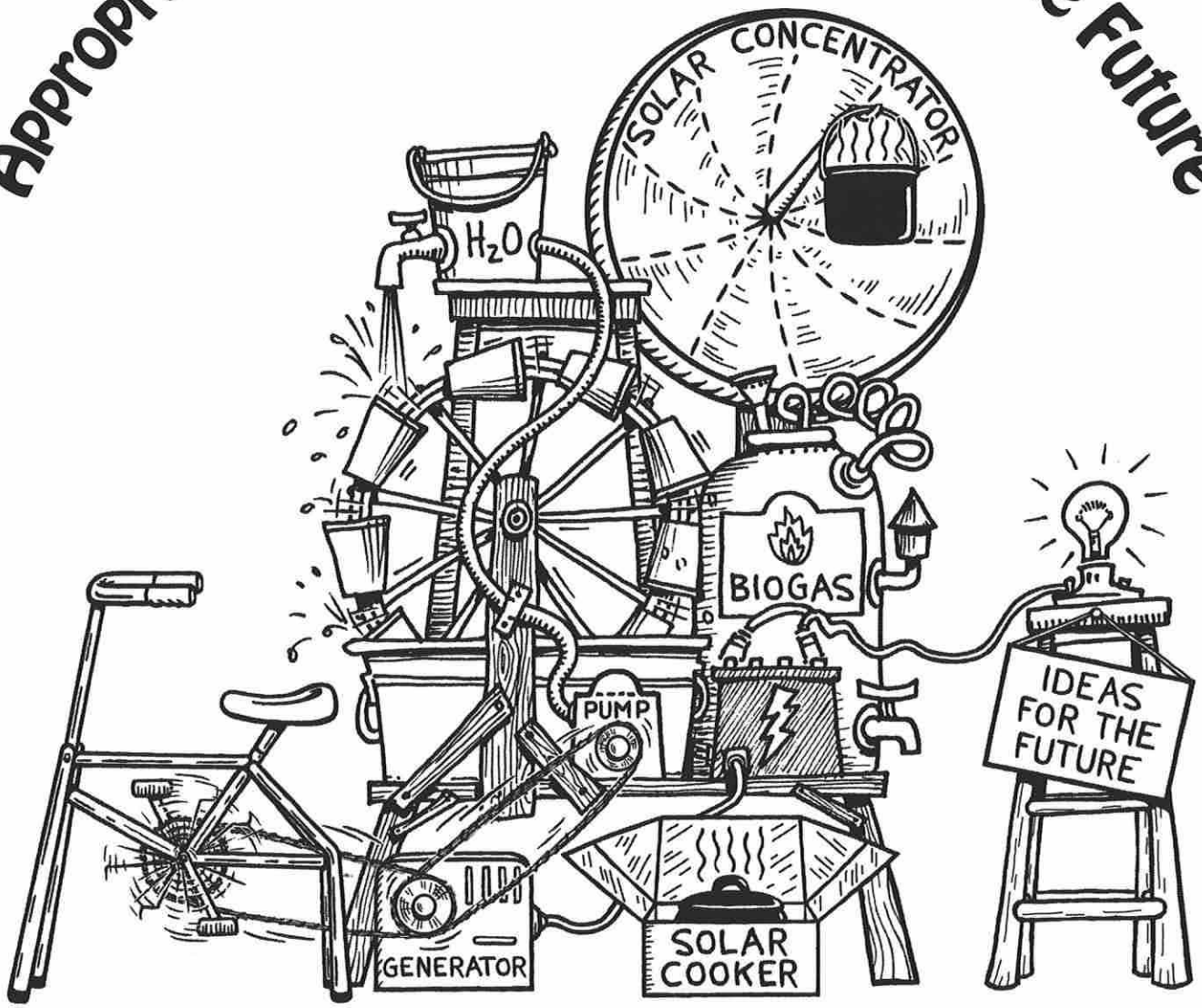
Appropriate Technology for a Sustainable Future



By John Eckfeldt

The Sustainable Technology Education Project - Phase 1

STEP-1

VICTORIA INTERNATIONAL DEVELOPMENT EDUCATION ASSOCIATION VIDEA

August 2003

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- The Victoria International Development Education Association (VIDEA)
- The GAIA Project, a partnership between the Sierra Club of BC and the Salvadorian Centre for Appropriate Technology (CESTA)
- John Eckfeldt, Technology Education teacher

Additional information about this project can be found on the VIDEA website at: www.videa.ca/step1

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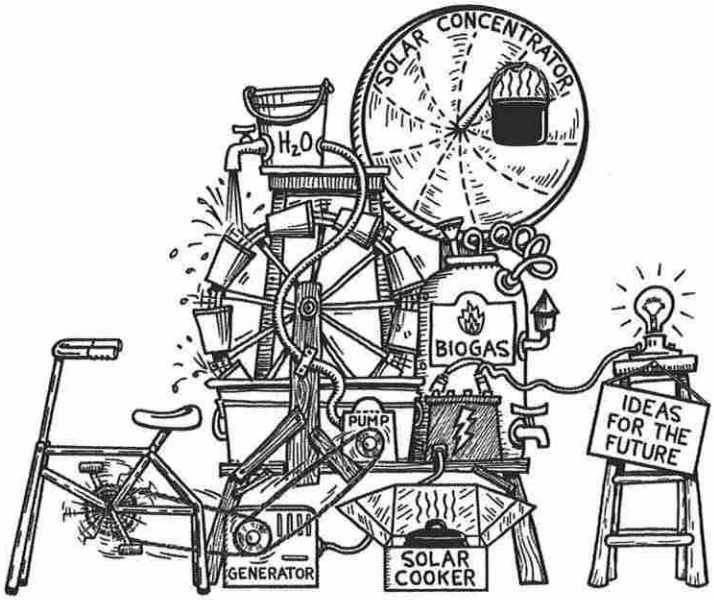
APPROPRIATE TECHNOLOGY FOR A SUSTAINABLE FUTURE



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PREFACE

WHY TEACH APPROPRIATE TECHNOLOGY?

As the population on the planet continues to grow, the resources needed to sustain life are stretched. It is our responsibility as educators to explore with our students the current challenges we face as global citizens and engage them in finding solutions. We invite teachers and students to examine appropriate technology (AT) as a sustainable solution to many challenges in the North (industrialized countries) and the South (developing countries).

GOALS OF THIS APPROPRIATE TECHNOLOGY RESOURCE GUIDE

- stimulate analysis of the positive and negative impacts of everyday technology
- examine local and global concerns about technology and promote appropriate technology as a sustainable solution
- promote the role that Canadian organizations and individuals play in the research and development of appropriate technology
- instill a sense of global citizenship and appreciation for human resourcefulness through the study, design and construction of appropriate technology alternatives

WHAT'S IN THIS RESOURCE GUIDE?

The resource guide is divided into three chapters. The chapters progress from exploring basic concepts of appropriate technology to building a functional solar cooker.

CHAPTER 1 INTRODUCTION TO APPROPRIATE TECHNOLOGY

- Explores what technology is, how we view it, and the need to critically examine it
- Introduces appropriate technology with a local and global perspective

CHAPTER 2 COOKING UP A SOLUTION

- Examines household cooking energy and its related problems both locally and globally
- Discusses a number of appropriate technology solutions
- Gives students an opportunity to build a simple solar or retained-heat cooker from plans

CHAPTER 3 EXPLORING SOLAR COOKING

- Describes solar cooking in greater detail and gives students an opportunity to build a more sophisticated solar cooker from plans
- Explores global applications of solar cookers
- Presents a solar cooker design challenge where students work as a team of inventors and builders to design and produce their own unique solar cooker

CHAPTER ORGANIZATION

Each chapter is divided into sections, each of which contains two components: a teacher information page and student handout pages, suitable for photocopying.

The teacher information page includes:

- key concepts
- materials required
- preparation
- lesson plan
- resources

The student handout pages include:

- background information
- numerous activities

> *The impact that appropriate technology can have on people has the potential to make the difference between prosperity and poverty, even between survival and death.*
>
> Wicklein & Katchmar, in Wicklein 2001

HOW TO USE THIS GUIDE

The teacher's page gives an overview of the lesson. The student handout pages contain the content of the lesson and are designed for photocopying and handing out to the class. No writing is required on the handouts, so they could be re-used by several classes. Numerous activities provide options for teachers and students.

The resource guide is designed to be very flexible. The chapters are presented in a certain order, but a teacher may wish to skip a chapter, or interweave activities from different chapters into one lesson.

Each chapter is designed to stand alone, so teachers can choose what is appropriate for their class. A teacher might choose to progress through the chapters as a class progresses through school years. For example, a teacher could cover chapter 1 in a Grade 8 class; chapter 2 in a Grade 9 class; and chapter 3 in a Grade 10, 11 or 12 class.

This resource guide is the first in a planned series on appropriate technology. It is available in print form and on the Internet. This material is intended primarily for use by high-school teachers and students, particularly in the discipline of Technology Education. However, it is applicable to other subject areas, such as science, social studies and global education, and could be used at the pre- and post-secondary levels. Ultimately, it could be used as part of an interdisciplinary study (e.g., combining Tech Ed, Science and Social Studies) or in conjunction with a field trip to a country in the South.

FEEDBACK

A Teacher Feedback form is provided in the Appendix. Please take the time to fill it out once you have used this resource. The form can also be filled out on the website.

1.1 QUESTIONING TECHNOLOGY

KEY CONCEPTS

* Technology can be hard to define.
* Technology is something we tend to take for granted.
* Technology is generally accepted as progress and is seldom criticized.
* Technology has many hidden side effects.

MATERIALS

* Photocopies of the Student Handout
* Magazines to cut up
* Materials for making posters
* Video (optional)

TIME

* 1-2 periods

TIPS TO CONSIDER BEFORE BEGINNING

1. Introduce this unit at the end of the previous class by asking students to bring in two definitions of the word "technology", one from a dictionary and one in their own words.
2. Show the video *Technology's Price* to introduce the topic.
3. Ask the students to compile a booklet on Appropriate Technology (AT) that could contain:
   * a coloured cover with a drawing of what AT means to them
   * their definition of technology and class notes on the discussion
   * write up of the activities in each section

THE LESSON PLAN

PREPARATION

1. Read the student handout 1.1 and decide which activities you wish to use with your class.
2. Write a thought provoker on the board for discussion at the end of class, such as "We are becoming the servants in thought, as in action, of the machine we have created to serve us." John Kenneth Galbraith (You could substitute another quote.)
3. Photocopy the student handout 1.1.
4. Obtain video (optional).

LESSON

1. Ask the students to define technology. Write their definitions on the board.
   * Ask the students what common technologies they use. List them on the board or write them on index cards and tape these on the board. Then group them into subject areas, such as transportation, communication, energy, food. (This list will be used later to determine which ones fulfill the criteria of AT.)
   * Ask students which technologies they could live without if they had to and put an "x" beside them.
   * Ask students which ones, if any, have negative impacts. Is there such a thing as good or bad technology? How do our technologies reflect our values?
2. Pass out the student handout 1.1. Have students read it and then guide them through the activities.
3. This would be a good time to show a video, if one is available.
4. Discuss the thought provoker on the board as a way of reviewing the lesson.
5. Give students a preview of what they will be doing in the next section.

RECOMMENDED RESOURCES

VIDEOS

Technology's Price. 1992. 28 minutes. NGS Publishing. This program focuses on various pollution and technology issues and their relationship to society and the concept of sustainable development. Ministry Recommended for Science 8-10. Closed Captioned.

RESOURCE GUIDES

Staniforth, S. 1997. *The Technology Trap. Transportation: Who's In the Driver's Seat?* Society Press. Victoria, B.C.
Staniforth, S. and S. Gage. 1998. *Follow the Paper Trail. Technology, Wood Consumption and Alternatives.* Society Press. Victoria, B.C.

BOOKS

Mander, Jerry. 1991. *In the Absence of the Sacred: The Failure of Technology and the Survival of the Indian Nations.* Sierra Club Books. San Francisco.
Ryan, J.C. and A.T. Durning. 1997. *The Secret Life of Everyday Things.* Northwest Environment Watch. Seattle, WA.

WEBSITES

www.adbusters.org Adbusters is a Vancouver-based, anti-consumerist magazine.
www.wired.com E-Waste: Dark Side of Digital Age. Wired magazine looks at the hazards of electronic waste.
www.zerowaste.org The Zero Waste Alliance (ZWA) is a non-profit organization dedicated to the development and implementation of practices that lead to the reduction and elimination of waste and toxics.
www.davidsuzuki.org The David Suzuki Foundation uses research and education to promote ecologically sustainable solutions.
www.worldwatch.org The World Watch Institute focuses on the interactions between key environmental, social, and economic trends and how to achieve an environmentally sustainable and socially just society.
www.teriin.org/terragreen Terragreen is an e-magazine that provides analytical, unbiased and straightforward reports about energy, environment and sustainable development in India.

