by limiting the number of electrical appliances they use. Have them compare their results.

At the Museum: Have the children find the electric meter. When they have found the meter, see if they can read the meter. Observe the disc-shaped wheel, lying flat and going around. How fast does it move? Switch the lights on and off and observe how the dial changes.

Post-Visit Activity Ideas

To the Teacher: These activity ideas are designed to help the students integrate their Museum experience with the classroom curriculum.

- **Create Your Own Electric Lemon:** You can really make a tiny electric cell or battery from a lemon. It is not powerful electricity but it still can create enough electricity that you can detect. The lemon works like an electric battery in that an electric battery needs two kinds of metal plus an acid. A car battery has sulfuric acid. A lemon has just a bit of citric acid. To make an electric lemon you are going to need two metals, the bit of steel in a paper clip and the copper in a piece of copper wire. Here's what you do. Straighten out one end of a paper clip and insert it into the lemon. Remove any insulation from the ends of the copper wire and insert one end into the lemon. Next, hold the ends of the paper clip and the wire. Touch your tongue to both of them at once. You should feel a tingling sensation on your tongue. That is caused by the electricity from your lemon. Your tongue acted almost like the switch that turns on a light. You completed an electric circuit between the two metals and the acid in the lemon, and that turned on a bit of electricity. Water conducts electricity and so does a damp tongue.

- **The Journey of Oil:** Have the children draw an illustrated time line of what they think happens to crude oil between the time it is in the ground and the time it is put in a car's gasoline tank. Follow up by going to the library to do research. Have them list or put in the items they forgot to include.

- **Circuit Construction:** Ask the children how many had an opportunity to walk through the giant circuit? Who can remember how to complete a circuit? Remind the students that a circuit is the complete path travelled by an electric current. Using the following equipment, a battery, bulb, and a wire, have the students determine which items listed below will close the circuit and make the bulb light and which ones would not. Have them test their predictions by placing the item between the bulb and the battery to complete the circuit.

wood pencil
plastic spoon
metal spoon
crayon

the leg of a chair
notebook
chalk
pin

tack
chair seat
your finger
paper clip

- **Alternative Energy Sources:** Have your students design a house that does not use gas or electricity. Have them use the alternative energy sources they discovered in the CHOICES section of the exhibit. Be sure to have them illustrate or tell how they would heat and light the house or anything else they want to do with it. Have them design an advertising brochure that will sell it to the public.

- **Create an Energy Haiku:** Have each of the children choose one energy concept from the Museum exhibit. Next, have them write an energy Haiku. Remember the 5-7-5 pattern. Example:

OIL

*Deep within the earth.
How much longer do we have?
Black, slimy and wet.*

- **A Car for the Future:** Have your students design a car of the future. Have them use the information they learned in the CHOICES section of the exhibit to aid them in their design. Have them make sure it gets good car mileage (if it uses gas). What energy source will provide the energy for this car? Why should we purchase this creation? Have the students make a commercial and then try to sell their car.

• **Transform Electric Energy Into Magnetic Energy:** Electric motors actually run on magnetic energy, as well as electricity. Here is how it works. An electric battery changes chemical energy into electrical energy. In turn, that electrical energy can make another change. It can produce a magnetic field. A coil of copper wire connected to battery terminals creates a magnetic field inside the coil. And it makes a magnet out of an iron nail. Have students create their own iron-nail magnet. Find some copper wire and a long iron nail for each student or group of students. Have them wind the copper wire tightly around the nail. Leave about a 4-inch piece of wire at each end. If the wire is insulated, remove the insulation from each end. Make loops of the wire, and fit one loop over each terminal of the 9-volt battery. Hold a paper clip or another metal object near the end of the nail. You will feel the magnetic attraction.

• **Solar Celebration:** Review with your students that solar energy is a form of energy that is produced by the sun. Prepare a solar celebration with your students. Have them develop and perform a solar dance, research Native American stories of the sun, and make food for the celebration by preparing their own solar recipes. Have them explain how they prepared the food using the sun's energy. You may want to share the following recipes with your students to get them started.

Solar Tea: Fill a jar with cold water. Put two tea bags in the water and screw the top on the jar. Place the jar in a sunny spot for about three hours. When the tea looks dark enough, take out the tea bags and serve over ice with lemon and sugar or honey.

Hot Citrus Cups: Cut a firm grapefruit and an orange in half. Cut the fruit sections out of both and mix them in a bowl with 1 tablespoon of honey. Put half of the fruit in each grapefruit cup and drizzle a little more honey over each cup. Cut a thin circle and six slivers from the orange rind to decorate the top of each cup with a sun. Cover with plastic wrap and leave in the sun to cook.

• **Conductor Deduction:** Read the students the following scenario: It was just before closing time when three men burst into the local NationsBank wearing ski masks and carrying guns. Within minutes, they had collected the bank's cash. Next, they ushered Joyce Franklin, the bank manager, Larry Washington, the bank teller and an elderly couple, the bank's last remaining customers, into the vault. One of the robbers then flipped open the panel door of the emergency circuit—the one that was designed to let someone locked inside the vault open the vault door—and yanked out a foot-long piece of wire, breaking the circuit. Then he closed the door. In the silence that followed, the frightened group stood trembling, staring at each other. Finally, Larry Washington quivered, "We are trapped". "How long before...we run out of air?" the elderly woman asked, holding onto her husband with desperation. "Perhaps we won't need to wait to be rescued." Ms. Franklin smiled. "Perhaps there is something we could use in place of the wire so we can activate the emergency circuit." Here is a list of items the group was able to collect among themselves.

purse	tie	handkerchief	pencil
wallet	earrings	box of steel paper clips	key ring
nail file	calculator	clipboard	scarf

Give your students the list of items collected. Have the students observe the list and discuss which item(s) could be used as a conductor to span the twelve-inch gap and complete the broken circuit? Test your idea by using the circuit tester made in the activity "Circuit Construction."

• Let's Sing About Energy •

I Am Trying

Tune – "Are You Sleeping?"

I am trying, I am trying
Not to waste, not to waste
En-er-gy, en-er-gy,
I can save, you can too.

Fix the faucet, turn off li-ghts
Close the door, close the door
Insulate and weather-strip,
insulate and weather-strip
Help us save, we need you.

Take them ou-t, use them u-p
Waste them too, waste them too
Will our children thank us,
when they're all depleted
Fossil fuels, we'll save you.

Bulbs, Bulbs on the Brain

Tune – "Home On the Range"

Oh, give me a light with a bulb burning bright,
With a wire, a battery and switch.
Then I'll have a good light if the contacts are
tight
And I'll learn as I sing and I play.

Refrain:

Bulbs, bulbs on the brain,
Now I see how a circuit is made -
Where electrons do flow through the
wires, I know,
To the bulb where the contacts displayed!

Electricity, true, can do such things for you
Keep you warm, keep you cool, help you work.
But don't crowd up your plugs or put
wires under rugs
Think of safety or you'll be a jerk!

Refrain:

Bulbs, bulbs on the brain,
And I know that I better beware
"Cause a big overload causes wires to explode!
In a smoke-puff or even a flame!

Save, Save, Energy

Tune – "Row, Row, Row Your Boat"

Save, save, en-er-gy
Every chance you get.
Energy, energy, energy, energy
Will our needs be met?

Homes, schools factories,
Does it matter whose?
Should not use our fossil fuels
Unwisely or we'll lose.

Oil, coal, natural gas
Precious fossil fuels.
Energy, energy, energy, energy
What are we going to use?

Question, think, participate
Your future's in this too.
Energy, energy, energy, energy
What are you going to do?

Happy Circuits to You

Tune – "Happy Birthday to You"

Happy circuits to you,
Whether old ones or new,
Check the wires for fraying,
Happy circuits to you.

Plug in, Plug in, you may be in
"Series" like Christmas lights!
Plug in, to "parallel", may all of your
Bulbs stay so bright.

Oh Electricity

Tune – "My Country 'Tis of Thee"

Oh, electricity, how you are helping me!
Of thee I sing.
You make the day so bright and even
Light the night
A hundred things you do so right -
You're a wondrous thing!

• Vocabulary •

AMPERE: a unit of measure of electric current. One ampere equals 6.2×10^{18} electrons passing a point in one second.

BATTERY: a device which stores energy by converting chemical energy into electrical energy.

CALORIE: a unit of heat energy equal to the amount of heat that will raise the temperature of one gram of water one degree Celsius. One calorie equals 4.18 joules.

CIRCUIT: the complete path travelled by an electric current.

COAL: a solid substance that burns and gives off heat. Coal was formed long ago from partly decayed vegetable matter under great pressure from the earth.

CONDUCTOR: a material through which electricity flows easily.

DISTRIBUTION: the term used by utilities to denote lower voltage electricity used in neighborhoods once it has left a substation.

ELECTRIC METER: a device that measures and records the amount of electricity used.

ELECTRICITY: energy produced by the flow of electrons through a conductor, such as copper wire, which can be transformed into other forms of energy, including light, heat, sound and mechanical.

FOSSIL FUELS: coal, oil, and natural gas.

GENERATOR: a machine that produces electricity by spinning a coil of wire in the presence of a magnetic field.

GEOTHERMAL: energy produced by heat from deep inside the earth.

HYDROELECTRIC: electricity produced by falling water spinning a turbine-generator.

INSULATOR: a material that will not allow electricity to flow through easily.

KILOWATT-HOUR (kWh): the amount of work delivered during the steady consumption of one kilowatt of power for a period of an hour.

KINETIC ENERGY: energy in motion.

NATURAL GAS: gas formed underground by the decomposition of prehistoric microscopic plants and animals.

NUCLEAR POWER: electricity produced by using the heat given off when atoms split.

OIL (petroleum): a liquid formed underground by the decomposition of prehistoric microscopic plants and animals.

SOLAR ENERGY: radiation energy from the sun falling upon the earth's surface.

SUBSTATION: a location where transmission voltage is reduced to distribution voltage.

TRANSFORMER: an electromagnetic device that raises and lowers the voltage of electricity.

TRANSMISSION: a term used by the utilities to denote high voltage electricity sent over long distances.

TURBINE: a device that spins when wind, water, or steam hit its blades.

VOLTAGE: the "pressure" that pushes electricity through a wire.

WATT: a metric unit of power, usually used in electric measurements, which gives the rate at which work is done or energy expended.