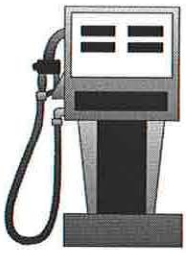
1.1 QUESTIONING TECHNOLOGY

Technology has improved the human condition in many ways — longer life spans, higher standard of living, and increased mobility and communication. New technology tends to be accepted as "progress," as the key to society's problems and a better future, but the impact of technology is never neutral.

We need to consider not only the usefulness of technologies but also their impact on the environment, health and society. We need to ask, "Is this technology necessary?" If it is, then we need to examine the whole life cycle of the technology to find ways to minimize any negative impacts.

For example, the usefulness of a car is obvious, but many of the costs are not so obvious. To manufacture a car, metals have to be mined and processed, plastics need to be made from oil, and rubber processed from trees. All the components need to be transported around the world to a factory, where cars are assembled. Before the car is even on the sales lot, the environment has been impacted in many ways.

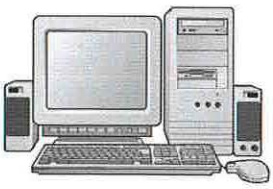
Now consider all the gasoline, oil and other chemical fluids needed to keep the car running. The car needs a system of roads, highways, bridges, and tunnels. Again, we need to ask where the materials come from and what environmental damage was caused along the way. By the end of its life, a car has converted millions of litres of fossil fuel into polluting gases and particles. Finally, the unsalvaged parts of a car go to the junkyard.



The negative impacts of technology on the environment can accumulate, leading to more serious problems such as a hole in the ozone layer and global climate change.

WHAT CAN WE DO?

We are consumers in a consumer society. Companies must continually produce new products and we must continually buy in order for them to make a profit. We are told that we "love to shop." Advertising creates new "needs" and built-in obsolescence keeps us coming back for more. For example, newer, faster computers make the older, slower ones obsolete in a very short period of time.



This compulsive shopping may be killing us. Why? Because we are depleting the world's resources and polluting the air and water and soil that we depend on to survive.

So how can we be smarter consumers? Let's consider the 3 Rs – Reduce, Reuse, Recycle. Of these, "Reduce" is first for a reason: it makes the most impact. When you go to buy something, ask

What is technology? We hear the word often enough, but do we really know what it means? Here are a few definitions:

- **Applied science, a technical means of achieving a practical purpose**
- **The use of tools, materials and processes to solve a problem or fill a need and improve the human condition**
- **Human innovation in action**

TIME MACHINE

Sixty years ago, there were no passenger jets, personal computers, microwave ovens, photocopiers, automatic washing machines, fluorescent lights, or shopping malls. Space shuttles and laser weapons were science fiction. In a lifetime, all this has changed.

We have so many time-saving devices these days that you might imagine having mostly "free time." Ivan Illich, world-renowned critic of institutional structures and proponent of alternative concepts, observed that if you include the time needed to earn money to buy and repair all the expensive "time-saving" gadgets in our lives, technology actually deprives us of time.

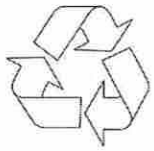
"

Much of what we purchase is not essential for our survival or even basic human comfort, but is based on impulse, novelty, a momentary desire. And there is a hidden price that we, nature and future generations will pay.

David Suzuki

"

yourself, "Do I really need this? What is its impact on the environment? Is there an alternative product with less wasteful packaging?" You can also select products that can be reused or recycled.



WHAT HAVE YOU GOT TO LOSE?

There are a lot of things you could do without and at the same time gain some benefit. For instance, if you rode a bicycle instead of driving your car, you would get exercise. Getting exercise is a healthy way to release stress. You would probably leave home earlier and not feel so rushed. If more people made that choice, there would be fewer traffic jams, and less pollution and related health problems.

ACTIVITIES

1. Write a list of common technologies you use. Indicate which ones you could live without, if you had to. Which ones, if any, have negative impacts? Is there such a thing as good or bad technology? Do these technologies reflect your values?
2. Collect technology-related stories and pictures from magazines, newspapers and the Internet and bring them to the next class. In small groups, discuss the articles, images and captions and how technology is portrayed in them. Questions to address might include:
   - What is the purpose of this item? (e.g., where is it from, who produced it and why?)
   - Who is it appealing to?
   - What are some possible problems with it? (e.g., what impacts can't we see? What was left out or ignored?)
   - How is technology portrayed here? (e.g., as positive, negative, beneficial, destructive?)

   Now share your findings with the whole class (posters are a good way), and discuss this question: "Why do you think society criticizes technology so rarely?"
3. Make a checklist of things to consider in your future purchases of technology (e.g., do I really need it? can it be recycled?) Now apply that checklist to three technologies you or your family purchased recently (these can be as simple as a pencil or as major as an automobile). How did they rate?
4. Do an Internet search for a critique of a technology and report back to the class (e.g., try Adbusters **www.adbusters.org**, Zero Waste **www.zerowaste.org**, E-Waste **www.wired.com**, The David Suzuki Foundation **www.davidsuzuki.org**, The World Watch Institute **www.worldwatch.org**, Terragreen **www.teriin.org**).

1.2 WHAT IS APPROPRIATE TECHNOLOGY?

KEY CONCEPTS

* Appropriate technology (AT) is suitable for the conditions of a given situation.
* AT solves problems in a way that is fitting for the people who will use it and sustainable for the natural environment.
* There are many ways we can use AT in our lives.

MATERIALS

* Photocopies of student handout 1.2

TIME

* 1-2 periods

TIPS TO CONSIDER BEFORE BEGINNING

AT is technology that is most suitably adapted to the conditions of a given situation. It is compatible with the human, financial and material resources that surround its application. (*A Handbook on Appropriate Technology. 1983.*)

"At present there can be little doubt that the whole of mankind is in mortal danger, not because we are short of scientific and technological know-how, but because we tend to use it destructively, without wisdom. More education can help us only if it produces more wisdom." (E. F. Schumacher, "founder" of the AT movement)

THE LESSON PLAN

PREPARATION

1. Read the student handout 1.2 and decide which activities you wish to use with your class.
2. Write a thought provoker on the board for discussion at the end of class, such as "When we try to pick out anything by itself, we find it hitched to everything else in the universe." John Muir (You can substitute your own quote.)
3. Photocopy the student handout 1.2.

LESSON

1. With the class, review what was covered in the previous lesson.
2. Pass out the student handout 1.2. Have students read it and then guide them through the activities.
3. Discuss the thought provoker on the board as a way of reviewing the lesson.
4. Give students a preview of what they will be doing in the next section.

RECOMMENDED RESOURCES

BOOKS

A Handbook on Appropriate Technology. 1983. Canadian Hunger Foundation. Brace Research Inst. McGill University, Montreal.

Hazeltine, B. and Bull, C. 2003. *Field Guide to Appropriate Technology*. Brown University, USA. Includes articles on topics such as energy, transportation, water supply and tools.

Schumacher, E.F. 1973. *Small is Beautiful: Economics as if People Mattered*. New York: Harper & Row. A classic of the AT movement.

Wicklein, Robert C. (Ed.) 2001. *Appropriate Technology for Sustainable Living*. 50th Yearbook of the Council on Technology Teacher Education. Glencoe McGraw-Hill. A good resource for Tech Ed teachers interested in AT.

WEBSITES: AT IN CLASSROOMS

www.stepin.org Case studies and projects for 11-16-year-old UK students.
www.consensusweb.net/sda Project for 16-18-year-old UK students.

1.2 WHAT IS APPROPRIATE TECHNOLOGY (AT)?

The term appropriate technology (AT) is used to describe:

1. a holistic approach to choosing a technology for a given situation
2. a specific tool, device or system
3. the social movement advocating the use of appropriate technology to address basic human needs

Technology - noun. The use of tools, materials and processes to solve a problem or fill a need and improve the human condition

Appropriate -adj. Especially suitable, fitting, or compatible

AT is technology that is most suitable to a given situation. Designers of AT must analyze a problem and try to solve it without creating more problems. The solution must consider the human, financial and material resources available.

CASE STUDY 1 : THE FREEPLAY WIND-UP RADIO

Trevor Baylis initially invented this radio to help health educators teach Africans about AIDS prevention over the radio. The problem was that most poor people had no electricity and couldn't afford to keep buying batteries. His simple idea for a wind-up radio set in motion what was to become an extraordinary story of AT in action.

The BayGen FREEPLAY(r) is powered by a Dynamo Power Generator driven by a replaceable spring that's good for over 6,500 hours of operation. A built-in handle is used to wind the spring for about 20 seconds. This will run the radio for approximately 30 minutes. The Freeplay radio pays for itself in just over a year with the savings on batteries. The latest version comes with a built-in solar panel, rechargeable batteries and a 110-volt plug. The radio has found a wide market in the developed world for emergencies, camping, boating, and hunting, and for people living in remote areas.

What other small electrical appliances could be powered by wind-up power?

Freeplay™

Energy for life

The appropriate technology movement began in the 1950s as one of the first efforts to critically examine technological choices on a global level. More recently, the principles of appropriate technology have evolved and been absorbed into the concept known as "sustainability."

Development: developing or being developed

Sustainable: of, relating to, or being a method of harvesting or using a resource so that the resource is not depleted or permanently damaged

Sustainable development: development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs. (Gro Bruntland, Director-General of the World Health Organization)

In order for any technology to be sustainable, you must look at the whole picture, not just the technical problem itself. Solving the problem becomes a study of reducing the costs (harm) to the environment, considering all the resources necessary to produce the technology, and assessing all the byproducts.

In addition, appropriate technology tries to solve the problem in a way that is fitting for the people who will use it. What is functional in one place may not work at all in another. What is accepted as appropriate may differ from community to community.

In North America, there are often choices for the type of technology we use. For example, we could choose to use bicycles or public transport rather than use a car. We are not rejecting the technology of the car, but deciding when it is "appropriate" to use one.

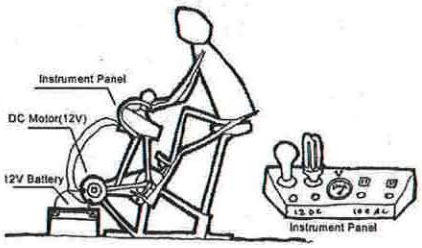
CASE STUDY 2 : HUMBOLDT STATE UNIVERSITY, CALIFORNIA

Pedal power is one of the most efficient ways to transfer human energy into motion. Before electric motors were invented, foot-operated treadle power was used to power many things from sewing machines to woodworking tools. Bicycles, best known as efficient transportation, have been adapted by inventors of appropriate technology to power all sorts of things from flour mills to construction machinery.

Students at the Campus Center for Appropriate Technology, Humboldt State University, have adapted bicycle technology to power food blenders, washing machines, belt sanders, saws, drill presses, TVs, and even computers.

If you work in a remote area or want live without electricity, pedal power may be the answer to your computer needs. Because computers are very sensitive to power surges, students have designed a way to plug a laptop into a battery connected to a generator. This generator is connected to a bicycle assembly, so you can charge up your batteries before using your computer.

What other devices could be adapted to pedal power?



Credit: P.E.D.A.L.

EXAMPLES OF AT DEVICES

HEAT

- Solar cookers for harnessing energy from the sun
- Efficient stoves for burning wood, charcoal, sawdust, rice husks
- Solar hot-water heaters for bathing, washing clothes and dishes

FOOD PROCESSING

- Solar food dryers for preserving grains, fruits and vegetables
- Hand-operated hydraulic presses for juice and oil extraction
- Pedal-powered machinery for dehusking nuts and seeds, threshing and grinding grain, and blending food

SANITATION

- Solar water pasteurizers and ceramic water purifiers for killing water-borne diseases
- Composting latrines for recycling human and plant wastes

"

The philosophy of appropriate technology reaffirms what most of the world's villagers know inherently — that culture, social systems, politics, religion, economics and ecology are all threads in the same fabric of life; and that technology exists only as a tool, a loom upon which all the other threads are woven.

Clavaud D. et al, 1982, in Wicklein 2001

"

Credit: P.E.D.A.L.

SOME CRITERIA FOR LOW-TECH APPROPRIATE TECHNOLOGY

- Simple - doesn't require complicated parts
- Small-scale construction - doesn't require big dams, buildings, factories
- Affordable and cost-effective - doesn't require a lot of capital
- Durable - resistant to breakage
- Environmentally friendly - non-polluting, energy-efficient, uses renewable resources
- People friendly - easy to build and use, affordable
- Labour intensive - generates local employment, not mass produced
- Community based - uses locally available materials and skills; produced, maintained and controlled by local people
- Flexible - can be adapted to different locations and tasks
- Ecological- can be recycled, reused, or repaired; parts can be replaced
- Safe - doesn't cause disease or death for workers, consumers or other living things

A technology does not have to meet all these criteria to be AT. The Freeplay radio, for example, is centrally produced in a few locations under mass-production conditions by disabled people.

WATER SYSTEMS

- Simple, hand-operated water pumps and solar-powered pumps for domestic use and irrigation
- Hydraulic ram pumps for pumping water uphill

TRANSPORTATION

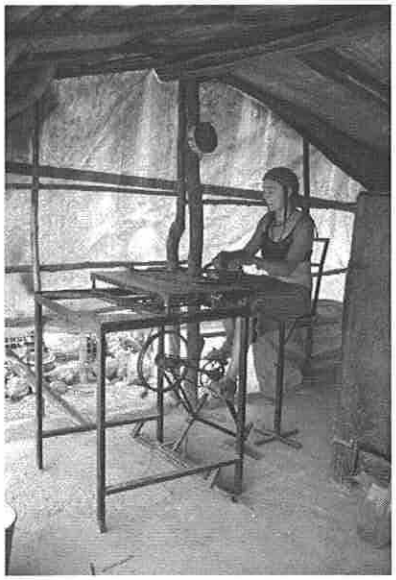
- Bicycles and tricycles for personal and cargo transportation

ENERGY

- Wind power for generating electricity
- Photovoltaics for generating electricity from solar power
- Small-scale hydropower systems for generating electricity
- Biogas systems for using methane from animal manure

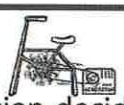
CONSTRUCTION AND ARCHITECTURE

- Low-cost, labour-intensive materials for construction (straw bale, cob, rammed-earth blocks)
- Architectural designs for passive solar or earth-sheltered buildings
- Solar architecture for heating the building
- Pedal-powered tools for building (band saws and drill presses)



A pedal-powered roofing tile machine in Sierra Leone.
Credit: One Sky

Recently, we have been hearing about new, renewable energy sources, such as wind power, photovoltaics, and tidal power. These are relatively "high tech" solutions that could be appropriate for certain locations. However, in this resource guide, we are going to focus on the kind of "low tech" AT solutions that E.F. Schumacher envisioned.

ACTIVITIES 

1. In a class discussion, decide which criteria you like best to determine if a technology is "appropriate."
2. Go over the list you prepared earlier, "Technologies I use," and indicate with a star which ones qualify as AT, using the class's criteria. How many qualified?
3. In small groups or individually, research one of the examples of AT devices or an application that interests you. Report your findings to the class.
4. Think about your community and identify one example of AT in use and one example of applications where AT could be used instead of non-renewable, polluting energy.
5. Visualize what the world would look like in 10 years if more AT were used. Individually or in small groups, design an alternative mode of transportation, considering the following elements:
   - Composition and source of materials
   - Source of energy
   - Number of passengers
   - Safety features
   - Special features
   - Public and private transit options
   - Environmental impacts
   - Social impacts
   - Cost
   - Product name
   - Promotional logo and slogan

   Be creative and inventive – have fun with this challenge! Present your creation to the class, including sketches or other visual aids.
6. Option: The AT Community Challenge.
   Your class is on a bicycle trip. Going through a wilderness area, an earthquake destroys the bridges. You will be without modern conveniences for an indefinite time, and must work together to create a sustainable community. In small teams, you must design an AT system to provide for one of the aspects your community needs, using only the materials you have with you, and what you can gather from the surrounding area. Remember to minimize environmental impact, and use renewable energy wherever possible.
   - Each team designs a system, such as water, food, lighting, transportation, or shelter.
   - Each team must work together to brainstorm ideas, choose one, sketch their ideas, and then make a model or a poster depicting the system.
   - Each team presents their system to the class and discuss the process they went through.
   - The teams arrange all their posters or models to indicate an integrated community of different AT systems.
7. Option: Do an Internet search of groups conducting AT research and development.
   - Campus Center for Appropriate Technology, Humboldt State University, California. University students work with pedal power, solar, and biodiesel.
   - The Centre for Alternative Technology, Wales. Europe's foremost eco-centre tests, uses and displays AT and offers courses.
   - The Intermediate Technology Development Group in England works with AT to develop practical answers to poverty.

1.3 GOING GLOBAL WITH AT

KEY CONCEPTS

* The majority of the world's population lives in developing countries (sometimes called the Majority World), where living conditions are far different from ours.
* AT is particularly suitable for developing countries.

MATERIALS

* Photocopies of student handout 1.3
* Class access to the Internet, if possible
* Video (see Recommended Resources)

TIME

* 3 periods

TIPS TO CONSIDER BEFORE BEGINNING

1. After the students have read the handout as far as International Development and AT section, show one of the videos listed in Recommended Resources or one of your choosing. This will help demonstrate what life is like in the South.
2. Consider inviting a guest speaker from a local non-governmental organization (NGO) or ask students to research an NGO and invite a speaker.
3. A second video would fit nicely at the end of this lesson.

THE LESSON PLAN

PREPARATION

1. Read the student handout 1.3 and decide which activities you wish to use with your class. Decide how you will schedule the reading and activities over several days.
2. Use Let Me Fix Your Problem as a thought provoker or choose your own variation on this theme. Option: Ask students to write a page or do a group skit about an imaginary technology that goes wrong. Why would people be skeptical about trying a foreign technology or an improved version of a faulty technology?
3. Photocopy the student handout 1.3.
4. Obtain a video (see Resources).

LESSON

1. With the class, review the material covered in the previous lesson.
2. Ask the class how many of them have moved here from another country or travelled in other countries, particularly ones in the South. Ask them to describe the level of technology used there compared to here. Did they see any AT in use? If you have travelled, share some of your experiences related to technology.
3. Pass out the student handout 1.3. Have students read as far as International Development and AT. Discuss the notion of North and South countries. What do we understand by the different terms? Why is there such a disparity?
4. Option: Show a video.
5. Have students read the remainder of the handout and guide them through the activities.
6. Discuss Let Me Fix Your Problem as a way of reviewing the lesson.
7. Give students a preview of what they will be doing in the next section.

RECOMMENDED RESOURCES

VIDEOS

No Spare Parts. 1990. 22 minutes. Asterisk Film and Videotape Productions Ltd. Victoria, B.C. In Ghana, everything is used and reused; nothing is discarded. It is a recycling lesson for the developed world. Available from VIDEA.

Trees, Toilets and Transformation. Inspirations from El Salvador. 1995. 28 minutes. Variations on a Wave. Victoria, B.C.

Producing Miracles Everyday. 1990. 23 minutes. Adobe Foundations. In the developing world, millions of people survive by creating their own unique jobs. Available from VIDEA.

BOOKS

Smillie, Ian. 2000. *Mastering the Machine Revisited.* ITDG Publishing. London, UK. This book is about the connection between poverty, aid and technology.

Weisman, A. 1998. *Gaviotas: A Village to Reinvent the World.* Chelsea Green Publishing Company. Vermont, USA.

Wicklein, Robert C. Ed. 2001. *Appropriate Technology for Sustainable Living.* 50th Yearbook of the Council on Technology Teacher Education. Glencoe McGraw-Hill. California, USA. The yearbook discusses issues related to technology teacher education.

WEBSITES

www.partners.ca/index.htm The Canadian Hunger Foundation / Partners in Rural Development. This site includes resources for teachers and students related to AT and international development. Primarily for grades 1-6.

www.idrc.ca The International Development Research Centre. This site highlights innovative science applications in West Africa, East Africa, and Latin America.

www.itdg.org The Intermediate Technology Development Group. Practical answers to poverty.

www.kidscanmakeadifference.org Kids Can Make A Difference. Inspiring kids to end hunger and poverty in their communities, their country and their world. For middle- and high-school students. A teacher's guide about poverty and hunger, including quizzes and fact sheets may be ordered.

www.videa.ca Vancouver International Development Education Association (VIDEA). Resources for educators and students on world issues and global citizenship.

1.3 GOING GLOBAL WITH AT

Why are the benefits of technology divided so unevenly amongst the world's population? Learn more at The Global Citizenship Website: www.videa.ca

As we go about our daily lives, it's easy to think that everyone lives as we do, and that we all share the same concerns. Yet the industrialized or developed nations make up 19 per cent of the world's population and consume 52.3 per cent of the world's energy. At least 2.4 billion people do not have access to toilets or latrines and over 1.1 billion people do not have access to clean drinking water.

Given that the standard of living in the North is causing severe damage to the environment, can the rest of the world live as we do? If not, how can we achieve a sustainable standard of living for all the world's people?

NORTH/SOUTH

Many terms are used to describe the disparity between different countries. These terms have changed over time and will probably continue to change to reflect current attitudes. Here are a few examples:

Rich	Poor
Haves	Have Nots
Developed	Developing or Underdeveloped
Industrialized	Non-Industrialized
North	South
Highly developed	Less developed
First World	Third World

The writers of this material prefer the term North/South, as it does not presuppose that the poor countries need to be like the rich ones. In many ways, people in the South have been leaders in AT, and we in the North could learn much from them about living lightly on the Earth.

Which terms do you prefer? Think up your own terms.

TECHNOLOGY TRANSFER

The exchange of technology between nations is called "technology transfer," and it can flow both ways. In the past, many of the technology transfers from the North to the South, such as nuclear power plants, electrical grids, highways and factories, were inappropriate because they:

- required expensive components
- required sophisticated training to operate
- were too large scale for the community
- created few jobs at a great cost
- produced products that were too sophisticated for the local educational level

- produced products that were too expensive for the local people to buy
- led to rapid urbanization
- required maintenance personnel who were not available locally
- required spare parts that were expensive and not available locally
- were unacceptable for use by the local people for social, cultural or political reasons
- transferred the technology without transferring the expertise or control of the technology

Although transferred technologies may have increased production for factory owners and industrial farms, they have often left the local people impoverished, under employed, and cut off from their traditional rural way of life. Some people consider technology transfer to be primarily a social process that requires the local community's resources, skills and knowledge, in order to be successful.

INTERNATIONAL DEVELOPMENT AND AT

Canadian International Development Agency

Agence canadienne de développement international

There are many organizations involved in the transfer of AT between the North and South. At the international level, the United Nations (UN), and in Canada, the Canadian International Development Agency (CIDA), are responsible for international cooperation programs. CIDA works with various international organizations, agencies and businesses to support projects in more than 100 of the poorest countries of the world.

There are also many non-governmental organizations (NGOs) working in the field of AT to meet the needs of local people. Below are a few Canadian NGOs.

THE SANCTUARY PROJECT'S CANADA/CUBA PROJECT

SANCTUARY FOUNDATION

The Sanctuary Project works with "at risk" youth in Canada, training them in bicycle mechanics, computer technology, ski and snowboard technology, and life skills. Sanctuary operates a similar program in Cuba, and ships thousands of donated bicycles to Cuba each year. Its goal is to promote bicycles, cargo tricycles and bike trailers as a fundamental component of Cuba's transportation system. Check out **www.sanctuary.bc.ca**.

PEDAL (PEDAL ENERGY DEVELOPMENT ALTERNATIVES) AND MAYAPEDAL

These creative inventors develop pedal-powered technologies as a means to reduce our negative environmental impact and improve our quality of life locally (Vancouver) and globally (Guatemala). They use recycled bicycle parts to make machines that are particularly useful in communities where electricity or gas-powered engines are expensive or unavailable. Their pedal-powered machines are used by cooperatives and individuals to grind grain into flour, dehusk corn, make roof tiles, pump water, blend food, and perform many other labour-saving tasks. In Guatemala, a women's poultry cooperative shares the use of a pedal-powered grinder to process its own chicken feed from whole grains, saving time and money and providing amusement in the process. Check out **www.pedalpower.org**.

THE GAIA PROJECT

As the international arm of the Sierra Club of Canada, the GAIA Project works on environmental restoration and community development in El Salvador and Bolivia. GAIA works in partnership with the Salvadoran Centre for Appropriate Technology (CESTA) to assist local communities in El Salvador to find AT solutions to their ever-increasing environmental problems. CESTA's work promotes technologies such as cargo tricycles, bike trailers, pedal-powered machines, agricultural techniques and composting latrines. Check out **www.gaiaproject.bc.ca**.

ONE SKY

Smithers, B.C.

One Sky works on projects to promote human rights and sustainable economics and to conserve and protect the environment. The organization works with appropriate technology systems, such as solar panelling, straw-bale construction and pedal-powered technologies. Check out **www.onesky.ca**.

LIGHT UP THE WORLD

University of Calgary, Alberta

This foundation works to provide poor villagers in the developing world with healthy, safe, affordable and environmentally friendly, home-lighting systems. The foundation uses low-energy White Light Emitting Diodes (WLED) powered by renewable resources, such as solar photovoltaics, pedal generators and small hydroelectric turbines. Check out **www.lightuptheworld.org.**

ACTIVITIES 

1. In small groups, research one of the NGOs described above or another of your choice and write a report. Consider the following questions:

   - What appropriate technologies does the group use?
   - What are the similarities and differences between your country and the developing country where the group works?
   - What is the relationship between the economy and the environment in each case?
   - What effects do culture and lifestyle have on people's willingness to adopt new technologies?
   - What could you do to help any of these NGOs?