• Local Energy Resources •

City of Austin Electric Department
Town Lake Center
721 Barton Springs Rd
Austin, Tx 78704-1194
Contact: Elaine Hermann
322-6120

• **Energy Kits:**

The Louie Safety Kit (K-2)
 The Louie Safety Kit (3-4)

• **Films:**

"The Electric Story: Coal" (Junior, Senior)
 "Coal: Bridge to the Future" (Senior High)
 "Zap Rap" (Junior High)
 "Learning About Solar Energy" (Elem.)
 "Louie the Lightning Bug and Electrical Safety" (all)

• **Booklets:**

About Energy: A Coloring & Activity Book
 Let's Learn About Electricity
 The Adventures of Aunt Energina and Her Energy Agents
 ABCD Electricity: Electrical Safety (braile)
 Louie the Lightning Bug Activity and Coloring Book

Lower Colorado River Authority (LCRA)

• **Teacher Training**

Workshop and Conference Information
 (800) 776-5272 ext. 4089

• **Field Trips:**

- Buchanan Dam
- Mansfield Dam
- Tom Miller Dam

Contact: Sylvia Womble Saenz
 (512) 473-3315 (Austin)
 1 (800) 776-5272 ext. 3315

• **Wirtz Dam**

Contact: Kay Rogers
 (512) 693-2132 (M. Falls)
 (512) 473-3270 (Austin)
 1 (800) 776-5272 ext. 3270

• **Ferguson Plant: Gas-fired power plant**

Contact: Norman Jones
 (512) 598-2525 (Marble Falls)
 (512) 473-3274 (Austin)
 1 (800) 776-5272 ext. 3274

• **Fayette Power Project: Coal-fired plant**

Contact: Becky von Minden
 (409) 968-6071 (LaGrange)
 (512) 473-3389 (Austin)
 1 (800) 776-5272 ext. 8706

AISD Science Resource Center
305 N Bluff Drive
Austin, Tx 78745
447-6474

• **Energy Kits:**

Offalot (K)
 Brightland(1-2nd)
 Fossil Fuel Junction (3-4th)
 Power Switch (5-6th)
 A Long, Long Time Ago (5th)
 Mining and My Environment (5th)

• **Filmstrips:**

"Harnessing the Sun" (all grades)
 "Energy From the Sun" (all grades)
 "This World of Energy" (all grades)

• **Video:**

"Currents of Power" (upper elementary)

Austin Children's Museum
1501 W Fifth Street
Austin, Tx 78703
472-2499 for reservations

• **Energy Kit:**

Taking Charge: An Educational Kit
 about Electricity (Elementary)

• **Teacher Resource Books**

Bibliography

Educator Resources:

The following materials are available through the **National Energy Foundation**, 5160 Wiley Post Way, Suite 200, Salt Lake City, Utah, 84116 (801) 539-1406

Energy Glossary and Games
Energy Projects for Young Scientists
Teach with Energy
Top Hit Energy Lesson Plans
Quick Energy for Elementary Teachers

Information About Energy and Electricity:

Ardey, Neil. *The Science Book of Electricity*, Gulliver Books, San Diego, 1991.
Ardey, Neil. *The Science Book of Energy*, Gulliver Books, San Diego, 1991.
Baines, Rae. *Discovering Electricity*, Troll Associates, New Jersey, 1982.
DeLucenary, George. *The Story of Electricity*, Dover Publications, New York, 1983.
Markle, Sandra. *Power Up: Experiments, Puzzles and Games Exploring Electricity*, Macmillan Publishing Co., New York, 1989.
Math, Irwin. *Wires and Watts: Understanding Electricity*, Aladin Books, Macmillan Publishing Co., New York, 1981.
Wood, Robert. *Physics for Kids: 49 Easy Experiments with Electricity and Magnetism*, Tab Books, Blue Ridge Summit, PA 1990.

Energy Posters:

The following materials are available through the **National Energy Foundation**, 5160 Wiley Post Way, Suite 200, Salt Lake City, Utah, 84116 (801) 539-1406

Electrical Generation Poster: The energy sources used to generate electricity (fossil fuels, nuclear, hydroelectric and geothermal), how power plants work and the transmission and distribution of electricity.

Electricity Serves our Community: Focuses on how electricity is made, distributed and used by the community.

Electrical Safety Poster: Focuses on how we can practice electrical safety in our community.

Sources of Energy Posters: Include individual posters of the following; Coal, Nuclear Energy, Renewable Energy, Oil, Water, and Natural Gas.

Taking Charge: An educational kit on electricity

OUTCOME: The outcome of this kit is to provide students with a basic understanding of electricity, its generation and its use in the community.

OVERVIEW:

Children should be aware of the many things electricity can do for us in our everyday lives. It makes living easier, safer, healthier and more fun. This educational kit is designed to assist teachers in teaching elementary school students about electricity, how it is generated and its use in the community. Students can discover what current and static electricity is, what makes a circuit and what materials conduct electricity. They can also generate electricity with hand generators, solar cells, and batteries and learn about electrical safety in our community.

This kit is designed to be supplemental in nature. It is not necessarily a unit of instruction. However there are many ways to use the materials. We simply encourage you to choose the activities and resources you feel will be appropriate for your students. The following materials are included in the kit: videos, posters, games, resource books and enough supplies for experimentation and self-discovery for a class of 30 students to work in groups of three. It also contains a teacher's guide with suggested activities, background information, vocabulary, bibliography and local resources.

MATERIALS PROVIDED IN KIT

- (1) Van de Graff generator (Electrostatic generator)
 - (1) fluorescent light bulb
 - (1) plastic box (milk crate)
 - (1) electrostatic box
 - (1) bag of wool/rabbit fur
 - (1) bag of rubber balloons
 - (1) bag of plastic combs
 - (10) hand generators
 - (10) bulbs in sockets
 - (10) electric buzzers
 - (10) motors with propellers
 - (10) battery holders
 - (1) bag of batteries
 - (1) bag of miniature light bulbs
 - (1) bag of insulated wire w/alligator clips
 - (2) parallel bulb bases
 - (10) bags of conductor and non-conductor materials
 - (1) box of samples or symbols of coal, oil and natural gas
 - (5) radiometers
 - (10) solar cells
 - (1) potato clock
 - (10) meter reading teaching devices
 - (1) meter model
-
- (3) **Posters:** Electricity Generation, Electricity Serves our Community, and Electrical Safety
 - (2) **Videos and Films:** Louie the Lightning Bug: Play it Safe Around Electricity and LCRA and Solar Energy
 - (1) **Games:** AC/DC Electric Circuit Game
 - (10) **Books:** The Science Book of Electricity, The Science Book of Energy, Discovering Electricity, My First Batteries & Magnets Book, The Story of Electricity, Power Up, Wires and Watts, Eyewitness Science: Electricity, and Physics for Kids.

Static Electricity

Concept: Static electricity occurs when free charged particles are not in motion.

Background Information: All things are made up of particles that are too tiny to see. These particles are called *atoms*. Atoms contain other particles that are even tinier. They are called *protons, electrons and neutrons*. Protons have a positive charge. (Each plus sign stands for a positive charge.) Electrons have a negative charge. (Each minus sign stands for a negative charge.) Neutrons have no charge at all.

Most of the time these charges are in balance. There is an equal number of positive and negative charges in each object. When certain materials are rubbed together, free electrons are transferred by friction from one to the other, and both materials become electrically charged. These charges are not in motion, but reside statically on each material, and hence this type of electricity is known as *static electricity*. We have all had experience with static electricity: lightning during a storm; sparks flying after we shuffle over a rug; hair standing up on end after brushing - all these are typical examples of static electricity. This type of electricity is produced by friction, mechanical energy.

Safety and Operation of the Van de Graff Generator

Safety: The generator has been designed to be safe when used properly. As with any other electrical appliance, you should follow the following safety rules:

1. Plug the generator into a grounded (3-prong) 110 volt, 60 Hz outlet only.
2. Do not operate the generator in a wet or damp location or outdoors.
3. Check the generator for loose, worn or frayed wires. Notify Austin Children's Museum staff as soon as possible if there is a danger.
4. Since discharge of electricity can have adverse effects on electronic devices, keep the generator away from appliances such as televisions, computers, microwave ovens, etc..
5. The shock caused by touching the generator directly is not harmful and is similar to the shock received when walking across a carpet and touching a metallic object. It may, however, feel uncomfortable and may cause initial alarm.
6. We recommend that our generator be operated under adult supervision.
7. When storing the generator, avoid damp or wet locations.
8. When not in use, unplug the generator.

Operation: Smooth performance of the generator depends on humidity. For best results, operate the generator at 75% (or less) humidity and it will function smoothly and steadily for hundreds of hours.

CAUTION: PERSONS WITH CARDIAC PACEMAKERS SHOULD NEVER OPERATE THE GENERATOR NOR SHOULD THEY EVER COME IN CONTACT WITH IT. DISCHARGE OF STATIC ELECTRICITY COULD CAUSE THE PACEMAKER TO BE DAMAGED OR MALFUNCTION.

Van de Graaf Generator Demonstration - A Hair Raising Experience

Objective: Given the opportunity to observe a Van de Graaf generator, the learner will be able to identify the effects of static electricity.

Materials:

- Van de Graaf generator
- plastic milk crate
- hand mirror

Preparation: Read safety and operation information before use. Next, place the plastic crate down on the floor so that a student standing on the crate can easily touch the ball of the generator. Plug in the generator.

Activity:

1. Invite a volunteer with fine, medium length hair to stand on the crate and put his/her hands on the generator ball (collector's dome). Warn the volunteer not to let go of the ball until the machine is turned off or he/she will get a slight shock.
2. As their hand starts to stand up, the students will roar laughter. At this time hold a mirror so the volunteer can see why everyone is laughing. Observe the effects of static electricity on the student.
3. Afterwards, turn the machine off by unplugging it and ask the volunteer to step down. Most of the electrons will slowly escape through the volunteers shoes.

Discussion of Results: The Van de Graaf generator is capable of producing very high voltages of static electricity. Inside the tube, an electric motor turns a long rubber belt connecting the metal ball at the top and the motor at the bottom. The belt picks up electrons from a metal grid at the base. A metal pick-up attached to the ball at the top sweeps the electrons off the belt and deposits them on to the ball. When a volunteer holds on to the ball at the top of the generator, the electrons distribute themselves over the surface of their body. Millions of electrons on adjoining hairs repel each other, causing the volunteers hair to stand up.

Van de Graaf Generator - Create Lightning

Objective: Given the opportunity to observe a Van de Graaf Generator, the learner will be able to identify the effects of static electricity.

Materials:

- Van de Graaf Generator
- grounding ball

Preparation: Read safety and operation information before use. Place generator on a table and plug in the generator. Connect the grounding ball to the base of the generator or ground it to a nearby object. Practice the demonstration several times before the children arrive so you know what to expect.

Introduction: A flash of lightning is a form of static electricity. In a storm, extra electrons build up on clouds and on the earth. When there are too many electrons, a huge spark jumps between clouds or between a cloud and the earth. The massive build-up of positive electrical charges on the generator's collector dome may be used to produce a replica of true lightning on a smaller scale.