2. Individually or in a small group, think about starting your own NGO with a focus on AT. What would be the purpose of your group? What part of the world would you work in, and what situation and problem would you address? How would you respect the local culture and environment?

A DAY IN THE LIFE: BEFORE AND AFTER AT

The Setting: A small country in Central America, where the people have suffered through years of civil war and political unrest. Many people have been killed or uprooted from their homes. Landmines left behind from the conflict are a constant danger, and deforestation, soil erosion and pollution are serious problems.

"BEFORE AT" SCENARIO

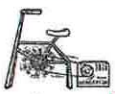
Carlos, a teenager, wakes up and we follow him through his morning. He goes to the outhouse – it's full. The air is hot and dusty already, as it has been since all the local forests were cut down for lumber and firewood. Carlos gets a drink of water, hauled from the polluted river.

Because his family is sick, Carlos must assume many of his mother's and sister's chores. He cooks a meagre breakfast over a smoky fire in the house. Mother coughs and wipes her burning eyes.

The garden has dried up, and there is a shortage of food because the harvest season was six months ago. All they have left is corn, which Carlos' mother must grind by hand. Without enough food from the garden, they were forced to eat or sell their livestock and chickens.

Parents and siblings are often forced to go to the city to look for work. Carlos spends the day walking long distances to gather firewood, and risks the danger of stepping on a landmine.

He is feeling sick, too. The future doesn't look good.

ACTIVITIES 

1. Discuss this scenario and think of ways AT might be applied in this village and here in your community.
2. Make a poster or a model showing this "before AT" scenario in either the village or your community.

LET ME FIX YOUR PROBLEM

In the mid-1950s, some very well meaning technologists thought that they could "develop" the South by imposing technologies designed for the North. Their program drastically affected the lives of people without providing useful technology. It took them years to figure out, for example, that farmers needed small cultivators, not tractors.

Imagine a group of aliens from a distant planet suddenly appearing in your community. They want you to try their advanced education technology, which eliminates the need to go to school. What you need is a small device implanted into your brain, at no cost. When you want to know about something, you simply program your personal digital processor, carried conveniently in a belt pouch, and instantly, you would "know" the information.

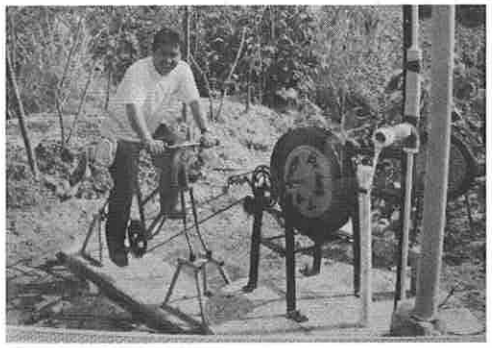
How many of you would be willing to try this unknown technology? Suppose a few tried it. It worked well for some, but others wound up with less knowledge than before they received the implant. Some were ridiculed and shunned by friends and neighbours.

Two years later, the aliens came back and said, "Oops, there was a glitch in the implant program, but we have fixed it, and the system works even better." How many of you would now try this new technology?

"AFTER AT" SCENARIO

Rosa, a teenager, lives in a village near an AT Centre, which has shared many of its experiments with the community. The composting latrine yields dry waste for the garden. Fast-growing Caribbean pine trees were planted around the village to cool the air.

Rosa now drinks purified water from her home's ceramic filter system. The water comes from the village well, where a pedal-powered pump brings the water up. Rosa cooks breakfast on a fuel-efficient stove, and then sets out the solar cooker to cook the day's meal while she goes to school. Spending the day at school was unheard of a few years ago, as most girls had to spend their days gathering firewood.



Credit: Tim Harvey

Her parents will be away during the day too. Her mother will be grinding the week's grain for their chickens at the women's poultry co-operative. Her father uses a pedal-powered cargo tricycle that he is purchasing from the AT Centre for his delivery business. Her older brother makes concrete roofing tiles, using a pedal-powered machine.

Rosa's family grows food organically, using fertilizer from the composting latrine and chicken manure. Corn is ground into cornmeal at the local co-op on a pedal-powered grinder. Surplus corn and fruit from the harvest will be preserved, using a solar food dryer.

The AT centre has recently received a grant to help train landmine amputees as AT technicians. Rosa hopes her younger brother will be able to work there, when he recovers from his wounds.

Rosa feels happy. The future looks good!

ACTIVITIES

1. Discuss this scenario and how it differs from the one you thought of. Who do you think decides what's needed and what's appropriate?
2. Make a poster or a model showing this "after AT" scenario in either the village or your community.
3. Write a scenario for your community showing it "before and after AT."

Believable? This scenario is typical of the way new seed, fertilizer, and technologies were introduced to farmers in the South.

(adapted from E.C. Pytlick et al. in Wicklein, Robert C. 2001)

2.1 THE COOKING-FUEL CRISIS

KEY CONCEPTS

* In the North, cooking fuel is mainly electricity or gas.
* In the South, cooking fuel is mainly plant or animal matter.
* Where cooking fuel is scarce, it may take all day to gather enough fuel for a meal
* Smoke from cooking fires creates health problems.
* AT provides alternative cooking methods that use clean, renewable energy and do not cause social and environmental problems.

MATERIALS

* Photocopies of the student handout 2.1

TIME

* 1/2 - 1 period

RECOMMENDED RESOURCES

BOOKS

Grant, T. and G. Littlejohn. 2001. *Teaching About Climate Change. Cool Schools Tackle Global Warming*. Green Teacher Magazine. New Society Publishers, Gabriola Island, B.C.

THE LESSON PLAN

PREPARATION

1. Read the student handout 2.1 and decide which activities you wish to use with your class.
2. Write a thought provoker on the board for discussion at the end of class, such as: With nearly 2.5 billion people burning traditional biomass fuels, it has been predicted that cooking-fuel shortages would be one of the main problems facing our world in the next century. (Earth Summit 1992, Rio de Janeiro)
3. Photocopy the student handout 2.1.

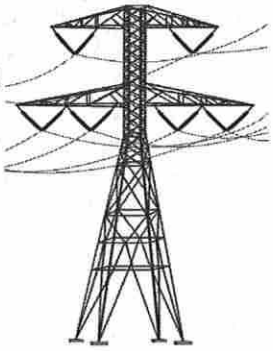
LESSON

1. With the class, review the material covered in the previous lesson.
2. Have a class brainstorming session to answer the following questions:
   * Where does your family's cooking fuel come from?
   * What environmental problems are associated with it? Is that source of energy sustainable?
   * If your energy source were cut off for several weeks by a natural disaster, such as an earthquake or ice storm, how would you cook your food or heat your home?
   * How do you think people handled this situation 100 years ago, before electricity and natural gas were available?
   * If this situation were to go on for a year and other people were competing for the same source of fuel, what would happen? Would the source be sustainable? What would the environmental impacts be?
   * What is a sustainable cooking fuel that is different from the one you are presently using? Would this fuel meet the criteria of AT?
3. Pass out the student handout 2.1. Have students read it and answer the activity questions in their notebook.
4. Discuss the students' answers as a class.
5. Discuss the thought provoker on the board as a way to review the lesson.
6. Give students a preview of what they will be doing in the next section.

2.1 THE COOKING-FUEL CRISIS

One of the most serious problems facing our world in this century is a growing scarcity of cooking fuel.

Here in Canada and the United States, we tend to take cooking fuel for granted — just turn a dial and "voila!" the stove or oven heats up. In the industrialized world, we generally have a surplus of energy for cooking. But what does it take to produce and deliver the electricity or natural gas to your stove? The construction and maintenance of facilities to generate electricity or process natural gas, and the systems to distribute that energy through electrical transmission lines and gas pipelines, are expensive in terms of energy, materials and money. The environmental impacts of clearing land for these projects include destabilizing of slopes and erosion, water siltation, pollution hazards and displacement of wildlife and human communities.



In the South, cooking food can involve difficulties that we may find hard to imagine. It is estimated that nearly 2.5 billion people, over one-third of humanity, cook by burning traditional biomass fuels. Excessive use of these traditional fuels has created environmental problems, such as deforestation, soil erosion, water pollution and greenhouse gas emissions, which contribute to global warming. Burning biomass also deprives the soil of compost, leading to less productive agriculture.

Biomass fuel: plant or animal matter that can be burned, such as wood, charcoal, crop residues or dried animal dung

When fuel is in very short supply, the dependency on cooking fires can create serious social problems. For example, women and children may have to spend a large part of their day gathering fuel to cook the day's food. For a child, fuel gathering may mean missing school, or for a mother it may mean spending less time with her family or tending a garden. Burning fuel indoors with poor ventilation causes many serious health problems. If a family has to buy fuel, they could end up spending more for the fuel than the food.

Ninety per cent of women in the rural areas of Central America and over 50 per cent in urban areas still cook over smoky, wood-burning stoves or open fires. (www.altgifts.org)

Powerlines and deforestation in Central America.
Credit: Tim Harvey

CASE STUDY

Marcia is teenager in Latin America. She lives in a rural area that has been devastated by war. Her father was killed and her older brothers have disappeared.

Marcia's day begins at 4 am as she hauls water from the river for drinking, cooking and watering a small garden. During the drought, Marcia must haul water for several hours.

Due to a recent outbreak of cholera, drinking and cooking water must be boiled. That means Marcia has to spend longer days gathering enough wood. The area around Marcia's village has been scoured of dead wood, so she must walk longer and longer distances to find enough sticks to bring home. Marcia must be very careful to avoid landmines. Everyday, she risks rape or kidnapping while foraging alone.

Back home, Marcia estimates that she has enough wood to boil the water and fry some bread. Her mother has been grinding the flour and nursing the baby. They are both exhausted.

ACTIVITIES 

1. Individually, or in small groups, write at least three answers to each of the following questions:
- How do you think the cooking-fuel crisis could be solved in the South?
- Why do you think people might resist changing their cooking habits?
- Why do some people rush to buy new cooking technologies, like microwave ovens and ceramic cook tops?
- What makes a new technology appealing? What makes you want to try a new technology?

2. Discuss your answers with the class.

2.2 COOKING UP SOLUTIONS USING AT

KEY CONCEPT

There are a number of AT solutions to the cooking-fuel crisis, including:

* biogas
* fuel-efficient stoves
* solar cookers
* retained-heat cookers

MATERIALS

* Photocopies of the student handout 2.2

TIME

* 1-2 periods

TIPS TO CONSIDER BEFORE BEGINNING

If you plan to investigate solar cooking further in the next chapter, you may want to wait until then to have your students research solar cooking.

THE LESSON PLAN

PREPARATION

1. Read the student handout 2.2 and decide which activities you wish to use with your class.

2. Write a thought provoker on the board for discussion at the end of class, such as: Women gather and carry fuel loads weighing 25-35 kilograms with their bare hands and primitive tools, while forest workers are provided with special equipment for their work. (You could substitute another quote.)

3. Photocopy the student handout 2.2.

LESSON

1. With the class, review the material covered in the previous lesson.

2. Pass out the student handout 2.2. Have students read it and then guide them through the activities. Options:

* Divide the class into groups and assign one of the AT technologies to each, before they have read about all four technologies.
* Ask all the groups to focus on the same technology and compare their results.
* Discuss the thought provoker on the board as a way of reviewing the lesson.
* Give students a preview of what they will be doing in the next section.

RECOMMENDED RESOURCES

VIDEOS

Letters from Kenya. 1995. Five minutes. Solar Cookers International. Describes a refugee-camp, solar-cooker project.

BOOKS

Blum, Beverly. Ed. 1997. *Solar Cookers – How to make, use and understand.* Solar Cookers International. 9th Edition. California, USA.

WEBSITES

www.re-energy.ca Re-Energy.ca is a downloadable, sustainable-energy project kit for grades 7-12, including construction plans for a biogas generator and solar cookers.
www.treeswaterpeople.org/justa.htm Information on rocket stoves.
www.solarcooking.org Slideshow about solar cookers.
www.miamicountryday.org A K-Grade 5 environmental program featuring solar cookers, teacher resources and a student-made slideshow about solar cookers.

2.2 COOKING UP SOLUTIONS USING AT

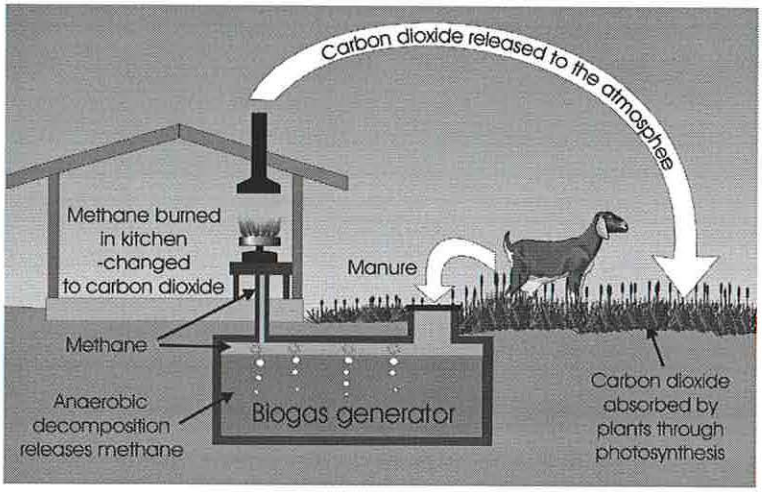
Developers of appropriate technology have come up with an array of solutions to the problems of obtaining and burning biomass fuels. In this section, a number of alternatives are presented.

BIOGAS

This technology involves recycling manure to create a clean-burning, almost odourless gas (60 per cent methane and 40 per cent carbon dioxide) that can be used for cooking. The byproduct is slurry that still contains the nutrients in the manure and can be spread on the fields as a fertilizer.

Production of biogas follows this simple process:

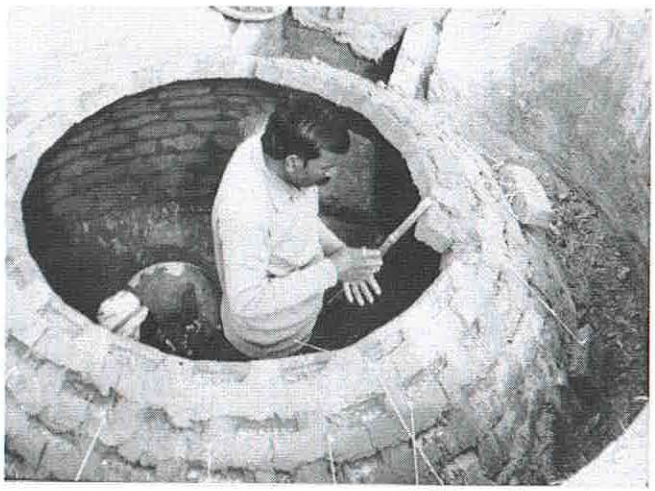
1. Waste is collected from cows.
2. One bucket of waste is mixed with one bucket of water.
3. This mixture is put into an underground tank where it produces a gas.
4. The gas is piped into the home, where it is burned as a fuel for cooking.
5. The leftover slurry in the tank is used as a fertilizer on the fields.
6. The plants that grow from the fertilized soil feed the cows.



Credit: www.re-energy.ca

Biogas technology is particularly suitable in rural areas where livestock are raised, as a regular supply of manure is required. The clean-burning biogas saves people from smoke-related eye and lung diseases and keeps homes and utensils free from soot.

Biogas can replace propane or natural gas (e.g., to run engines, electrical generators and stoves). Instructions for building a simple biogas generator are on the Re-Energy.ca website.



Building a biogas digester
Credit: Canadian Hunger Foundation

FUEL-EFFICIENT STOVES

A great deal of biomass fuel can be saved by using energy-efficient stoves instead of an open fire or a stove that allows most of the heat to go up the chimney. Fuel-efficient stoves are designed to burn the fuel hotter and cleaner than traditional stoves.

Rocket stoves, for example, are designed to burn small pieces of wood very efficiently. Cooking is done on top of a short insulated chimney. The stoves are typically constructed out of recycled materials, such as tin cans and old stovepipes.

Branches, twigs, small wood scraps, or just about any small combustible material will burn in a rocket stove. The pieces of wood or other material burn at their tips, which creates a very hot fire with hardly any smoke. Relatively little heat is absorbed by the mass of

the stove body or the insulated chimney, ensuring that most of the heat goes into the cooking pot.

Another efficient stove is the Kenyan jiko, which is similar in appearance to an inefficient metal stove that was already in use there. The addition of a ceramic lining helps diffuse and retain heat, reduce carbon-monoxide emissions, shorten cooking time, cut down on burn injuries, and achieve fuel savings of 25 to 50 per cent.

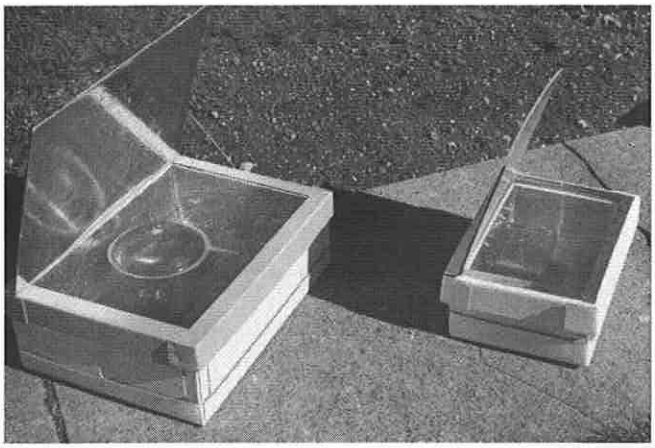
SOLAR COOKERS

Solar cookers produce heat from sunlight. When light from the sun is reflected or focused on a dark-coloured pot, the pot absorbs the heat and transfers it to the contents. Taking advantage of the greenhouse effect, you can put your pot inside a box with a transparent lid, so that light shines into it and heat can't escape. Solar cookers can be simple, inexpensive, one-pot models made from cardboard boxes, aluminum foil, and oven bags, or high-tech arrays of dish-shaped mirrors used to provide cooking heat for institutional cafeterias.

Food cooked in a solar oven is more nutritious, due to the gentle cooking process that preserves the moisture and other nutrients. Besides cooking and baking, solar cookers may be used for other tasks, such as purifying water, especially where water supplies are unsafe and fuels are unavailable.

Solar cookers do not use energy from any other source and don't pollute the air or produce greenhouse gases. If people used solar cookers for some of their cooking needs, millions of trees would be saved.

In this country, cooking outside in a solar cooker can help reduce fuel costs and keep your house cool in the summer. Solar cookers can also be used for camping and as part of an emergency kitchen for times when electricity or gas is cut off.



Cookers made from cardboard boxes

Credit: Solar Cookers International

RETAINED-HEAT COOKERS

This is an age-old method that can greatly reduce the amount of fuel used to cook food. Food is brought to a boil, simmered for a few minutes, and then put into an insulated container. The insulation prevents most of the heat in the food from escaping, and no additional energy is needed to complete the cooking process.

The insulated container may be as simple as a pit dug in the ground and lined with an insulating material or hot rocks. A sack, basket or box can be filled with insulating material, such as straw, hay, rushes, feathers, sawdust, rags, wool, or shredded paper.

Although the cooking time is longer — often twice that of normal stovetop cooking — the energy used to cook the food may be reduced by 20 to 80 per cent. The fuel saving is greatest for foods that require a long simmering period, like beans, grains, stews, and soups.

Retained-heat cookers are second only to solar cookers in their potential to conserve resources. They're easy to build, easy to use, and have many other advantages:

- timing is not critical, since meals are kept hot until serving time
- the risk of burning the food on the bottom of the pot is eliminated
- flavour and nutrients are retained by cooking at a lower temperature
- the time tending a fire or stove is shortened, freeing up time for other tasks
- money saved on fuel can be used to buy more nutritious foods
- health improves with decreased exposure to smoke

A solar box cooker can be quickly converted to a retained-heat cooker by the addition of insulating material around the cooking pot, for times when clouds appear or the sun sets.

ACTIVITIES 

1. Divide into small groups and research one of the examples of AT cooking methods above, by visiting at least two websites. Present your findings to the class. Be creative — consider using a poster, skit or model.
2. How might each one of these AT methods be used in the North? Write down your ideas and the benefits that would result, as well as reasons why these technologies might not be adopted here.
3. Option: Demonstrate the technology your group researched by building a scale model or performing an experiment. Here are some examples of what you might do.
   - Biogas - build a scale model or build the working version described at the Re-Energy.ca website below.
   - Fuel-Efficient Stove - build a scale or full-sized model based on your research, using recycled materials like tin cans and pipes. Note: Do not attempt to build a fire in it.
   - Solar Cooker - build a simple solar cooker from the Solar Cookers International website (e.g., pizza box cooker).
   - Retained-Heat Cooker - build a box to insulate a mug or pot. At the beginning of class put an egg in and cover it with boiling water. At the end of class, check it to see how cooked the egg is. Compare your results with those of other groups.

WEBSITES FOR RESEARCH

www.re-energy.ca

www.partners.ca

www.solarcooking.org

www.treeswaterpeople.org

3.1 SOLAR COOKERS

KEY CONCEPTS

* Solar cookers concentrate the energy of the sun by focusing and capturing the sun's rays.
* Solar cookers are a simple and effective solution to energy over-consumption in the North and energy shortages in the South.
* There are three basic types of solar cookers: box cookers, panel cookers, and concentrating cookers.

MATERIALS

* Photocopies of the student handout 3.1

TIME

* 1 period

TIPS TO CONSIDER BEFORE BEGINNING

1. To provide a mixture of theory and hands-on work, spend the first 20 minutes of the class on one of the information sections 3.1 or 3.3, and the remainder of the time on one of the hands-on project sections 3.2 or 3.4.

2. If you have an Internet connection in the classroom, you could divide the class into groups. Each group, in turn, could watch the slideshow or listen to an interview at the Solar Cookers International website, while the rest of the class completes the activities.

THE LESSON PLAN

PREPARATION

1. Read the student handout 3.1 and decide how you will structure the class.
2. Write a thought provoker on the board for discussion at the end of the class, such as "Solar cooking means people can buy more food and less fuel; it relieves degradation of the environs where there is now energy famine; it eases the burden of women who forage for firewood. Low-cost, solar ovens can be manufactured virtually anywhere in the world. They work." (SHE Inc.)
3. Photocopy the student handout 3.1.

LESSON

1. With the class, review the material covered in the previous lesson.
2. Pass out the student handout 3.1 and have students read it and answer the questions in their notebooks. Answer sheet is provided in Appendix A for your use.
3. Discuss the thought provoker on the board as a way to review the lesson.
4. Give students a preview of what they will be doing in the next section.

RECOMMENDED RESOURCES

BOOKS

Blum, Beverly. Ed. 1997. *Solar Cookers - How to make, use and understand.* Solar Cookers International. 9th edition. California, USA.

Radabaugh, Joseph. 1991. *Heaven's Flame - A Guide to Solar Cookers.* Home Power Inc. Oregon, USA.

WEBSITE

www.solarcooking.org The Solar Cookers International website is a great resource for photographs and information, cooker kits, pasteurizing indicators, and a Teacher Kit.

3.1 SOLAR COOKERS

CHECK OUT THIS RESOURCE:

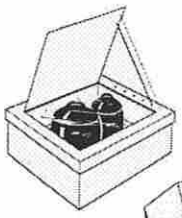
Solar Cookers International
www.solarcooking.org

Solar cookers concentrate energy by focusing and capturing the sun's rays. Using only the energy from the sun, these cookers can be as effective as conventional ovens. Not only is the source of energy easily accessible in most locations, but solar cookers can also be made almost anywhere in the world. Solar-cooking advocates believe that increasing the use of solar cookers would help alleviate problems of energy over-consumption in the North and fuel shortages in the South.

TYPES OF SOLAR COOKERS

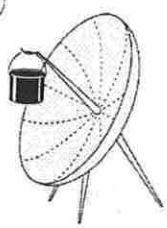
There are three basic types of solar cookers:

1. box cookers

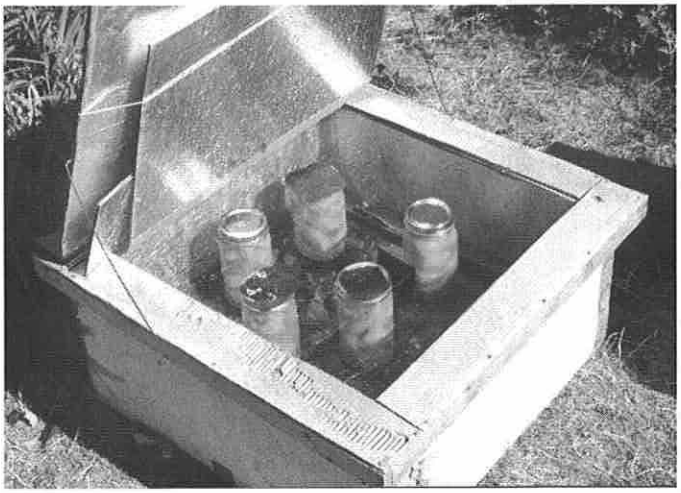


2. panel cookers

3. concentrating cookers



SOLAR BOX COOKERS



A single reflector box cooker
Credit: Solar Cookers International

Solar box cookers consist of an insulated box with a transparent lid. Sunlight enters the box and the heat is trapped inside. A car left in the hot summer sun is like a solar oven. To increase the amount of sunlight captured, a reflector can be placed outside the box to direct more sunlight through the transparent glazing. Solar box cookers don't need to be perfect to work, but a well built cooker can reach temperatures from 121 °C (250 °F) to 218 °C (425 °F).