Activity:

1. Place the grounding ball near the dome of the Van de Graff generator. When the discharge occurs, you will actually see these bright lightning discharges that are accompanied with crackling sound. For brighter and more frequent lightning discharges, keep the grounding ball or rounded object close to the collector dome (about 1/2 an inch to a couple of inches).
2. For a greater effect turn off the lights and close the blinds or curtains. Explore the following questions with your students. What would happen if the grounding ball is withdrawn farther away from the dome? What conditions could lessen the effect of the discharge? How could you use this demonstration to describe the effects of lightning?

Discussion of Results: Masses of air rise and fall during thunderstorms. They rub up against rain clouds. This causes them to become electrically charged. Lightning will occur when two objects of different charges get close to each other. A spark will fly from a negatively charged cloud to a positively charged cloud. It will also go from a charged cloud to the ground or from the ground to a charged cloud. When the Van de Graaf Generator accumulates a massive build-up of positive electrical charges on the surface of the collector's dome, a spark or lightning discharge will be emitted when a negatively charged or neutral object is placed near the collector's dome.

NOTE: High humidity affects the results of this demonstration.

Van de Graaf Generator - A Bright Idea

Objective: Given the opportunity to observe a Van de Graaf Generator, the learner will be able to identify the effects of static electricity.

Materials:

- Van de graaf Generator
- fluorescent light bulb

Preparation: Read safety and operation information before use. Place the generator on a stable table and plug in the generator.

Introduction: The Van de Graaf Generator can be used to light a variety of light emitting devices such as incandescent (filament type) bulbs, fluorescent tubes or lamps, gas filled tubes, old radio tubes and even tiny neon tubes.

Activity:

1. Hold or have a student hold the fluorescent tube in the vicinity of the generator ball (collector's dome). Observe what happens to the light.
2. Try different types of light bulbs. Ask your students where they think the energy is coming from to light the bulb. What happens when you hold the bulb up to a foot away from the collector's dome. How does this differ as the bulb is brought closer to the dome? What happens when the bulb touches the dome?

Discussion of Results: The outside glass surface of the bulb nearest the generator dome will acquire a negative charge. This charge builds up on the glass surface until it becomes so intense it discharges. As a discharge occurs, negative charges rush through the entire body of the bulb lighting the bulb because the light tube is filled with a gas that glows when electrons pass through it.

Making Static Electricity - Stuck on You

Objective: Given the opportunity to create static electricity, the learner will be able to discover the events that cause static electricity.

Materials: *For each team:*

- (2) balloons
- comb
- piece of fur/wool
- pieces of styrofoam or pith balls

Preparation: None

Introduction: Begin with some questions; Have you ever received a shock inside your house on a cool dry day? How did it feel? What made it happen? Allow time for student speculation before explaining that what they felt was *static electricity*. Draw a large circle on the chalkboard and place the words static electricity within the circle. Have the students provide additional information about static electricity and place that information around the large circle. That information may include facts about how it feels, what it looks like, how it happens and other forms of static electricity.

Activity: Have the students create their own static electricity to discover more information about static electricity and how it occurs.

1. Distribute comb, wool/fur, and pieces of styrofoam to the student teams. Place the styrofoam pieces (small pieces about one-fourth inch square) on their tabletop and have them rub the comb with their fur/wool vigorously for about 25 seconds to give the comb a charge. NOTE: DO NOT USE COMBS IN HAIR. Next, tell them to bring the comb near the styrofoam pieces without touching the styrofoam pieces. Observe what happens to the styrofoam. If nothing happens, have the students rub the comb vigorously again with the fur/wool. Have the students describe what they have observed. What happens when they touch the styrofoam? Why?
2. Give every student a piece of paper. Have them fold it in half and draw the outline of a picture onto one side of the paper. Holding both halves of the paper together, have the students cut out the pattern, making sure to leave the horse joined together at the top of its head and tail. Stand the object on the desk or tabletop and charge the comb again with the fur/wool. Next, hold the comb in front of the picture and the picture will move towards the comb. Have the students have a race to see who can get their picture across the desk or tabletop first.
3. Distribute balloons and piece of wool/fur to the student teams. Have the students blow up one balloon and tie the end in a knot. Rub the balloon with the wool/fur or their hair and have them hold the balloon against a wall or desk. What happens? Next, have the students blow up the other balloon and rub the balloon with the wool/fur or their hair. Place the balloon next to the first balloon. Observe what happens and record their results. See how long the balloons stay on the wall. Have the students time them using a watch. Whose balloon stays on the wall the longest?

Discussion of Results: When the students rubbed the comb with the piece of wool/fur some of the electrons left the wool/fur and went to the comb. The comb now had more electrons and became negatively charged. Since the styrofoam is neutral or lacks electrons, the comb attracted the styrofoam because a basic rule of electricity is that opposite charges attract each other.

After being rubbed with the wool/fur, the balloon stuck to the surface it was placed against. By rubbing the balloon, we gave it a negative charge. The wall attracts the balloon because it has a positive charge and opposite charges attract. When the second balloon was placed near the first balloon, the balloons repelled each other. Since both balloons have a negative charge a force of repulsion occurred between like charges, pushing the particles apart.

• Let's Sing About Energy •

I Am Trying

Tune – "Are You Sleeping?"

I am trying, I am trying
Not to waste, not to waste
En-er-gy, en-er-gy,
I can save, you can too.

Fix the faucet, turn off li-ghts
Close the door, close the door
Insulate and weather-strip,
insulate and weather-strip
Help us save, we need you.

Take them ou-t, use them u-p
Waste them too, waste them too
Will our children thank us,
when they're all depleted
Fossil fuels, we'll save you.

Bulbs, Bulbs on the Brain

Tune – "Home On the Range"

Oh, give me a light with a bulb burning bright,
With a wire, a battery and switch.
Then I'll have a good light if the contacts are
tight
And I'll learn as I sing and I play.

Refrain:

Bulbs, bulbs on the brain,
Now I see how a circuit is made -
Where electrons do flow through the
wires, I know,
To the bulb where the contacts displayed!

Electricity, true, can do such things for you
Keep you warm, keep you cool, help you work.
But don't crowd up your plugs or put
wires under rugs
Think of safety or you'll be a jerk!

Refrain:

Bulbs, bulbs on the brain,
And I know that I better beware
"Cause a big overload causes wires to explode!
In a smoke-puff or even a flame!

Save, Save, Energy

Tune – "Row, Row, Row Your Boat"

Save, save, en-er-gy
Every chance you get.
Energy, energy, energy, energy
Will our needs be met?

Homes, schools factories,
Does it matter whose?
Should not use our fossil fuels
Unwisely or we'll lose.

Oil, coal, natural gas
Precious fossil fuels.
Energy, energy, energy, energy
What are we going to use?

Question, think, participate
Your future's in this too.
Energy, energy, energy, energy
What are you going to do?

Happy Circuits to You

Tune – "Happy Birthday to You"

Happy circuits to you,
Whether old ones or new,
Check the wires for fraying,
Happy circuits to you.

Plug in, Plug in, you may be in
"Series" like Christmas lights!
Plug in, to "parallel", may all of your
Bulbs stay so bright.

Oh Electricity

Tune – "My Country 'Tis of Thee"

Oh, electricity, how you are helping me!
Of thee I sing.
You make the day so bright and even
Light the night
A hundred things you do so right -
You're a wondrous thing!

Interaction of Electrostatic Charges - Kissing Balloons

Objective: The learner will be able to identify that static electricity is produced when electrons are removed from or added to an object.

Materials:

- (2) balloons
- string
- black marking pen

Preparation: Blow up two balloons and attach them to two lengths of string that are about 1 meter in length. Draw a face on both balloons adding puckering lips and eyes. Suspend one balloon from the ceiling or a support so that it hangs level to your face.

Activity:

1. Rub the suspended balloon's face with your hair. Let go of the balloon and let it hang, then approach it and ask it for a kiss. The balloon will come toward you and give you a kiss.

2. Next, hang the second balloon (a girl?) with a similar face near the first balloon. Rub your hair in its face, too. Let the two balloons hang loose. Ask the first balloon if (he?) wants to kiss the "new friend". He will turn his face away from the new balloon.

Discussion of Results: Electrically charged objects are produced by a separation of charges. All matter contains both positive and negative charges. When these objects' charges are equal in number, the object is electrically neutral. When certain materials are rubbed together, *friction* causes the negative charges to be transferred from one surface to the other. The object that gains the negative charges (-) becomes negatively charged, while the object that loses the negative charge becomes positively charged.

When you rubbed the balloon with your hair, the balloon gained electrons from the object it was rubbed against giving the balloon a negative charge. The balloon was attracted to you because opposite charges attract each other. When you rubbed the second balloon you also gave it a negative charge. When the two balloons came together they repelled each other because like charges repel each other. By touching them with our hands, we neutralize them by taking some of their excess electrons.

Electrostatic Box - Electrical Fleas

Objective: The learner will be able to identify that static electricity is produced when electrons are removed from or added to an object.

Materials:

- electrostatic box w/plexiglastop
- pith balls
- fur/wool piece

Preparation: Place the electrostatic box on a flat surface.

Introduction: You are probably familiar with some of the effects of static electricity: static electricity makes the sparks when you comb your hair on a cool day and it makes balloons stick to the wall at a party. In this activity, static electricity makes "electrical fleas" jump up and down.

Activity:

1. Have a student charge the plexiglas top by rubbing it vigorously with the piece of fur/wool. Next, have a student run their fingers over the plexiglas surface. Observe what happens. Watch the "fleas" dance. Try different types of materials for charging the plastic, including your hand. See what materials the students can come up with to use in place of the fur /wool. Explore the question of what makes the "fleas" dance?

While the fleas are dancing, have the students place their ear on the plastic top. Have them listen to the tapping of the fleas as they hit the plastic. The tapping rate slowly decreases as the charge on the plastic is depleted. The dance of the fleas sounds like the clicking of a Geiger counter measuring a radioactive source that is decaying.

2. Recharge the plexiglas top by having a student rub the top of the electrostatic box vigorously with the piece of fur/wool. Next, have a student drop extra pith balls on top of the plexiglas top. Have the students observe what happens. How do the pith balls react differently than in the first activity? What is the same?

Discussion of Results: Both the plastic and the pith balls start out electrically neutral. That is, they have an equal number of positive and negative charges. When you rub the plastic with the fur/wool, the fur transfers negative charges to the plastic. These negative charges polarize the pith balls which means they attract the positive charges to the tops of the pith balls and push the negative charges to the bottom of the pith balls.

The attraction between the negative plastic and the positive charge concentrated the top of the pith balls makes the pith balls jump to the underside of the plastic. When the pith balls actually touch the plastic, some of the plastic's negative charge flows through the pith ball. The top of the pith ball becomes electrically neutral. But since the whole pith ball was originally neutral, the pith ball now has some excess negative charge. The negatively charged pith ball and the negatively charged plastic repel each other strongly, which causes it to jump back down. As the pith ball's excess negative charge slowly drains away the ball again becomes neutral and is ready to jump up to the plastic once more.