Solar box cookers can be as simple as a cardboard box with a sheet of glass or plastic sheeting as a lid. Non-toxic black paint, soot or fire-darkened clay can be used on the bottom of the oven and the pots to make them absorb heat better. Insulation, such as crumpled newspaper, cardboard, or foil will make the cooker more efficient. Aluminum foil wrapped over any rigid, flat material will make an effective reflector.

A cardboard cooker may last for years, but a more permanent model can be made from wood, sheet metal or plastic. In many parts of the world, the materials for a solar box cooker cost less than a family will spend for biomass fuel in two weeks. In the South, box cookers have been made from locally available items such as baskets, or even a pit dug in the ground.

A box cooker made from a basket
Credit: Solar Cookers International

Box cookers have several advantages over other types of solar cookers:

- food cooks slowly, with even heat
- three or four dishes can be cooked at a time
- there is no need to refocus reflectors throughout the day
- they are very stable, not affected by little gusts of wind
- they are easy to construct, use and maintain

Disadvantages of box cookers include:

- they can be cumbersome and expensive to transport, especially to remote locations
- they take up space when not in use
- glazing materials can be expensive, breakable and difficult to obtain

SOLAR PANEL COOKERS

Solar panel cookers are quite a recent design consisting of several reflective panels arranged in a semicircle to focus the sun's rays onto a dark-coloured pot inside a plastic oven-roasting bag or under a glass bowl. This arrangement eliminates the need for a glazed and insulated oven chamber. Panels can be made in a very short time using pieces of flat cardboard and aluminum foil. These cookers will heat one or two dishes at a time.

A panel cooker in action
Credit: Solar Cookers International

A solar panel cooker has many advantages:

- does not need to be adjusted during several hours of cooking
- can be adjusted for different latitudes by tilting the panels
- is stable in moderate wind
- costs less than other solar cookers
- is easy to make
- doesn't need a window or insulation materials
- folds flat for easy carrying and storage
- is easy to set up, take down and store

A South African cooker
Credit: Solar Cookers International

SOLAR CONCENTRATING COOKERS

Solar concentrating cookers use a mirrored, concave disk to focus even more sunlight than the panel design. As long as the disk tracks the sun, these cookers get very hot. The high intensity of the focused sunlight means that foods must be stirred to avoid scorching on the bottom and the user must be very careful to avoid burns or eye injuries.

More sophisticated versions use automatically tracked parabolic reflectors to heat large quantities of food or generate steam. These community-scale solar cookers can cook food for hundreds or thousands of people in a short period of time, depending on the number and size of the reflectors.

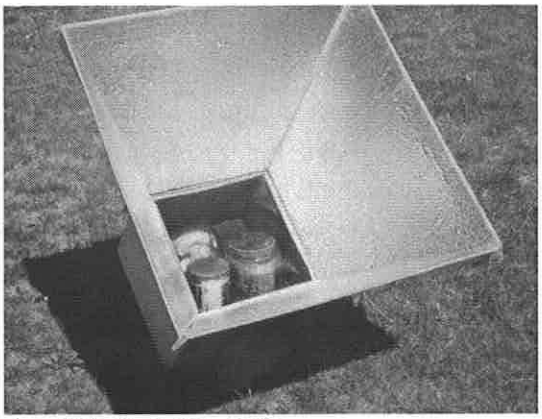
The world's largest, solar-steam cooking system, used to cook for 15,000 people a day, is in Tirumala, India. It has been functioning satisfactorily since October 2002. It generates approximately 4,000 kilograms of steam per day and is expected to save approximately 118,000 litres of diesel fuel per year.

Solar Cooking Review, March 2003

FREQUENTLY ASKED QUESTIONS ABOUT SOLAR COOKERS

WHO MADE THE FIRST SOLAR COOKER?

Solar box cookers are the earliest form of solar cooking in Western culture. In 1767, Horace de Saussure, a Swiss naturalist, experimented with cooking in a solar box. He reported successfully cooking fruits with temperatures of 87.5 °C (189.5 °F).



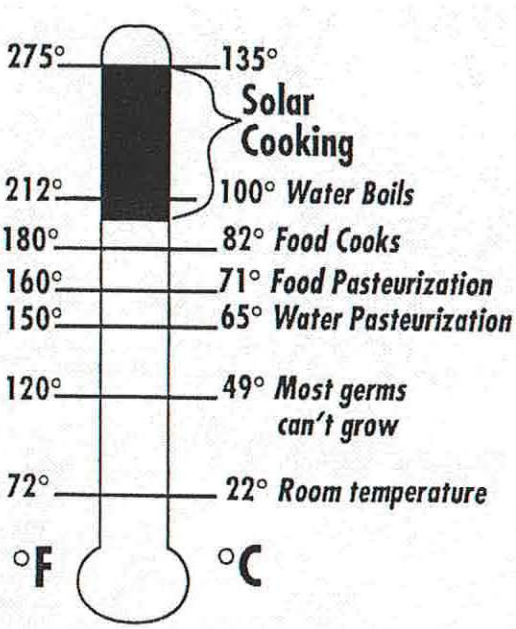
A multiple reflector box cooker
Credit: Heavens Flame

HOW HOT DO SOLAR COOKERS GET?

How hot a cooker gets depends not only on construction materials and the number and size of reflectors, but also on a other factors, such as the angle of the sun, altitude, and weather.

For example, the temperature reached by box and panel cookers depends primarily on the number and size of the reflectors used. Maximum temperatures for empty solar box cookers, focused in full sunlight, have achieved

a range from 104-149 °C (220-300 °F), depending on size and location. These temperatures are more than adequate, since water boils at 100 °C (212 °F) and many foods will cook at 88 °C (190 °F). Higher temperatures cook larger quantities and cook faster, whereas lower temperatures cook slower. The advantage of cooking at lower temperatures is that food can be left cooking for periods of time without burning.



Credit: Solar Cookers International

WHERE CAN SOLAR COOKERS BE USED?

In tropical regions, from the equator to 20-degrees, sun angles are good for year-round, solar box cooking. In most of the South, solar cookers could be used 200-300 days a year. Even as far north as Canada, you can cook for nine months of the year, when the sky is clear.

WHAT CAN SOLAR COOKERS BE USED FOR?

A solar cooker can cook anything you would normally cook in a conventional oven. Solar cookers can be used for many non-cooking uses, including:

- pasteurizing water and food
- sterilizing medical equipment
- canning foods
- drying foods and small firewood
- killing insect infestations in grains and dried foods
- incubating yeast dough or yogurt

HOW DO YOU PASTEURIZE WATER?

In many countries, water-borne bacteria kill millions of people annually, many of them children. All three types of solar cookers can make water safe to drink by sterilizing (boiling) or pasteurizing. Pasteurization takes place at 65 °C (150 °F) in only 20 minutes. This treatment kills all human disease pathogens, but doesn't waste the energy needed to bring water to a boil. For more information on solar water treatment check the Solar Cookers International website or do a web search for SODIS (solar water disinfection).

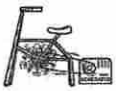
A WAPI in action

Credit: Solar Cookers International

WHAT IS A WAPI?

The Water Pasteurization Indicator (WAPI) is a simple, clever device that consists of a clear plastic tube partially filled with soybean wax that melts at about 70 °C (158 °F), slightly above the pasteurization temperature. To pasteurize water, place a container of water in a solar cooker and put the WAPI in the water, with the wax at the top of the upright tube. When the water temperature reaches 70 °C, the wax melts and flows to the bottom of the tube, indicating that the water has been pasteurized and is now safe to drink. The WAPI is reusable by arranging it so the solidified wax is at the top of the tube again.

The WAPI allows a person to place a container of water in a solar cooker in the morning and return later in the day, knowing for certain whether or not the water is now safe to drink.

ACTIVITIES 

After you have read the handout, answer these questions in your notebook.

1. What are four advantages of solar cookers?

2. What are two ways to increase the amount of sunlight captured?

3. What are three disadvantages of adding more reflectors?

4. What are three advantages of SBCs?

5. What can act as the 'oven box' in a solar panel cooker?

6. What are four advantages of a solar panel cooker?

7. How do concentrating cookers work?

8. What are three disadvantages of concentrating cookers?

9. How hot do solar cookers get?

10. Can solar cookers be used in Canada? When?

11. Pasteurization takes how long and at what temperature?

12. What is a WAPI?

13. Who was Horace de Saussure, what did he do, and when?

3.2 BUILDING A SOLAR COOKER FROM PLANS

KEY CONCEPTS

* The ease of building a simple and effective cooker is one of the most attractive aspects of solar cooking.

MATERIALS

* Photocopies of solar cooker construction plans and student handout 3.2
* Cardboard boxes, white glue, aluminum foil, masking tape, utility knives, rulers
* Pot, thermometer or ingredients for s'mores (graham crackers, marshmallows, chocolate bars)

TIME

* 3-4 periods

TIPS TO CONSIDER BEFORE BEGINNING

1. Consider stockpiling recycled material ahead of time. An oven roasting bag or clear food wrap for the glazing could be used instead of glass or clear acrylic.
2. Determine how many class periods will be allocated for the project. Decide if you will structure the class for a mixture of theory and hands-on work. This motivates students to do the written work so they can get on with building something.
3. If the weather does not cooperate on the scheduled test day, you could postpone the test or set up a heat lamp. Each team could test their cooker for a specified time (i.e., 30 minutes).

THE LESSON PLAN

PREPARATION

1. Read the student handout 3.2 and decide how you will structure this hands-on project.
2. Decide how to divide the class into teams.
3. Decide what you will supply and what the students will supply.
4. Build the Quickie Cookit in Appendix B yourself. Option: Choose from one of the other designs in the student handout 3.2.
5. Decide how you will have the students test the cooker. One way would be to use a set amount of water and a given time, then measure the temperature of the water. A tastier method is to see if the cooker will melt a s'more made of graham crackers sandwiched around a marshmallow and a piece of chocolate bar.
6. Write a thought provoker on the board for discussion at the end of class, such as "It is important for Westerners to use the appropriate technology they advocate. Otherwise the attitude is that this technology is being pushed off onto Third World countries, and may be second rate, or even dangerous." (Edie Farwell, Ladakh Project)
7. Photocopy the student handout 3.2 and the construction directions for the Quickie Cookit in Appendix B.

LESSON

1. With the class, go over the answers to the questions in 3.1, using the answer sheet in Appendix A.
2. Pass out the student handout 3.2 and the construction plans and guide students through the process.
3. Discuss the thought provoker on the board as a way to review the lesson.
4. Give students a preview of what they will be doing in the next section.

RECOMMENDED RESOURCES

BOOKS

Blum, Beverly. Ed. 1997. *Solar Cookers - How to make, use and understand.* Solar Cookers International. 9th edition. California, USA.

Radabaugh, Joseph. 1991. *Heaven's Flame - A Guide to Solar Cookers.* Home Power Inc. Oregon, USA.

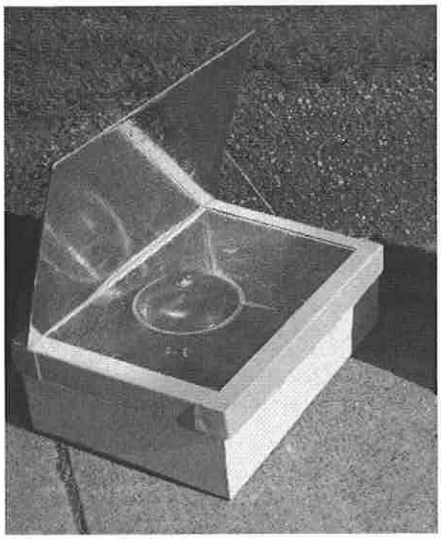
WEBSITES

www.solarcooking.org This site features the solar cooking archive, with lots of photos, information and plans, including the easy-to-build "minimum" cooker.

3.2 BUILDING A SOLAR COOKER FROM PLANS

Some solar cookers are very simple in design. With the use of a little geometry, cardboard, plastic oven bags, and aluminum foil, you can build a variety of solar cookers. Here are a number of designs, starting with the easiest models for students to build, and increasing in difficulty.

Pizza-Box Solar Cooker - This design uses a pizza box and was featured in chapter 2. **www.solarnow.org/pizzabx.htm**



A "minimum" solar box cooker
Credit: Solar Cookers International

Quickie Cookit - This model is made from a cardboard box, cut in half. See Appendix B.

The Solar Panel Cooker - This is the original panel cooker. See the Solar Cookers International website **www.solarcooking.org**

Foldable Family Cookit - This is another cooker by Solar Cookers International that is distributed to refugee camps in Africa.

Multi-Reflector Solar Box Cooker - This Canadian design is featured at **www.re-energy.ca**, including pictures of it working in the snow.

The "Minimum" Solar Box Cooker - This design requires two cardboard boxes and more time than the others. Solar Cookers International says it is a full-power cooker that is not "minimum" in terms of its capabilities.

Solar concentrating (or parabolic) cookers are more difficult to build than panel or box cookers, and are not included here.

ACTIVITIES

PERIOD 1

1. Divide into teams.
2. Study the instructions for building a solar cooker. Ask your teacher to clarify anything that you are not sure about. Make a list of the materials you will need and decide who is responsible for bringing them to the next class.

PERIOD 2

1. Build your solar cooker.
2. Based on your teacher's instructions, decide who will provide the testing materials.

PERIOD 3

1. Test your cooker as instructed by your teacher.
2. Compare/contrast your results with the other teams and write an evaluation of your design, including ways you would improve it.
3. Do an Internet search to learn more about solar-cooking techniques and recipes. What are some good tips you could share?

3.3 GOING GLOBAL WITH SOLAR COOKERS

KEY CONCEPTS

* Solar cookers have tremendous potential to help with the cooking-fuel crisis in the South.
* There are many non-governmental organizations (NGOs) working in the field of solar cooking and international development.

MATERIALS

* Photocopies of the student handout 3.3
* Internet access, if available

TIME

* 1-2 periods

RECOMMENDED RESOURCES

Websites are listed in student handout 3.3.

THE LESSON PLAN

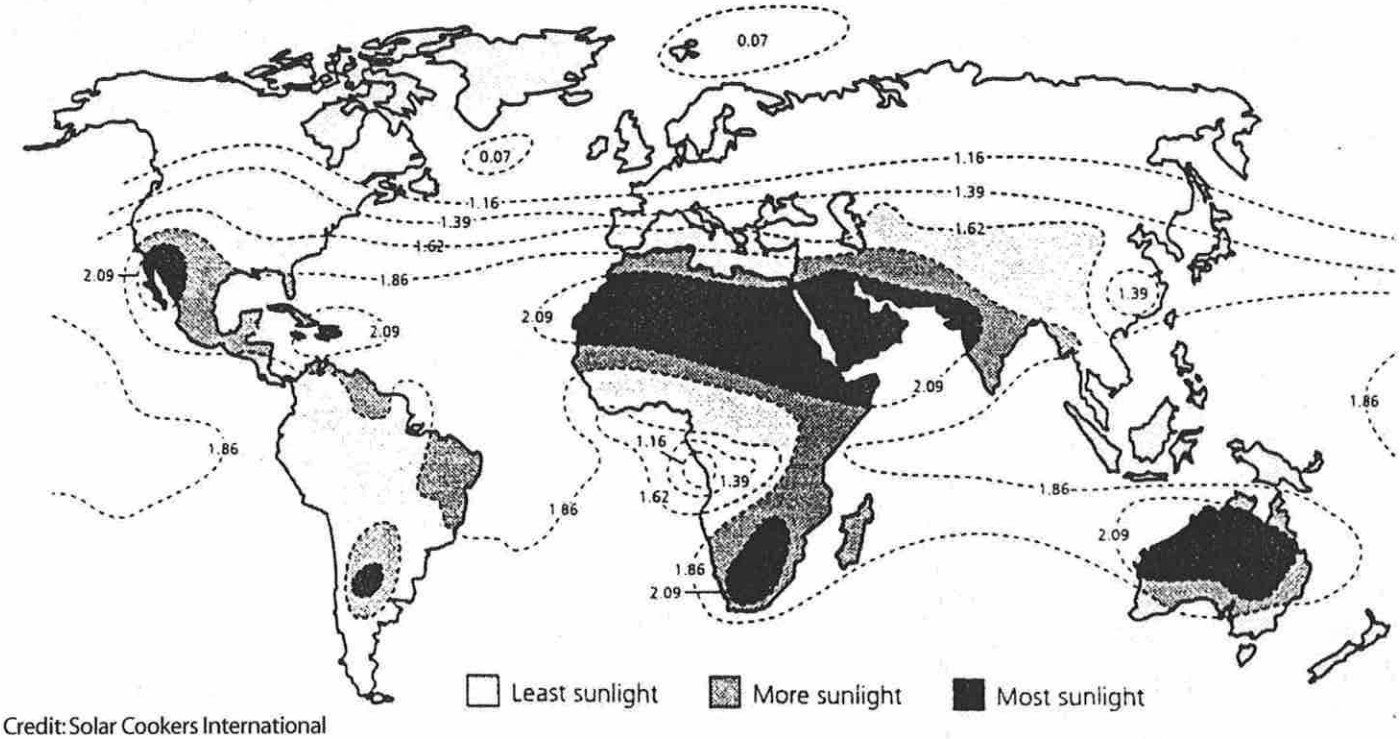
PREPARATION

1. Read the student handout 3.3 and decide which activities you wish to use with your class.
2. Write a thought provoker on the board for discussion at the end of class, such as: The vast majority of the world's people do not even know that it is possible to cook with the sun's energy alone.
3. Photocopy the student handout 3.3.

LESSON

1. With the class, review the material covered in the previous lesson.
2. Pass out the student handout 3.3. Have students read it and then guide them through the activities.
3. Discuss the thought provoker on the board as a way to review this lesson.
4. Give students a preview of what they will be doing in the next section.

3.3 GOING GLOBAL WITH SOLAR COOKERS



Credit: Solar Cookers International

> *Fortuitously, a majority of the two billion people relying on ever-scarcer, ever-more-expensive biomass fuels live in areas of abundant sunshine.*
>
> SHE Inc.

FREQUENTLY ASKED QUESTIONS

IF SOLAR COOKERS ARE SO GOOD, WHY ISN'T EVERYONE USING ONE?

Solar technology has only recently been promoted as an answer to urgent shortages of fuel. The most successful introductions of solar cookers have occurred where the need was the greatest, the weather was favourable, and a community-based approach was taken, such as in the Central American Solar Energy Project described below.

WHERE ARE SOLAR OVENS BEING USED THE MOST?

Solar Cookers International (SCI) reports that there are solar cooking projects in most of the countries of the world, with over 100,000 cookers in use in both India and China. SCI recently started a project in Kenya where 5,000 families are now solar cooking. SCI's website and newsletter feature successful projects around the world.

SOLAR COOKERS IN INTERNATIONAL DEVELOPMENT

There are many non-governmental organizations (NGOs) working in the field of solar cooking in countries all over the world. Here is a description of several that work locally and internationally.

SOLAR COOKERS INTERNATIONAL (SCI)

This largely volunteer group facilitates solar-cooking workshops all over the world and runs solar-cooking projects in African refugee camps and communities. See the website **www.solarcooking.org** for illustrated

construction plans, photographs, documents, project success stories and an international directory of solar-cooking promoters. SCI produces a newsletter, *The Solar Cooker Review.*

Women in Africa carry home cookers they made at an SCI workshop.
Credit: Solar Cookers International

THE CENTRAL AMERICAN SOLAR ENERGY PROJECT (CASEP)

Based in Virginia, this non-profit, private foundation supports community-based, solar-box cooking projects in Costa Rica, Guatemala, Honduras, and Nicaragua. Women are taught to build and use solar ovens as a means of improving their diet, health, and economic condition. Solar projects are integrated with other educational programs, such as adult literacy, radio-broadcast, high-school courses, elementary-school ecology courses, organic agriculture, and medicinal-herb culture. The CASEP website features an excellent slideshow about its projects and its five-step development model.

This CASEP design features a drawer for easy access.
Credit: CASEP

SOLAR HOUSEHOLD ENERGY, INC. (SHE, INC.)

SHE, Inc. is a private enterprise that conducts research and development, and trains and supports small business in making and marketing solar ovens. See the "Hotpot" panel cooker design at **www.she-inc.org.**

ULOG

Based in Switzerland, this group teaches appropriate technology in the South, while promoting solar cooking in central Europe. ULOG sells completed solar ovens, assembly kits and do-it-yourself construction plans. See the website **www.ulog.ch/english.**

ACTIVITIES

1. Individually or in small groups, research one of these NGOs or find another one on the Solar Cookers International website.
2. Present your findings to the class or write a report, giving some specific examples of projects, type of cookers, successes and failures, and lessons learned.

3.4 SOLAR COOKER DESIGN CHALLENGE

KEY CONCEPTS

* You don't need to be a rocket scientist to come up with a good solar cooker design.
* Some of the simplest designs work the best.
* Through the process of building and evaluating their own solar cooker, students can learn even more about this subject.

MATERIALS

* Photocopies of the student handout 3.4

TIME

* 4-8 periods

TIPS TO CONSIDER BEFORE BEGINNING

1. Consider tailoring the project to your class, using the Solar Cooker Design Challenge Options in Appendix C.
2. Consider the challenge parameters carefully, especially the amount of time set aside for designing, building and evaluating.

THE LESSON PLAN

PREPARATION

1. Read the student handout 3.4 and the Solar Cooker Design Challenge Options in Appendix C.
2. Decide if you will follow student handout 3.4 or create your own challenge.
3. Build a cooker yourself to help you determine all the parameters.
4. Photocopy the student handout 3.4 and the challenge you plan to use.

LESSON

1. With the class, review the material covered in the previous lesson.
2. Divide the students into teams. Discuss how many professions work in teams to solve problems – technicians, engineers, architects, and aerospace designers.
3. Pass out the student handout 3.4. Have the students read the handout and make sure students understand the parameters, the schedule, and the evaluation.
4. Guide students through the design challenge.
5. At the end of the final day, discuss the thought provoker: What did you like and what would you improve in this learning resource about appropriate technology?

3.4 SOLAR COOKER DESIGN CHALLENGE

DESIGN CONSIDERATIONS

When designing your own solar cooker or modifying existing plans, there are a number of considerations to address. The foremost consideration is, "Who are you building it for?" If it is for people in the North, fancy high-tech materials might make it more attractive to them, and help them see how they can integrate alternative energy into their lives.

However, if you are designing for the more than a billion people in the world who could really benefit from a solar cooker but don't have access to expensive materials, consider a simple design using cheap, accessible materials.

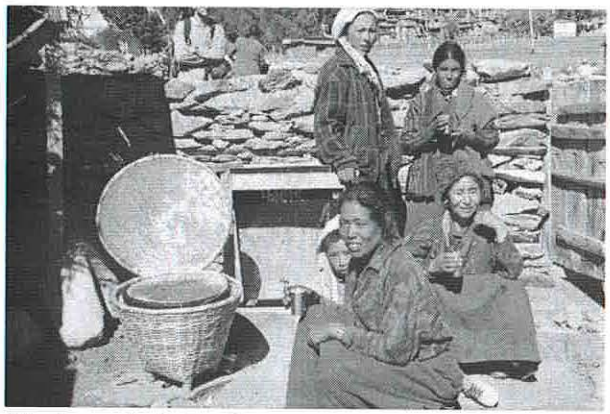
Other design considerations include:

- type of cooking
- size of pot
- ease of construction, particularly for nonprofessional builders
- ease of operation
- dependability under a variety of conditions
- versatility
- cost

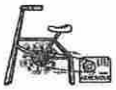
Once you've considered those functions, you can start thinking about the specific components of your cooker — oven box, insulation, glazing, reflectors, and a stand. Visit the Solar Cooking International website for some good design tips and suggestions for further research.

Many of the most useful designs available today were made by ordinary people working in their backyards or garages.

Solar cooker builders in Peru.
Credit: Solar Cookers International.



A basket cooker in Nepal.
Credit: Solar Cookers International

ACTIVITY 

THE SOLAR COOKER DESIGN CHALLENGE

The local Provincial Emergency Program (PEP) has asked your team to design and build a prototype collapsible solar cooker that could be used in your community in the event that a disaster such as an earthquake, flood or storm cuts off electricity to this region for a prolonged period. Once a design has been selected, PEP would mass produce 1,000 of them to be kept in storage in the event of such an emergency.

DESIGN PARAMETERS

Performance - The cooker must be capable of pasteurizing water by heating one litre to 170 °F for five minutes using sunlight.

FEATURES (SPECIFICATIONS)

- Size - The oven box must be capable of holding a minimum of one 2-litre pot. The cooker must be collapsible to save storage space when not in use.
- Weight - The unit must weigh under five pounds.
- Glazing - The unit must not incorporate glass or any breakable materials.
- Materials - The use of low-cost materials is a priority.

TIME FRAME

- Period 1 - Divide into teams. Begin a team work log to note what your team accomplished each day. Develop sketches of at least three different solutions to the problem.
- Period 2 - Choose one of the solutions you sketched and develop detailed, dimensioned drawings and a materials list for building a cardboard prototype. Decide who will bring materials to start construction the next period.
- Periods 3-7 - Construct your cardboard prototype, then test and evaluate it.
- Period 8 - Demonstrate your cooker to the class and explain the design process you went through to create it.
- Option - Based on what you learned from your prototype, create final design drawings for a wooden or sheet-metal version. Build and evaluate it.

DOCUMENTATION

Submit your project documentation for marking, including but not limited to:

1. Title page with product name, and names of team members
2. All design sketches and product specifications
3. Team work log
4. Results of the solar test
5. Project evaluation - What did you enjoy the most and the least about this project? What would you do differently to improve your product or the process you went through?