Van de Graaf Generator: The Inside Story

Generating Electricity

Concept: Electricity is produced when a generator converts mechanical energy into electrical energy.

Background Information: The generation of electrical energy is a fascinating and wondrous process. Electricity is made by energy conversion – changing one form of energy to another. Three things are needed to produce electricity: a magnetic field, a coil of wire and some source of mechanical energy.

In a power plant, a turbine is used to convert the force of steam or water into mechanical (tumbling) energy. A turbine is made up of many fanlike blades attached to a shaft. As steam or water is applied to the turbine blades, the shaft turns. The shaft is connected directly to the electrical generator. An electrical generator is a machine consisting of a magnet on a shaft surrounded by a coil of wire. As the magnet rotates inside the coil, electrons flow through the wire. This is electricity.

Electricity is produced at three major types of power plants: *fossil fuel*, *hydroelectric* and *nuclear*. The City of Austin has four power plants to generate electricity – the Holly, Decker, and Seaholm plants burn natural gas or, if necessary, oil. The Fayette plant in LaGrange, Texas, burns coal as its fuel. As these fossil fuels are burned, they create heat that boils water and produces high pressure steam. The steam in turn becomes mechanical energy to spin the blades of the giant turbine-generator producing our electricity. Hydroelectric power is produced by harnessing the force of falling water to spin the turbine-generator. Uranium atoms are split in nuclear power plants. The heat created by the splitting atoms changes water into steam which is used to power the turbine-generator.

The activities in this section use hand generators to generate electricity. The students will use their own mechanical energy to power the generator instead of steam or water.

Purple People Power

Objective: The learner will be able to use a hand generator to convert mechanical energy into electrical energy.

Materials: *For each group of students:*

- hand generator; including output wire plugged into the back of the generator
- light bulb assembly
- electric buzzer assembly
- motor and propeller assembly

Preparation: Be sure the output wire is plugged into the back of the hand generator. Gather supplies.

Introduction: When introducing children to this activity, set out the components and let them discuss their probable functions. Tell the children that a hand generator converts mechanical energy from your hand into electricity that can be used to power different objects. Discuss the possible uses of energy from the hand generator. Show them the poster *Electricity Serves Our Community* and discuss how electrical energy can be used in their community.

Activity:

1. Divide the students into smaller groups or teams. Pass out the materials to each group/team.
2. Demonstrate how to use the hand generator by attaching the wires to the various assembly components. The various assembly components have two contact points provided by the bolts. One point brings the current or energy to the component assembly while the other point returns the current/energy back to the hand generator. The wires from the hand generator can be clipped onto the bolts of the component assemblies by pinching the ends of the clip and placing it around the bolt. This completes the path of the current/energy.
3. Next, have the children explore and play with the materials. See if they can make the light bulb light, the buzzer sound and the propeller spin.

Here are a few ways to extend the learnings from the previous explorations.

- Suggest that the groups work together to explore with as many combinations of their materials as they can think of.
- Suggest to the students to try to use two or three assembly components at the same time.

Find out what happens to the brightness of the bulb, the volume of the buzzer's sound, and the rotational speed of the motor when the following variations are performed.

- What happens when you turn the generator handle in the opposite direction.
- What happens when you turn the generator faster? Slower?
- Observe what happens when you unplug one of the connections.

Discussion of Results: A generator converts mechanical energy (the energy of moving parts) into electrical energy (the flow of electrons through a conductor (the wire)). Lighting the bulb or operating an electrical component demonstrates a whole series of energy conversions. Chemical energy in the cells of your body was converted into the mechanical energy of your muscles, which the hand generator changed into electrical energy. The electricity passing through the filament of the bulb got it so hot (thermal energy) that it radiated light energy. The buzzer converted electrical energy into sound energy and the motor converted electrical energy back to mechanical energy.

NOTE: While the hand generator is sturdily constructed, excessive speed in rotating the handle can result in stripping gears and damage to the unit. If while rotating the handles in any of the activities you should experience a sudden "slippage" or decrease in effort required, check to see if your circuit is overloaded or shorted out.

Generator or Motor?

Objective: The learner will be able to use the hand generator to change electrical energy into mechanical energy.

Materials: *For each group of students:*
hand generator with output cord

Preparation: None

Introduction: The hand generator can function as either a generator or a motor depending upon the form of energy supplied. Discuss with your students that a motor is able to change electrical energy into mechanical energy. Brainstorm a list of motors that we see everyday and the job the motor performs. (i.e. a lawnmower cuts grass, a refrigerator motor keeps our food cool, etc.)

Activity:

1. Have the students attach the wire clips of their hand generator directly to the wire clips of another groups hand generator. Predict what will happen when one student turns their generator handle. Record their predictions.
2. Next, have one student turn the handle of the generator while the other student holds their generator by the handle only. Many children will be surprised by the result: the handle of the other generator will begin to rotate just like a motor! Note the direction in which the handle is turning. Is it clockwise or counterclockwise?
3. What happens when you reverse the direction of rotation? Again, have students make a prediction before exploring.
4. Finally, have the students switch roles. Allow the students a few moments to explore and play with the materials. Afterwards write down what observations they observed.

Discussion of Results: The hand generator can function as either a generator or a motor depending on the form of energy supplied. A generator changes mechanical energy into electrical energy; a motor changes electrical energy into mechanical energy.

The Electric Cell or Battery

Concept: A battery converts chemical energy into electrical energy.

Background Information: Many people have seen or used a battery before. It can be used to power games, toys, radios, flashlights and lots of other things. But what is a battery and how does it produce electricity?

A battery is really an *electric or dry cell* that produces electricity by converting chemical energy into electrical energy. When looking at battery you will notice that every battery has some kind of container and two metal ends or *terminals*. If you were to slice open a battery or dry cell you would find two substances; a thick paste made of manganese dioxide and zinc. The chemical reaction takes place between the zinc atoms and the manganese dioxide atoms. When zinc reacts with manganese dioxide, the zinc atoms lose electrons and the manganese dioxide atoms absorb those electrons. The freely moving electrons in route between the zinc and manganese dioxide form an electric current. As the manganese dioxide atoms gain electrons, they become manganese oxide atoms and are unable to absorb any more electrons. When all the zinc and manganese dioxide atoms have reacted, no more electricity is produced, and the battery is said to be "dead".

If the zinc and the manganese dioxide were in direct contact with each other, this reaction would happen very quickly and soon be finished. So when an battery is assembled, a separation layer – usually in the form of a piece of paper – is inserted between these two materials. This doesn't totally stop the reaction. That is why a battery will eventually go dead even if it's never used. But, since the paper resists the flow of electrons through it, the reaction is greatly slowed down.

Can You Light It?

Objective: The learner will be able to use a battery to power a light bulb.

Materials: *For each group of students:*

- one D cell battery in a battery holder
- a bulb and bulb holder
- two lengths of insulated wire with alligator clip ends

After the initial exploration, you can distribute one at a time:

- electrical buzzer assembly
- motor and propeller assembly
- insulated wire with alligator clips on the ends

Preparation: Group your students together in small groups or teams. Pass out the materials to each group/team.

Introduction: When introducing children to this activity have the children set out the materials and let them discuss their probable functions. Ask the children to find the battery. What does a battery do? Why do we have batteries? What do they power? Next, have them find the bulb in the bulb holder. Discuss how the light bulb uses electrical energy to make light and heat energy. Finally, have the students find the wire. Discuss that the function of a wire is to conduct the electrical current from the energy source in a safe manner. In this case, the battery.

Activity:

1. The goal of the activity is simply to use the battery, bulb and wire to get the bulb to light. After they succeed, suggest that they put two set-ups together in any combination, noticing the effect on one or both bulbs.
2. Now give each team an electric buzzer and another wire. Have them explore how they can get the buzzer to sound. Why doesn't the buzzer work with only one battery? See if they can work together with another group to get the buzzer to sound using two batteries.
3. Suggest the groups work together to explore with as many combinations of their materials so they can think of. Discuss with the class what kinds of combinations worked and what to remember when using the battery.

Solar Energy

Concept: Light energy can be converted into heat, mechanical and electrical energy.

Background Information: Anyone who has had a sunburn, walked through a greenhouse, hung clothes on the line to dry, or watched spring arrive recognize the power of the sun. In a one-to-two week period, the sun transmits more energy to the earth's surface than all of the energy stored in the earth's known reserves of coal, oil, and natural gas.

The sun is the most inexhaustible and the cleanest form of energy known. Its heat and light arrive week in and week out - free. But not in uniform amounts each day, or in concentrated form, and not at all at night. Consequently, the barriers of greater use of solar energy by a world faced with dwindling energy resources are significant: mainly, diffusion and the inability economically to store solar energy, use it directly or to convert it to electricity.

Activities in this section cover how solar energy can be converted into heat, mechanical and electrical energy.

Basic Solar Cell Operations:

1. The solar cell converts energy from sunlight into electricity which is transmitted through the lead wire. (1.7 V , 500mA)
2. The photocell should be positioned so that the sunlight strikes the surface of the solar cell at a right angle. If the light strikes the solar cell at an angle, a weaker electrical current will be produced. In addition, if light fails to strike any portion of the solar cell a weaker amount of electricity will be produced. Sunlight which passes through glass, such as a window pane, before striking the solar cell will also generate a weaker current.
3. Although performance will not be affected by connecting the + and - terminals of the solar cell (i.e. short circuiting the cell), students should be discouraged from directly connecting the two wires of the solar cell together.
4. The solar cell may peel apart if dropped or bent.
5. Be careful not to allow dirt or dust to accumulate on the face of the solar cell. Wipe with a dry cloth to remove dust or dirt.

And Then There Was Light, Sound and Movement

Objective: 1) The learner will be able to use solar cells to convert the sunlight energy into electricity to power motors, buzzers and lights. 2) Through the use of solar cells, the learner will be able to observe the direct conversion of light into electricity and mechanical energy.

Materials: *For each group of students:*

- solar cell; including lead wires with miniature insulated clips (1.7V)
- light bulb assembly
- electric buzzer assembly
- motor and propeller assembly

Preparation: The experiments in this activity work best if used in direct sunlight. Operation is possible even if an incandescent light is used in place of sunlight. In this case, however, the 60W or more incandescent light bulb must be placed as close as several centimeters (1 inch or so) to the solar cell. Colored and frosted bulbs will not work.

Introduction: When introducing children to this activity, set out the components and let them discuss their probable functions. Tell the children that a solar cell converts energy from the sun into electricity that can be used to power different objects. Discuss the possible uses of energy from the sun. Show them the poster *Renewable Energy Sources* and discuss how solar energy can be used in their community.

Activity:

1. Divide the students into smaller groups or teams. Pass out the materials to each group/team.
2. Demonstrate how to use the solar cell by attaching the wires to the various assembly components. The various assembly components have two contact points provided by the bolts. One point brings the current or energy to the component assembly while the other point returns the current/energy back to the solar cell. The wires from the solar cell can be clipped on to the bolts of the component assemblies by pinching the ends of the clip and placing it around the bolt. This completes the path of the current/energy.
3. Next, have the children explore and play with the materials. See if they can make the light bulb light, the buzzer sound and the propeller spin.