APPENDIX A

SOLAR COOKERS ANSWER SHEET

1. What are four advantages of solar cookers?

- they do not require electricity, gas, or firewood
- they could save millions of trees, reduce pollution and improve quality of life around the world
- they are a simple, elegant and effective solution to irresponsible energy consumption in the North and energy shortages in the South
- they are easy to build, practical, inexpensive and can be manufactured virtually anywhere in the world

2. What are two ways to increase the amount of sunlight captured?

- reflectors can be added
- the glazing can be tilted to face the sun

3. What are three disadvantages of adding more reflectors?

- harder to build
- more susceptible to being toppled by the wind
- must be turned more often to follow the sun

4. What are three advantages of solar box cookers?

- slow, even cooking and can cook three or four dishes of food at a time, enough for a family
- do not need much moving during the day to focus the sun's rays into the oven, so the cook's attention can be given to other chores
- very stable, not affected by little gusts of wind
- ease of construction, use and maintenance makes them very accessible

5. What can act as the oven box in a solar panel cooker?

- a plastic oven roasting bag
- a glass bowl

6. What are four advantages of a solar panel cooker?

- doesn't need to be adjusted during several hours of cooking
- can be adjusted for different latitudes just by tilting the back panels
- is stable in moderate wind
- costs less than other kinds
- is easy to make
- doesn't need a window or insulation materials
- is compact (folds flat for easy carrying and storage)
- is easy to set up, take down and store

7. How do concentrating cookers work?

They use a mirrored surface in the shape of a concave disk to focus sunlight onto the bottom of a pot or a steam generator.

8. What are three disadvantages of concentrating cookers?

- more complicated to make than box or panel cookers
- must be focused often to track the sun
- require careful use to prevent burns and eye injuries

9. How hot do solar cookers get?

104-149 °C (220-300 °F)

10. Can solar cookers be used in Canada? When?

Yes. Whenever it is clear except during the three coldest months of the year.

11. Pasteurization takes how long and at what temperature?

20 minutes at 65 °C (150 °F)

12. What does WAPI stand for?

Water Pasteurization Indicator

13. Who was Horace de Saussure, what did he do, and when?

A Swiss naturalist experimenting as early as 1767. He reported successfully cooking fruits with temperatures of 189.5 °F (87.5 °C).

APPENDIX B

A QUICKIE COOKIT

The Quickie Cookit is an easy cooker to build for school demonstrations.

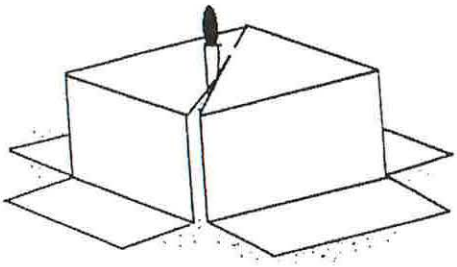
MATERIALS

Cardboard box - about 50 cm x 50 cm (20" x 20") makes two Cookits

Aluminum foil - about .6 square metres (6 square feet)

Glue and/or tape

Utility knife



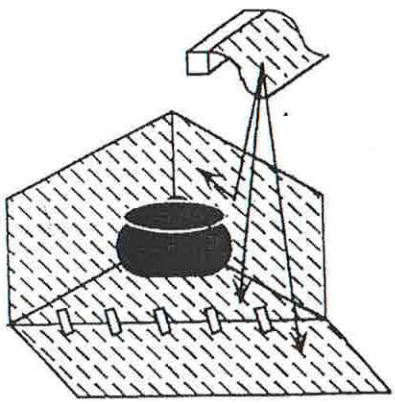
BUILDING INSTRUCTIONS

1. Cut box in half diagonally. Each half has two walls and a 3-sided bottom.
2. Tape an extra strip of cardboard to the cut edge of the bottom for an adjustable front panel.
3. Cover entire inside with aluminum foil.

COOKING INSTRUCTIONS

1. Place your food in a dark-coloured pot with a tight-fitting lid.
2. Place the pot in the centre of the Quickie Cookit and cover it with a clear glass bowl or a plastic oven roasting bag.
3. Point the Quickie Cookit toward the sun and prop the front flap up with stones or blocks so that there is a small shadow under it.

Now the food will cook without sticking or burning. All you need to do is test the food to see when it's cooked.



SOLAR COOKER DESIGN CHALLENGE OPTIONS

This is the most open ended of the activities in this resource guide, and the scope and sophistication of the projects will depend on the teacher, the students' abilities, the tools and materials available, and the design itself. Projects could range from cardboard prototypes to finished products of wood, sheet metal or plastic. Select from the options below to customize your own challenge or leave it to the students to decide.

THE CHALLENGE

Sponsor options - Provincial Emergency Program, CIDA, BC Hydro, Solar Energy Society of Canada, United Nations

Process options - design on paper only, build a scale model, build and test a prototype, improve an existing design, adapt an existing product to solar (e.g. a toaster oven), test an existing product (e.g., the teacher's sample), design a component of a product (e.g., the oven box or reflector), design a prototype and build a finished product, build from a set of instructions and suggest improvements to the instructions and the product.

Product options - no limitations, single reflector cooker, multiple reflector panel cooker, concentrating cooker

Purpose options - cooking food, pasteurizing water, non-cooking uses

Location options - Canada, The South, anywhere

User options - disaster relief personnel, refugees, school or hospital workers, household members, campers, people with disabilities

DESIGN PARAMETERS

Performance options - pasteurize water (can be tested with a WAPI), cook food (rice, beans, etc.), bake food (marshmallow s'mores or natchos in 20-30 minutes, cookies or hot dogs in 30-45 minutes), perform a non-cooking function (heat physiotherapy compresses)

Feature options

- Size: no limitation, minimum number of pots, collapsible to save storage space when not in use, fit in a box, fit into a mailing tube (e.g., a kit without the cardboard)
- Weight: no limitation, number of kilograms
- Glazing: no limitation, must not incorporate glass or any breakable materials, must use glass (single pane / double pane), oven bags
- Materials: no limitation, low-cost materials, recycled materials, materials available in the developing country, materials available around your house, cardboard / wood / sheet metal
- Other: weatherproof, wind resistant, collapsible, solar/electric hybrid

TIME FRAME

Decide how many class sessions are needed to build, test, evaluate and then demonstrate the cooker to the class.

APPENDIX D

RESOURCE GUIDE FEEDBACK FORM

Please give us your comments. Your feedback will help improve our materials.

RESOURCE GOAL

The goal of this resource is to introduce students to basic concepts of appropriate technology and international development. In your opinion, did it do so?

Yes ____ No ____ Please explain why or why not:

RESOURCE ORGANIZATION

What did you like or not like about the general organization of the chapters and sections?

RESOURCE CONTENT

Please evaluate the amount of information provided on the following themes:

Questioning technology	not enough____	too much____	just right____
Appropriate technology	not enough____	too much____	just right____
The global cooking-fuel crisis	not enough____	too much____	just right____
AT cooking solutions	not enough____	too much____	just right____
Solar cookers	not enough____	too much____	just right____

Which of the topics above did you find the most useful?

Which of the topics above did you find the least useful?

Any other comments about the information presented?

MESSAGING

Messages about technology, appropriate technology and international development were:

clearly defined	Yes____	No____
balanced, fair and educational	Yes____	No____

If no, why not?

ACTIVITIES

Activities were:

engaging/interesting	Yes____	No____
provoking of critical thought	Yes____	No____
suitable for information delivery	Yes____	No____

Which activities did you find the most useful?

Which activities did you find the least useful?

Any other comments or suggestions?

School _____

Your Name _____

Address _____

Thank you. Please send this evaluation form by mail, fax or email.

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CURRICULUM CONNECTIONS

This resource guide meets the British Columbia learning outcomes for Technology Education 8-10, Technology Education 11 and 12: Drafting and Design, Technology Education 11 and 12: Industrial Design, and Science and Technology 11.

Educators in other provinces and states can use these learning outcomes as guidelines for their course requirements.

TECHNOLOGY EDUCATION 8 - 10

SELF AND SOCIETY

- understand how humans shape technology and the impact that current and future technological advances have on our society, culture, and environment
- identify practical problems involving technology in a variety of contexts
- identify role models in technological occupations, including those sensitive to culture, gender, and physical ability

COMMUNICATIONS

- produce initial concept sketches and final drawings using a design process
- use information gathering and communication methods to solve problems involving technology and to create effective presentations

PRODUCTION

- build skills in designing and developing products and systems that improve the human condition
- match materials to specific product requirements
- devise a production process
- identify ways to minimize waste and reuse products

TECHNOLOGY EDUCATION 11 AND 12: DRAFTING AND DESIGN

GRADE 11

DESIGN PROCESS

- describe aesthetic and functional factors that influence design
- utilize design and problem-solving processes to communicate ideas and develop solutions
- create and critique design solutions
- complete a design project from design brief to the presentation of a solution
- describe how product and system designs are influenced by specific criteria

APPENDIX E

ETHICS

- assess the appropriateness of technological solutions when engaged in design activities
- describe how globalization affects product design, manufacturing, production, and marketing processes and systems on society and the environment
- identify environmental, social, and cultural diversity considerations associated with the design of products, systems, and graphic images

GRADE 12

DESIGN PROCESS

- apply research methods and techniques to solve design problems
- use appropriate tools and materials to develop and present design ideas
- synthesize knowledge and concepts from other disciplines and the community in the process of designing
- describe the relationships between design and society, culture, and the environment, with reference to specific examples
- use appropriate representation and drafting techniques to detail solutions, proposals, and plans, using a variety of techniques

ETHICS

- apply responsible environmental and social considerations and technological solutions in the design of products, systems, and graphic images
- evaluate the impact of globalization on the design, manufacturing, and marketing of product systems and graphics
- assess how design reflects society, culture, and the environment

TECHNOLOGY EDUCATION 11 AND 12: INDUSTRIAL DESIGN

GRADE 11

DESIGN AND COMMUNICATION

- solve design problems using a variety of strategies
- assess the appropriateness of design solutions
- demonstrate ability to collaborate to analyze and solve design and communication problems
- interpret and create accurate design representations
- select and use materials and components in designs to reflect specific design criteria and community standards
- apply concepts from other disciplines to the design process

PRODUCT DEVELOPMENT

- identify impacts of production and manufacturing processes on society and the environment
- produce finished products or systems from plans or designs (drawings, plans, schematics)
- develop and modify products or systems to address:
  - waste reduction
  - specified design criteria (form, function, aesthetics, ergonomics, end-user needs)

ENERGY, POWER AND TRANSPORTATION

- compare ways of using emerging and alternative energy sources to power mechanical devices
- describe the impact of energy, power, and transportation systems on society and the environment
- construct a device or system that is energy efficient

GRADE 12

DESIGN AND COMMUNICATION

- synthesize knowledge and concepts from other disciplines and the community in the design process
- assess how design reflects society, culture, and the environment
- assess and modify designs using specific criteria, including: cost effectiveness, available resources, and environmental impact

PRODUCT DEVELOPMENT

- assess how social, economic, and environmental conditions influence the choice of tools, manufacturing, and production processes used in developing products or systems
- appraise products or systems and justify modifications to design or production processes

ENERGY, POWER AND TRANSPORTATION

- describe ways to integrate emerging and alternative energy sources to power mechanical devices
- evaluate social, economic, and environmental conditions that affect the selection of transportation systems
- modify transportation devices and power systems to improve performance or efficiency
- design and construct devices and systems that use one or more energy sources (traditional and alternative) to achieve a measurable outcome

APPENDIX E

SCIENCE AND TECHNOLOGY

GRADE 11

THE NATURE AND INTERACTION OF SCIENCE, TECHNOLOGY AND SOCIETY

- describe what technology is and how it evolved
- identify and analyze the interrelationships between science, technology, and society
- demonstrate an awareness that today's science and technology decisions will influence the future of society

ENERGY AND ENVIRONMENTAL TRADE-OFFS

- identify the environmental impacts and societal benefits of a specific source of energy
- describe the interactions between society, technology, use of energy sources, and the design of energy systems
- identify technologies created as a result of society's concern for dwindling non-renewable energy resources (e.g., solar power, electric cars)
- identify alternative energy sources in B.C. and the potential impact of their use

FOOD PRODUCTION AND DISTRIBUTION

- describe the relationships between world food production, shortages, and distribution
- describe the interactions between science and technology that contribute to food production and distribution

TECHNOLOGY FOR THE HOME

- identify the influence of technologies on family life and the home
- discuss the changes in lifestyle created by so-called labour-saving appliances in the home

CONSUMERISM AND POPULATION

- describe world population growth and the factors contributing to it
- outline scientific and technological solutions to the problems associated with population growth
- compare the consumption of resources in developed countries with that in developing countries
- analyze their individual consumption of resources (e.g., water, paper, food, electricity)
- describe the use of technology in the advertising industry and the influence of advertising on consumption patterns
- differentiate between human needs and human wants

THE FUTURE

- analyze the effects of technologies on society and predict future effects, locally and globally
- demonstrate an awareness that decisions made today will influence the future of society

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