Here are a few ways to extend the learnings from the previous explorations.

- Find out what happens to the brightness of the bulb, the volume of the buzzer's sound, and the rotational speed of the motor when the following variations are performed.
 - Compare results obtained on a clear day against the results on a cloudy day.
 - What happens when the light strikes the solar cell at an angle or when the solar cell is turned the other way?
 - What happens when you cover half of the solar cell with your hand?
When half of the solar cell is covered, the output current will be reduced by approximately half.
 - What happens if an incandescent light bulb (60W or more), or another light source is used in place of sunlight?
 - What happens when light reflected from a mirror strikes the solar cell?

Discussion of Results: A solar cell is made up of photovoltaic cells. These cells convert the sun's energy into electrical energy. Photovoltaic cells absorb light energy causing the electrons of atoms in the photovoltaic cells to energize. The electrons move the energy from atom to atom in the cell, producing an electric current.

My Radiometer

Objective: The learner will be able to observe the conversion of light energy into heat and mechanical energy (moving paddles) using a radiometer.

Materials:

- Radiometers
- Electric lamp, approximately 150 watts (not supplied in kit)
- Opaque sheet of paper (not supplied in kit)
- ruler

Preparation: None

Introduction: Place the radiometer in the sun and observe. Discuss with the students: Does this prove that the sun is a source of energy? What forms of energy come from the sun (heat, light, radiation). Draw a large sun on the blackboard and have the students list all of the possible uses of solar energy. Write their responses on the rays of the sun.

Activity:

1. Conduct the following radiometer demonstration.
 - A. Set a radiometer and a lamp on a level table or counter approximately 30 cm from each other. Focusing the lamp on the radiometer, turn on the lamp and observe the radiometer. Have a child count the number of turns the paddles make in 1 minute. Inform the students that the lamp is converting electrical energy into light and heat energy.
 - B. Next, vary the distance between the lamp and the radiometer from 30 cm to 1 m and observe the radiometer, again have a student count the number of turns in a minute.
 - C. With the lamp 30 cm away from the radiometer, alternately hold and take away an opaque piece of paper in from of the lamp. Note the effects of the speed and completeness with which you block the light on the radiometer. Again count the number of turns in 1 minute.
 - D. Make a bar graph illustrating your data - the number of turns in 1 minute per investigation
2. Have the students work in groups to conduct the previous investigation. Give each group a radiometer, a piece of opaque paper and a light source. You can graph their results in a larger class graph. Are their similarities? Differences?
3. Discuss with the students that we must also convert the stored energy of coal, oil and natural gas in order to use their energy. Their energy is stored as chemical energy and through burning is converted to heat and light energy that is used to generate electricity.

Question for Class Discussion:

- What effect does intensity of light (distance and or shading) have on the radiometer?
- What are some of the ways a radiometer could be used for doing work?
- How might the sun be used as an energy source?

Discussion of Results: Outside of the radiometer, the air is filled with trillions of small bits of air called atoms. When the light's energy strikes these atoms, they take on heat and move faster but because the air around us is filled so completely with other atoms, the warmer ones quickly bump into others and stay in the same relative position. However, inside the radiometer 99% of the air has been removed, leaving only *thousands* of atoms inside the radiometer in comparison with the trillions of atoms outside of the radiometer. This means that each particle of air inside the radiometer is able to move around much more freely than on the outside. The vanes, or wings on the radiometer are alternately dark and light in color. When the atoms strike the dark vanes they take on a great deal of energy and "kick" away at terrific speed causing the vanes to move.

Conductors and Insulators

Concept: Some materials carry electricity better than others.

Background information: Electrons that have been "knocked" out of the outer shell of an atom are known as "free" electrons. These free electrons can exist by themselves outside of the atom, and it is these electrons which are responsible for most electrical phenomena. The movement of free electrons constitute an electrical current.

All substances normally contain free electrons that are capable of moving from atom to atom. Metallic materials such as copper, iron, silver, lead and aluminum, contain numerous free electrons capable of carrying an electric current. These materials will let electrons flow or move through them easily and are called *conductors*.

Materials that are made of atoms that hold their electrons tightly are called nonconductors or *insulators*. These materials contain few electrons and are used to stop electricity from going where it should not go. Plastic, rubber, cork, glass, wood and cloth are good insulators.

Materials that have an intermediate number of free electrons available are known as semiconductors. The more free electrons a material contains, the better it will conduct electricity.

Conductor or Insulator?

Objective: 1.) The learner will be able to predict and test which materials are conductors and insulators using a hand generator or a battery. 2.) The learner will be able to define conductor and insulator and give three examples of each.

Materials:

- hand generators
- bags of assorted test materials
- light bulb, buzzer and propeller assemblies

Preparation: Make copies of the enclosed Conductor or Insulator Worksheet for each group of students.

Introduction: Ask your students which materials will conduct or allow electricity to travel through it to complete a circuit. Read the following list of objects; aluminum foil, eraser, penny, paper, glass, key, pencil, paper clip, cork, plastic and rock. Pass out the Conductor or Insulator Worksheets to the student group and have the students circle "YES" or "NO" to show which materials they think will operate the electrical assemblies.

Activity: Test the students predictions by creating a "conductor tester".

1. Pass out the generators, test objects, and electrical assemblies to the student groups. Have each group prepare a "conductor tester" by connecting one alligator clip of the hand generator to one bolt of the electrical assembly. Have one student operate the hand generator, while the other student touches the other end of the hand generator alligator clip to the open bolt of the electrical assembly, closing the circuit and making the electrical assembly light, buzz or move.
2. Next, have the students test the conductivity of the assorted test materials with the hand generator conductor tester by clipping the open end of the alligator clip to one of the assorted test materials and touching it to the open bolt on the electrical assembly. If the electrical assembly lights, moves or buzzes, the material is a conductor, if nothing happens, the material is an insulator.

Extension Activity: Compare the results of this activity to materials which are purposely used as conductors and insulators in our environment.

Discussion of Results: Some materials made the electrical assembly work. Others did not make the assembly work. What does this tell us about these items? Most metals are conductors of electricity. Iron, lead, silver, copper, and aluminum are conductors. Most non-metal materials are non-conductors or insulators. Wood, cloth, cork, rubber, glass, and plastic are insulators. Insulators can be used to prevent electricity from harming you. That is the reason the wires in this kit are wrapped with a plastic materials. It is a safety device.

Worksheet - Conductor or Insulator?
Taking Charge

USE THE FOLLOWING EQUIPMENT: Hand generator, electrical assembly and assorted test materials and make a conductor tester. Check to see which items below will conduct electricity and make the assembly work.

Test Results:

ITEMS	PREDICTIONS	RESULTS
aluminum foil	Yes No	I C
eraser	Yes No	I C
penny	Yes No	I C
paper	Yes No	I C
glass	Yes No	I C
key	Yes No	I C
pencil	Yes No	I C
paper clip	Yes No	I C
rock	Yes No	I C
cork	Yes No	I C
plastic lid	Yes No	I C

Conductor Deduction

Objective: The learner will be able classify materials as either conductors or insulators.

Materials: None

Preparation: copies of the list of items (optional)

Introduction: none

Activity: Read the students the following scenario or make copies of the story for your students:

It was just before closing time when three men burst into the local Nations Bank wearing ski masks and carrying guns. Within minutes, they had collected the bank's cash. Next, they ushered Joyce Franklin, the bank manager, Larry Washington, the bank teller and an elderly couple, the bank's last remaining customers, into the vault. One of the robbers then flipped open the panel door of the emergency circuit—the one that was designed to let someone locked inside the vault open the vault door—and yanked out a foot-long piece of wire, breaking the circuit. Then he closed the door. In the silence that followed, the frightened group stood trembling, staring at each other. Finally, Larry Washington quivered, "We are trapped". "How long before...we run out of air?" the elderly woman asked, holding onto her husband with desperation. "Perhaps we won't need to wait to be rescued." Ms. Franklin smiled. "Perhaps there is something we could use in place of the wire so we can activate the emergency circuit." Here is a list of items the group was able to collect among themselves.

purse
wallet
nail file

tie
earrings
calculator

handkerchief
box of steel paper clips
clipboard

pencil
key ring
scarf

Give your students the list of items collected. Have the students observe the list and discuss which item(s) could be used as a conductor to span the twelve-inch gap and complete the broken circuit?

Extension Activity: Test the students predictions using the conductor tester made in the activity "Conductors and Insulators."

Discussion of Results: Ms. Franklin hooked together enough of the steel paper clips to span the distance and complete the circuit. In fact, the group got out of the vault so quickly that they were able to call the police in time for the robbers to be caught only a block from the bank. The paper clips when strung together acted as a conductor so that the electrical current could pass through them and open the vault door.

Circuits

Concept: A circuit is a path taken by an electrical current.

Background Information: An electrical circuit is the system by which an electric current is directed, controlled, switched on, or switched off. Circuits can contain from two or three to many hundred different components, according to the way in which the current is to be controlled.

The primary requirement of a circuit is that it form a complete path; electrons must be able to flow through the whole system so that as many electrons pass back into the source of the current as leave it. For example, when an electrical current leaves a battery it may travel to a light bulb and then it must travel back to the battery to make the light bulb light.

A circuit may be described in one of two ways: 1.) Open or incomplete, 2.) Closed or complete. If the electrical current is able to flow completely through the circuit, the circuit is said to be a *closed circuit*. If the electricity is unable to flow completely through the circuit, the circuit is said to be an *open circuit*. Opening and closing a switch starts and stops the flow of electrons in a circuit.

There are two basic circuits in which electricity flows through: series or parallel circuits. A *series circuit* is an electrical pathway in which several components are connected to each other and eventually to an electrical source. All components share the same electrical circuit, so what happens to one component happens to all of the components. If one component in the series goes out, they all go out. The components are interdependent.

In a *parallel circuit*, each component has its own complete path to follow. The electrical components are connected individually to the electrical source, thus the electrical current has more than one path to follow. If one component goes out, it has no effect on the other components since each component is directly connected to the energy source. Parallel circuits allow for individual control of each electrical component. Buildings, most appliances, motors, etc., are wired in parallel circuits.

A *short circuit* is caused by the overloading of an electric current along a circuit. Circuits, made of wire, can accommodate only a limited amount of electricity. With too much current flowing through a wire, the metal wire melts from the extreme heat and the circuit is broken.

Electricity On the Go - Simple Circuits

Objective: 1.) The learner will be able to predict and test ways to construct a complete circuit. 2.) The learner will be able to identify the three components that make a complete circuit: a source of electricity, a conductor and an electrical device.

Materials: *For each team of students:*

- light bulb assembly
- battery and battery holder and/or hand generator
- (2) alligator clip wires

After the initial experimenting, you can distribute, one at a time:

- a buzzer assembly
- battery and battery holder
- (1) alligator clip wire

Preparation: None

Introduction: Stimulate discussion by holding up or displaying the different components and ask the students to discuss or predict their probable functions. If the students do not supply the information, make sure that these ideas are covered: 1) A battery is the source of electrical energy 2) The light bulb changes the electrical energy into light energy and 3.) The wire conducts or carries the electricity. A circuit is simply the complete path taken by an electrical current.

Activity:

1. Distribute the materials to each group of students. Explain to the students that their task is simply to get the bulb to light. Allow 10-15 minutes of discovery time.

After they succeed, suggest that they put two set-ups together in any combination, noticing the effect on one or both bulbs. This is good practice to reinforce their understanding of a complete circuit. How many different ways can the components be arranged to light the bulb? What must happen to get the light bulb to light? Have volunteers draw on the chalkboard arrangements that made the bulb light? Why didn't other arrangements make the bulb light?

2. Now give each team a buzzer and another alligator clip wire. Can the buzzer sound when the light goes on? Or when the light goes out? Again, have the students discover the various possibilities.
3. Suggest that several groups work together to discover with as many combinations of their materials as they can think of.

Note: Trouble-shooting is an important part of this activity. Some batteries and bulbs may be dead, some connections will be loose, and some wires may heat up. Encourage the students to persist, letting them know that they will be able to figure out what's wrong and that you have lots of extra pieces.

Discussion of Results: Through discovery, the students will realize that to complete a circuit they must connect the wires from the battery/generator to the component and back to the battery making a complete circle.

A Circle of Wires

Objective: The learner will be able to construct a group circuit.

Materials: *For each student:*
• alligator clip wire

For the demonstration:
• (1) light bulb assembly
• (1) hand generator

Preparation: Arrange the room so that you can have your students sit in a large circle on the floor.

Activity:

1. Have the students sit in a large circle on the floor. Assign one student to be the light bulb and have them hold on to the light bulb assembly. Assign the student sitting directly on the opposite side of the light bulb student to be the energy source and have them hold the hand generator. Next, give everyone in the circle an alligator clip wire.
2. Explain that everyone is going to help construct a group circuit. Ask the students what they will need to construct a complete circuit. After discussion, have the students connect their wire to the person sitting next to them being sure to connect the wires to the light bulb assembly and the hand generator.
3. Have the student who is the hand generator operate the generator to generate an electric current. Will the light bulb light? If not, have the students check their connections. Can they problem solve and come up with a solution. What happens when one child "breaks" or disconnects their wire. (*The circuit is broken and the flow of electrons has ceased.*)
4. Explore other connections and arrangements with the students. What kinds of circuits can you make?

Discussion of Results: By connecting the wires together, the students made a path for the electric current to travel through. The electric current traveled through the wire to the light bulb and then back to the generator, making a complete path.

Connections in Series and Parallel

Objective: The learner will be able to construct and identify a series and parallel circuit.

Materials: For each student team:

- hand generator
- (2) light bulb assemblies
- (2) alligator clip wires

Preparation: None

Activity: Have the students construct and explore a series and parallel circuit.

1. Pass out (1) hand generator, (2) light bulb assemblies and (1) alligator clip wire. Have each group try to light up both light bulbs using the hand generator and the wires. Allow the students about 15-20 minutes of discovery time. Afterwards, have the students share with each other how they were able to get their light bulbs to light. Observe the brightness of the bulbs. Explain that this circuit is called a series circuit.
2. Next, have one student operate the hand generator and have another student unscrew one of the light bulbs in the circuit. Observe what happens to the other bulbs. (*Both lights go out*) What reasons can you think of for the result? (*Loosening the bulb causes a break in the circuit, which stops the flow of electricity to everything in the circuit*)
3. Give each student group another wire and instruct them to light the light bulbs using two wires instead of one wire. Allow the students 15-20 minutes of discovery time. Challenge the students to construct a circuit so that when one bulb is unscrewed, the other bulb remains lit. Afterwards, have the students share their discoveries. How is this circuit different than the first circuit. (*Each bulb should have a double path back to the battery*) Have the students compare the brightness of the bulbs to the first circuit they made. This circuit is called a parallel circuit.
4. Stimulate discussion by reading the following paragraph to the class:

"You are going with your parents to buy outdoor party lights. At the store you find two different types of lights. One type is wired in series and the other is wired in parallel. Which would be easier to check for a burned-out bulb? Explain your answer."

The students should say that the parallel-wired lights would be easier because only the burned-out bulb would go out – the other bulbs on the string would stay lit. In the series-wired lights, one bad bulb would cause all of the lights to go out.

Extension Activities: Try the same activities but add additional components to the circuit. Instead of the hand generators have the students use the battery or solar cells as the energy source. See if they can construct both a series and parallel circuit.

Discussion of Results: A *series circuit* is a circuit in which all the bulbs or components are dependent upon the other. If a bulb is loosened or removed, this breaks the circuit and all of the components go out. The voltage of a series circuit is also shared among all of the components. If there is one bulb and a 1.5v battery, the bulb will glow brightly with 1.5 volts. If there are two bulbs, the voltage is divided by two, so that each bulb is only receiving .75 volts from the battery. As a result it will be dimmer. If there are three bulbs, the voltage is cut in thirds.

In the second circuit the light bulbs were arranged in a *parallel circuit*. Each bulb has its own complete circuit with an energy source. Since all bulbs have a direct connection to the power source when one bulb is removed the others remain lit. Equal voltage is delivered to each bulb so that four bulbs burn as brightly as one bulb.

Resources Included In Kit

Books:

- Ardey, Neil. *The Science Book of Electricity*, Gulliver Books, San Diego, 1991.
- Ardey, Neil. *The Science Book of Energy*, Gulliver Books, San Diego, 1991.
- Baines, Rae. *Discovering Electricity*, Troll Associates, New Jersey, 1982.
- Challoner, Jack. *My First Batteries & Magnets Book*, Dorling Kindersely Inc., 1992.
- DeLucenary, George. *The Story of Electricity*, Dover Publications, New York, 1983.
- Markle, Sandra. *Power Up: Experiments, Puzzles and Games Exploring Electricity*, Macmillan Publishing Co., New York, 1989.
- Math, Irwin. *Wires and Watts: Understanding Electricity*, Aladin Books, Macmillan Publishing Co., New York, 1981.
- Parker, Steve. *Eyewitness Science: Electricity*, Dorling Kindersley Inc., New York, 1992.
- Wood, Robert. *Physics for Kids: 49 Easy Experiments with Electricity and Magnetism*, Tab Books, Blue Ridge Summit, PA 1990.

Posters:

- *Electrical Generation Poster*: The energy sources used to generate electricity (fossil fuels, nuclear, hydroelectric and geothermal), how power plants work and the transmission and distribution of electricity. (The National Energy Foundation)
- *Electricity Serves our Community*: Focuses on how electricity is made, distributed and used by the community. (National Energy Foundation)
- *Electrical Safety Poster*: Focuses on how we can practice electrical safety in our community.

Videos and Films:

- *Louie the Lighting Bug: Play It Safe Around Electricity*
- *LCRA and Solar Energy*

Student Games

- *AC/DC Electric Circuit Game*: Students will be introduced to the basic laws of electric circuitry. The game has a deck of 84 cards, each representing a component of an electric circuit. Players must complete a circuit with out being shocked or shorted out. For two to six players.

Additional Resources

Educator Resources:

National Energy Foundation: The following materials are available through the National Energy Foundation, 5160 Wiley Post Way, Suite 200, Salt Lake City, Utah, 84116 (801) 539-1406

- *Energy Glossary and Games:* An easy to use 32 page reference for approximately 900 energy related words and easy to understand definitions. It also includes word games, puzzles, activities and creative ways to make the glossary fun and practical. (\$5)
- *Energy Projects for Young Scientists:* Contains information on how to conduct experiments and investigations; provides tips on competing in energy and science fairs; and includes 60 energy projects to assist students in designing and implementing their own energy projects. (\$10)
- *Teach with Energy:* Contains fundamental energy and science lessons with an emphasis on electrical energy for grades K-3. Includes lesson plans, student worksheets and background information covering eight energy resources. (\$20)
- *Top Hit Energy Lesson Plans:* Lesson plans are divided into grade level books: K-1, 2nd, 3rd, 4th, 5th and 6th. Each book contains lesson plans that include the time needed for implementation, materials, procedure, assessment questions and more. (\$5 each book, \$30 for all 6 books)
- *Quick Energy for Elementary Teachers:* Contains activities, experiments and games that require little preparation time. (\$5)

U.S. Department of Energy: The U.S. Department of Energy has free materials available entitled "Science Activities in Energy". Please write to The U.S. Department of Energy, Office of University and Science Education Project, Washington D.C., 20585.

Energy Posters:

National Energy Foundation: The following materials are available through the National Energy Foundation, 5160 Wiley Post Way, Suite 200, Salt Lake City, Utah, 84116 (801) 539-1406

- *Electrical Generation Poster:* The energy sources used to generate electricity (fossil fuels, nuclear, hydroelectric and geothermal), how power plants work and the transmission and distribution of electricity.
- *Electricity Serves our Community:* Focuses on how electricity is made, distributed and used by the community.
- *Electrical Safety Poster:* Focuses on how we can practice electrical safety in our community.
- *Sources of Energy Posters:* Include individual posters of the following; Coal, Nuclear Energy, Renewable Energy, Oil, Water, and Natural Gas.

Vocabulary

AMPERE: a unit of measure of electric current. One ampere equals 6.2×10^{18} electrons passing a point in one second.

BATTERY: a device which stores energy by converting chemical energy into electrical energy.

CALORIE: a unit of heat energy equal to the amount of heat that will raise the temperature of one gram of water one degree Celsius. One calorie equals 4.18 joules.

CIRCUIT: the complete path travelled by an electric current.

COAL: a solid substance that burns and gives off heat. Coal was formed long ago from partly decayed vegetable matter under great pressure from the earth.

CONDUCTOR: a material through which electricity flows easily.

DISTRIBUTION: the term used by utilities to denote lower voltage electricity used in neighborhoods once it has left a substation.

ELECTRIC METER: a device that measures and records the amount of electricity used.

ELECTRICITY: energy produced by the flow of electrons through a conductor, such as copper wire, which can be transformed into other forms of energy, including light, heat, sound and mechanical.

FOSSIL FUELS: coal, oil, and natural gas.

GENERATOR: a machine that produces electricity by spinning a coil of wire in the presence of a magnetic field.

GEOHERMAL: energy produced by heat from deep inside the earth.

HYDROELECTRIC: electricity produced by falling water spinning a turbine-generator.

INSULATOR: a material that will not allow electricity to flow through easily.

KILOWATT-HOUR (kWh): the amount of work delivered during the steady consumption of one kilowatt of power for a period of an hour.

KINETIC ENERGY: energy in motion.

NATURAL GAS: gas formed underground by the decomposition of prehistoric microscopic plants and animals.

NUCLEAR POWER: electricity produced by using the heat given off when atoms split.

OIL (petroleum): a liquid formed underground by the decomposition of prehistoric microscopic plants and animals.

SOLAR ENERGY: radiation energy from the sun falling upon the earth's surface.

SUBSTATION: a location where transmission voltage is reduced to distribution voltage.

TRANSFORMER: an electromagnetic device that raises and lowers the voltage of electricity.

TRANSMISSION: a term used by the utilities to denote high voltage electricity sent over long distances.

TURBINE: a device that spins when wind, water, or steam hit its blades.

VOLTAGE: the "pressure" that pushes electricity through a wire.

WATT: a metric unit of power, usually used in electric measurements, which gives the rate at which work is done or energy expended.

Attachment:
Evaluation mat.

"Brain-Storming"

Williams Elem.
5th Grade
(Group I)
1/14/92

A.C.C.
Lab School
(4-5 yr. olds)

**GO POWER
EDUCATOR FEEDBACK
Compiled October, 1993**

The following statistics, gathered from a very small group of educators (14) who attended field trips during the GO POWER exhibit is nonetheless helpful information regarding thinking and possible trends of educators in our visitor group.

1. How did you hear about us?:

33% from other teachers or principals, 33% from brochures

2. Did you encounter reservation problems?

100% said no.

3. Did you receive/use your educator's packet?

50% either didn't receive it or use it.

4. Did you visit the Museum before your tour?

71% did not.

5. Were the concepts appropriate?

On a scale of 1-3, with 3 being very, the mean score was 2.43 - highest for grades 1 and up.

6. How did the exhibit content fit with your curricula?

Answers included

Meshed with Earth Day

We do not teach energy

Above age level, not a part of our curriculum

Study energy conservation during Earth Week

Send guide sooner

Thank you for letting us go on scholarship

A little difficult

You need more space

I've taught the digestive system this year and energy is part of our science curriculum

The kids loved every minute of it

Where were the green apron staff?

Is it possible to have part of the museum brought out to a school for a special demonstration?

Excellent - we were getting ready for our science fair and many exhibits were on power!

7. What programs or exhibits would you like to see?

50% Everyday science/technology

79% How different people live

29% Creative arts and drama

64% Health and the Human body

Other topics: bats, animals, food, prevention, spiders

8. Did you find staff helpful?

100% yes

9. Will you return?

100% yes

10. What kind of educator training would you suggest we offer?

- 29% Drama to teach subject matter
- 36% Field trips to support school learning
- 71% New science teaching methods
- 50% New cooperative learning activities

11. How would you grade our Museum?

On a traditional 4 point scale

- 4.31 Learning Content
- 4.38 Program/performance
- 4.77 Staff
- 4.77 Galleries

GO POWER 1993

Family visitor comments

- I like this place alot.
- I think you teach kids
- I like this place alot.
- I think you teach kids in a fun way
- I think you have a neat program
- I like this place because it is fun to be in the Austin Children's Museum
- Great place. Enjoyed everything, especially the whole foods market. Our 9 month old loved the toddler playscape. Great ideas!
- Had a great time
- Had a wonderful time
- Wonderful job
- Austin Children's Museum was fun I will cum a gine (come again). Send a letter.
- From Voight Elementary thank you so much. It wad great
- What I like is the body show.
- I really enjoyed the toddler playscape. I think those girls need a raise.
- *Re GO POWER exhibit: Very impressive. My children enjoyed it greatly.*
- *Enjoyed the exhibit alot. Since a brought a 4 yr old, 7 yr oldd, and 9 yr oldd O could have used a volunteer person to explain more to my non-reader. But it was a very good exhibit. I learned alot!*
- The place should be bigger or expanded. It would be better.
- *Wonderful. I enjoyed all the exhibits and the power/physics show.*
- This was a pretty interesting place to me.
- Wonderful
- Fun time for Flannery, Max and Me. Thanks
- Great place!
- It's a really nice place. I like it and I'm 11. Thanks
- This place is swell. Love the energy exhibit.
- T.A. Brown School: Our kids really loved our trip here. It's nice to know that kids can actually get their hands on everything without getting into trouble, and they learned so much! - A happy parent.
- I like it very much. But Make more things.
- I like the Museum as much as my mom.
- I liked the Museum.
- It was great!
- *I thought it was wonderful, I learned alot more about energy.*
- *I think the exhibit is very succesful for ages 8 and up. The displays were sometimes placed to high for even this age child, and required fairly advanced vocabulary. My 9 year old girl really enjoyed it, but my 6 year old didn't understand it. We need good science exhibits to pique the interest of children so they will explore, and I encourage your participation in this endeavor. Thank you.*
- Disappointing.
- I wish you didn't close so early.
- The Museum was great.
- We have enjoyed our time with you. Your museum is a delight for young and old. I'll tell the appropriate museum folks in San Antonio. Thanks for your hospitality!
- Pretty cool - see you all again!

- We love it. We're definitely coming back!
- My kids loved the shopping area - and grocery buying - day to day-real life-role play - is ecellent!
- Having great fun!
- Do some audio visual on preventing accidents around the house.
- Great fun! I love it!
- *I thought the museum was very fun. The best part was the bike, car and running thing. But why did you take the bear away because I never heard it talk?*
- Great. But you could use some seating for adults. I pregnant and tired.
- We enjoy coming here. It would be nice if you had a water fountain and different types of crafts. And someone that demonstrated ways to make crafts from different types of materials.
- I love drawing. But I love drawing dinosaurs.
- *I brought my 3rd grade class and they loved it! My compliments to the person who designed the "Educator's Guide" - excellent!*
- It was exciting and I am from dallas.
- I enjoyed this place alot. Especially the electronic computer!
- Awesome!
- Great!
- The Austin Children's Museum is very fun and interesting. Thank you for letting my class and I visit.
- I've enjoyed the Museum. It is fun to find out new things!
- I like everything here. You guys think of the most interesting things. I've been here before and I love it!
- I like this place because it teaches people alot of things and the people that work here too.
- *The space ship from recycled materials was wonderful.*
- I didn't have a bad time. It wasn't so bad.
- What do you do for people over 3?
- Mt dad wants to know why you don't explain the perfect circles of sunlight that shine on the floor od the theatre (through the holes in the skylight?). He says that it's an image of the sun (which is why we can view the sun's eclipse throuugh a pin-hole in a shoe box). I think it would make an excellent lesson.
- Nice comment book.
- *I like the circuit toys!*
- *Nice exhibit - but would like to have the tour guide give a more detailed explanation of each display - felt a bit lost.A bit more one on one.*
- *The exhibit is great, especially for 3 1/2 yr old boys who LOVE to push buttons, etc. This is the best place in Austin to take kids. Thanks!*
- Our 2 1/2 yr old enjoyed everything. I wish there were more museums like this across the US
- *Excellent GO POWER exhibit./ Fun and learning experience.*
- *Great gas meter demonstration and electric meter. Maybe I'll turn off the lights when I go home.*
- Austin Children's Museum is real fun.
- There is a science center in Dallas that is way cool. It is alot bigger than this.
- *Cool exhibit. I like the energy exhibit.*
- This is a nice place for kids. Wish they had this when I was young.

GO POWER DESIGNS

done

Car/Bus	17
Solar house	15
Solar panels	2
Solar plane	2
Solar hair dryer	2
Windmill	2

Solar Powered T-shirt

Father-in-law talking - sound/power transformer

Solar map: electronic map goes in your car with arro

Nuclear power

Trash generator

Solar powered camping oven

Sand machine

Light

Data system

Sky crawler

Big balloon

Make gasoline from trash

Automatic room cleaner

Hovering chicken car

Two person space ship

Volcano power house

Sunpower from other stars

Laser power

Solar boat

Sapce car 2000

Go Up car

Organic waste energy converter

Organic Waste - Energy Converter

I helped design the future at $G^0 = P^1$ Power

JHC

a new way to be used as
made from old trash and
the old gasoline from totally
crashed cars.

Brain power

We can

all
work
together
to save

our
world

wind power

I helped design the future at G^oPower Ginny Smith

City of Austin

Proclamation

*Be it known by these presents that
I, Bruce Todd, Mayor of the City of Austin, Texas,
do hereby proclaim
February 6, 1993
as*

Go Power Day at the Austin Children's Museum

*in Austin, and call on all citizens to join me in visiting and in recognizing
the importance of the Go Power Exhibit February 6-June 6, 1993 at the
Austin Children's Museum, in which visitors will learn about the Sources,
People, Pathways and Choices involved in energy production and utilization
through kinetic sculpture, computer simulations, participatory exhibits and
other programming.*

*Mayor
Bruce Todd*

*James E. ...
City Clerk*

Happenings

CHILDREN

Summer theater

The deadline to apply for Summer Youth Community Theatre 93 is Monday. The program, which features theater workshops and a production of *An Enemy of the People*, is open to teen-agers. Call 448-2299.

Romper club

Miss Renee's Romper Club is being offered this summer at Hancock Recreation Center, 811 E. 4th St. The club, which teaches sportsmanship, is for children ages 3-5. Call 441-1567.

Austin Children's Museum

The Austin Children's Museum is at 1501 W. Fifth St. Hours are 10 a.m. to 5 p.m. Tuesday through Saturday and noon to 5 p.m. Sunday. Admission is \$2.50 for adults and \$1.50 for children ages 17 and under. Call 472-2499.

■ "Go Power: An Interactive Traveling Exhibit on Energy" is on display through June 6.

■ Robert Krampf presents "hair-raising" electricity demonstrations at 2 p.m. today and Sunday.

■ The museum's Junior Volunteer Summer Program is open to youngsters in seventh grade and up.

Robert Krampf demonstrates electricity at the Austin Children's Museum at 2 p.m. today and Sunday.

Discovery Boxes. Hours are 10 a.m. to 4 p.m. Saturdays and 1-4 p.m. Sundays. The boxes allow children to explore various aspects of nature. Call 327-8181.

Good Day Ranch

Good Day Ranch, a children's zoo at 10807 Rawhide Trail, is open 10 a.m. to 6 p.m. Wednesdays through Sundays. The ranch features pony rides, cart rides, picnic areas and a gift

LECTURES

The refugee experience

Erica Ayala, a Guatemalan refugee who has been living in Mexico for seven years, speaks about her experience working with other refugees at 7 p.m. Sunday at First Unitarian Church. Call 474-4782.

ETC.

Austin American-Statesman
Fri., May 28, 1993; p. 2
Main Events

Hair-raising experiments

Robert Krampf has brought his traveling science show "Watt is Electricity: the Million Volt Electric Show" to *Late Night with David Letterman*, CNN and, now, to Austin. His 45-minute demonstration uses such contraptions as the "hair-raising" Van de Graff static generator, Faraday's Cage and the million-volt Tesla coil (which shoots off 4-foot sparks). Krampf entertains as he teaches the basics of electricity and electrical safety. When: 2 p.m. Saturday and Sunday. Where: Austin Children's Museum. Admission: Included with museum admission — \$2.50.

David Santos (left) of The Robot Group and Lower Colorado River Authority employees Ronnie Woot and Ronnie Harfender (right) assemble the "Go Power" exhibit for the Austin Children's Museum, which opened February 6 and will be on display until June 6. For exhibit information, call 472-2499.

Time Out

For The Weekend

Saturday, February 6, 1993
Austin American-Statesman

A new, interactive exhibit at Austin Children's Museum explains how energy works / 5

HAPPENINGS

Brasileiro bash

Tonight's the night for Austin's annual Carnaval, when costumed revelers check their inhibitions at the door for pre-Lenten dancing and live music / 6

DINING

Still the tops

In its 15th year of unique success, after another incarnation Jeffrey's continues its tradition of imaginative, urbane dining / 11

COMMUNITY ARTS

Valentines

A heartwarming make-believe story from Belinda Acosta heralds the arrival of Valentine's events / 13

YOUR GUIDE TO FAMILY EVENTS, FINE ARTS AND DINING

Happenings

Illuminating power lesson

Austin Children's Museum exhibit reveals truth behind light switches

By Harley Jebens
American-Statesman Staff

Energy. It's kind of a nebulous concept. A switch is flipped, and the lights come on. Gas is pumped into a car's tank, and the car moves. Food is eaten, and people move. But the way gas and food are converted to energy, and the reason that flicking that switch turns on the lights can be a bewildering notion.

"Go Power," an interactive exhibit for school-age children, which opens today at the Austin Children's Museum, will attempt to clear up some of that wilderness.

Paul Orselli, the developer of the exhibit, said that "Go Power" shows the "pathways and transformations of energy." Through kinetic sculpture, computer simulations, participatory exhibits and other activities, the exhibit teaches about the sources, people, pathways and choices involved in energy production and utilization.

A kinetic sculpture greets visitors as they enter the museum. Kids can turn cranks and push pistons that cause wind turbines and other mechanisms to move about. "The sculpture shows the transformations and movements of energy," Orselli said.

"We start the exhibit with the sources of energy," he continued. "The leaves of our solar sunflower can be manipulated to face a light source, causing the flower to light up. We want to show that oil, coal and natural gas all ultimately come from plants, from decayed plant matter of millions of years ago. So we have thin slices of coal for people to see, where the leaves of actual plants are visible."

Exhibit-goers get a chance to simulate a search for natural gas, find out about transformers and generators, ask questions (via a computer simulation) of people who work for utilities, and see how energy is used in the home in a simulated kitchen. In another part of the exhibit, kids can use an interactive computer program to make their own energy choices (for example providing a city with power solely through solar or wind energy) and see the results of those choices.

Orselli said, "We worked with kids in the classroom during the development stages of 'Go Power' and that's where we got the idea for the transparent gas

Will Hodges and his mother Francie Hodges watch as Evan Williams tries an exhibit showing how meters measure money.

meters. Kids would ask us, 'How do meters measure something we cannot see?' And the transparent meter shows that — how a meter measures the amount of electricity you use. Once we showed them that meters measure money, they got the idea really quickly."

"One of the first things the kids came up with is that food is fuel for the body. That led to the 'food is fuel' laser dissection of the exhibit. Kids can choose how they're going to go on a trip — they can walk, or go on a bicycle, or sit in a car — and then they can choose the fuel to power that journey. And then the computer takes you on an animated journey that simulates a journey you could take using that mode of transportation and that fuel. You can choose to go in a car, and then pick a glass of juice for your fuel. You aren't likely to go too far. But then you can decide to walk, and then pick peanut butter as your fuel, and then the computer will take you on a longer journey."

An initial grant of \$112,000 two years ago from the U.S. Department of Energy (one of the department's first science museum educational grants) helped get the idea of this exhibit off the ground. The Informal Science Foundation division of the National Science Foundation awarded the museum \$151,157 to develop "Go Power."

The design and construction of the 1,200-square-foot exhibit was truly a local — and cooperative — effort. The Lower Colorado River Authority provided letters of support for the initial "Go Power" grant, as well as in-kind

Staff photo by David Kennedy

the sunflower at the Austin Children's Museum. The sunflower lights up when a child touches it.

GO POWER
An interactive exhibit about energy production and utilization. The exhibit is designed for children ages 5 to 12. It includes a kinetic sculpture, a transparent meter, a laser dissection, a computer simulation, and a simulated kitchen.

the kinetic sculpture. The exhibit was provided by the Lower Colorado River Authority. The design of the exhibit was by the Informal Science Foundation. The exhibit is part of the "Go Power" grant. The exhibit is designed to be interactive and educational. It includes a kinetic sculpture, a transparent meter, a laser dissection, a computer simulation, and a simulated kitchen. The exhibit is designed to be interactive and educational. It includes a kinetic sculpture, a transparent meter, a laser dissection, a computer simulation, and a simulated kitchen.

experiments. It has got a colorful, interactive backdrop. There are hands-on activities. There is sophisticated information. But it operates on a simple level. A younger child might be interested in seeing the inside of a computer, seeing the bellows pumping, knowing something we cannot see. An older child can think about the energy behind the exhibit. We want to be entertained by the exhibit, but we want them to take these things and start thinking about them when they leave."

That is that effort. Orselli and the museum staff are developing educational materials to aid in teaching about the museum's concept of energy.

"Go Power" will remain at the Austin Children's Museum until June 6. The exhibit will then go on tour, where it is scheduled through 1996, making stops in Denver, Chicago and Mobile, Ala.

The museum, at 1501 W. Fifth St., is open from 9 a.m. to 5 p.m. Tuesday through Saturday and noon to 5 p.m. Sunday.

Family Guides

Useful new books for your travel library

Inspected, Rated, & Approved: Bed & Breakfasts & Country Inns (\$14.95, The American Bed & Breakfast Association). Families who do a lot of traveling can get the lowdown on accommodations from this official guidebook of the bed and breakfast industry. Included are more than 450 bed and breakfasts that have passed a careful inspection and rating system across the country. Each entry has an association rating (from acceptable to outstanding), includes descriptions of the lodging, rates, meals, and area attractions, and indicates whether families are really welcome. Most entries also have guest comments, and one chapter lists bed and breakfast reservation agencies and tips on selecting accommodations.

Guide to The Amish Country by Bill Simpson (\$9.95, Pelican Publishing Company). Pennsylvania's Amish Country attracts about four million visitors every year, and there is more to see and do there than most families might realize. In this guide, local resident Bill Simpson gives an insider's scoop on where to stay, how to find the local fairs, firehouse suppers, and farmer's markets, and where to find the best restaurants, museums, and covered bridges. A sampling of his suggestions: book lodgings during winter months, when rates are substantially lower; try the local delicacies (especially the shoofly pie and homemade root beer); and bike on Sundays, when traffic is slowest.

An Electrifying Exhibit

Learning all about energy in Texas

ON FEBRUARY 6TH, the Austin Children's Museum opens *Go Power*, an exhibit designed to teach families how energy sources are created and used. Sponsored by the U.S. Department of Energy and the Lower Colorado River Authority, the attraction includes computer simulations, kinetic sculptures, and hands-on activities. Visitors can explore the control room of a power plant, try out new energy devices, use a computer to simulate solar power, or become energy investi-

gators and track the paths of electricity, natural gas, and alternative energy sources around a kitchen. The exhibit, which will run through June 6th, is scheduled to travel to other cities in 1993, including Mobile, Alabama, and Chicago. Admission to the museum and the exhibit is \$2.50 for adults, \$1.50 for children ages 17 to 2, and free for children under 2. For information, call 512-472-2494.

Midwinter Delights

What's going on: cowboys, carnivals, and colorful cultures

Cowboy Poetry Gathering. From January 26th to the 31st, thousands of cowgals and guys will stampede into Elko, Nevada, for the ninth annual celebration of this uniquely western event. In addition to poetry readings, there are workshops in cowboy songwriting and rawhide braiding, displays of ranch crafts, and entertainment, such as western films, yodeling, the Cowboy Music Jamboree, and the fabulous Buckaroo Breakfast. A weekend pass is \$12; children ages 12 and under are admitted free. Call 702-738-7508 for more information.

Mobile Mardi Gras. The New Orleans celebration may be more famous, but Alabama has been home to this exciting fete since 1703. From February 10th to Mardi Gras Day on the 23rd, merriment is in high gear, with parades of elaborately decorated floats and costumed marchers, balls, colorful carnivals, and the coronation of the Mardi Gras king and queen. Admission to the parades is free. Call 800-252-3862 for information.

Chinese New Year. This year, from January 23rd to February 6th, San Francisco hosts a colorful and culturally enriching festival. To help ring in the Year of the Rooster, visitors can attend the Miss Chinatown U.S.A. pageant, a variety of cultural programs, and a huge, visually stunning parade on February

6th. Throughout the event, Chinatown merchants line the streets with Chinese wares and delicacies. Admission is free for most events. Call 415-391-9680 for information.

Dining, Family-style

A Massachusetts restaurant with unusual extras

DAVID'S RESTAURANT in the historic whaling port of Newburyport, Massachusetts, offers a dining arrangement that

Cowboy poetry festival in Nevada

truly caters to parents and children. The lower level has a children's dining area with child care, where kids can play and dine. The playroom is equipped with child-size tables and chairs, videos, toys, games, and crafts, and the menu has plenty of kid favorites, such as pizza, cheese melts, chicken nuggets, ice cream, and juice popsicles. Adults have their choice of two dining atmospheres: a formal upstairs restaurant serves elegant standards, such as grilled salmon or sautéed lobster, and a downstairs pub offers hamburgers and pizzas. Parents' entrees range from \$14 to \$21 in the formal restaurant and from \$6 to \$9 in the pub; meals for children ages 18 months and older cost \$3, regardless of the choice. For more information, call 508-462-8077.

GO POWER
Traveling Exhibit Schedule

1993

Sept. 20 - Dec. 26 Youth Museum of Southern West Virginia
Beckley, West Virginia

1994

Jan. 10 - May 5 Discovery Center Museum
Rockford, Illinois

June 5 - Aug. 24 Ann Arbor Hands-On Museum
Ann Arbor, Michigan

Sept. 18 - Jan. 15 Exploreum
Mobile, Alabama

1995

Mar. 6 - May 29 Texarkana Museums
Texarkana, Texas

June 15 - Aug 13 Children's Hands-On Museum
Tuscaloosa, Alabama

Sept. 4 - Nov. 26 Chicago Academy of Sciences
Chicago, Illinois

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