Listen to The Land

Presented by Kraft, Inc.
at EPCOT Center

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Listen to The Land

Can scientists find better ways to grow important crops? What is the overlooked potential of unfamiliar plants? How will space explorers grow food on the moon? At The Land, presented by Kraft, Inc., visitors can learn about food crops and agricultural technologies that may someday feed the earth's growing population, and perhaps even colonies in space.

There is something at The Land for all generations. While the pavilion's large-scale exhibits cover six acres under one roof, amateur gardeners can still gain new ideas for growing healthy tomato plants in their own backyards.

The Land pavilion is located at EPCOT Center in Florida's Walt Disney World vacation resort. Kraft and Disney dedicated The Land on October 6, 1982—the same month that EPCOT Center welcomed its first visitors. The pavilion is the world's only major display of food and fiber crops from all climate zones under one roof. In addition, The Land annually produces tons of fresh vegetables and fish for EPCOT Center restaurants.

The pavilion's three major shows complement one another: "Symbiosis," a wide-screen film about people's partnership with nature worldwide; the Kitchen Kabaret, an animated musical review about good nutrition; and the "Listen to The Land" boat ride through live plant and fish growing areas. Visitors can take a closer look at the greenhouses on the "Harvest Tour" led by one of the agricultural scientists or student interns. In addition, the pavilion offers two dining experiences—the Farmers Market, an informal Americana plaza with eight fast-food booths, and The Land Grille Room for fine dining.

Guests at The Land learn about creative solutions—some new and others that are today's variations on older methods—for growing food. For instance, integrated pest management demonstrates that there are alternatives to trying to completely eliminate pests. Trickle irrigation delivers small, precise amounts of nutrient solutions to where it is needed most, the plant roots. Computers monitor environments and control systems, like crop scheduling and water flow in the Aquacell, far more accurately than could be done manually. In the pavilion's biotechnology laboratory, tissue culture yields disease-free plants for the greenhouses.

The Land's purpose, and the underlying reason for Kraft's sponsorship, is to demonstrate how intelligent and constructive land use can help fulfill the world's future food needs. The pavilion illustrates that, while no one has all the answers, scientists are researching ways to provide nutritional food supplies; and most importantly, they are making progress toward that goal.

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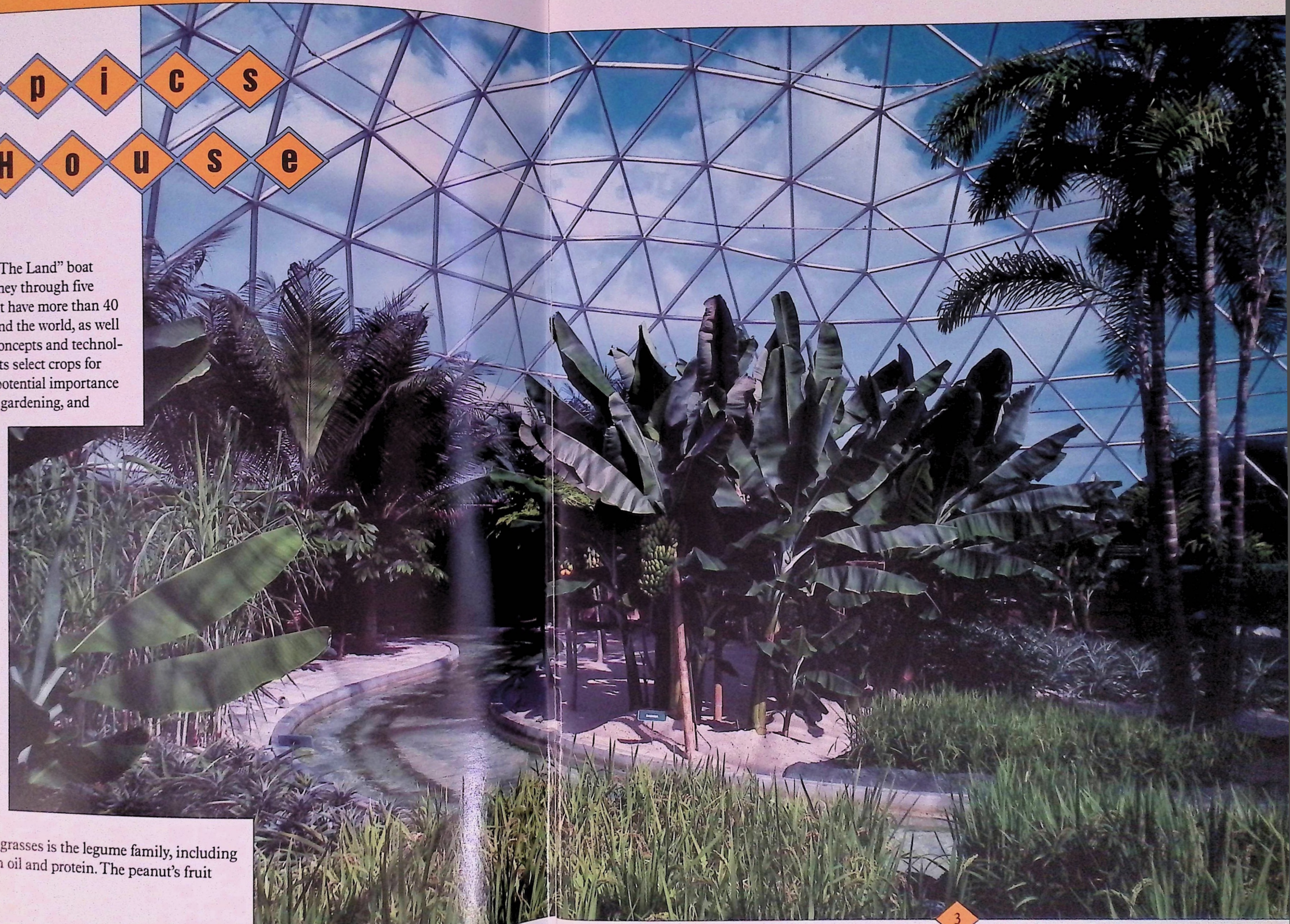
Tropics House

On the "Listen to The Land" boat ride, guests journey through five greenhouses that have more than 40 crops from around the world, as well as agricultural concepts and technologies. The Land's horticulturists select crops for the show based on present or potential importance to agriculture, including home gardening, and seasonal adaptability to the greenhouse environments. The staff often divides crop plantings to simultaneously display various development stages and ensure continuous harvests. Crops native to Southeast Asia, Africa, Latin America and the southern United States grow in the Tropics House.

Tropical bounty ◆ At The Land, rice—a member of the grass family, the most important one for food—grows in rocky terraces under the 60-foot-tall Tropics dome. Rice provides a staple food for much of the population. Another grass, sugarcane, produces 60 percent of the world's sugar.

Almost as significant as the grasses is the legume family, including familiar peanuts which contain oil and protein. The peanut's fruit grows underground.



The palm family also has many economically important members, like the towering peach palm, the tallest plant in The Land. The peach palm produces nutritious fruit and the vegetable delicacy called "heart of palm." The coconut palm provides food and a beverage, as well as oil for cooking and soap. It also has fiber for mats, brushes and rope; and its leaves and trunks make good building materials.

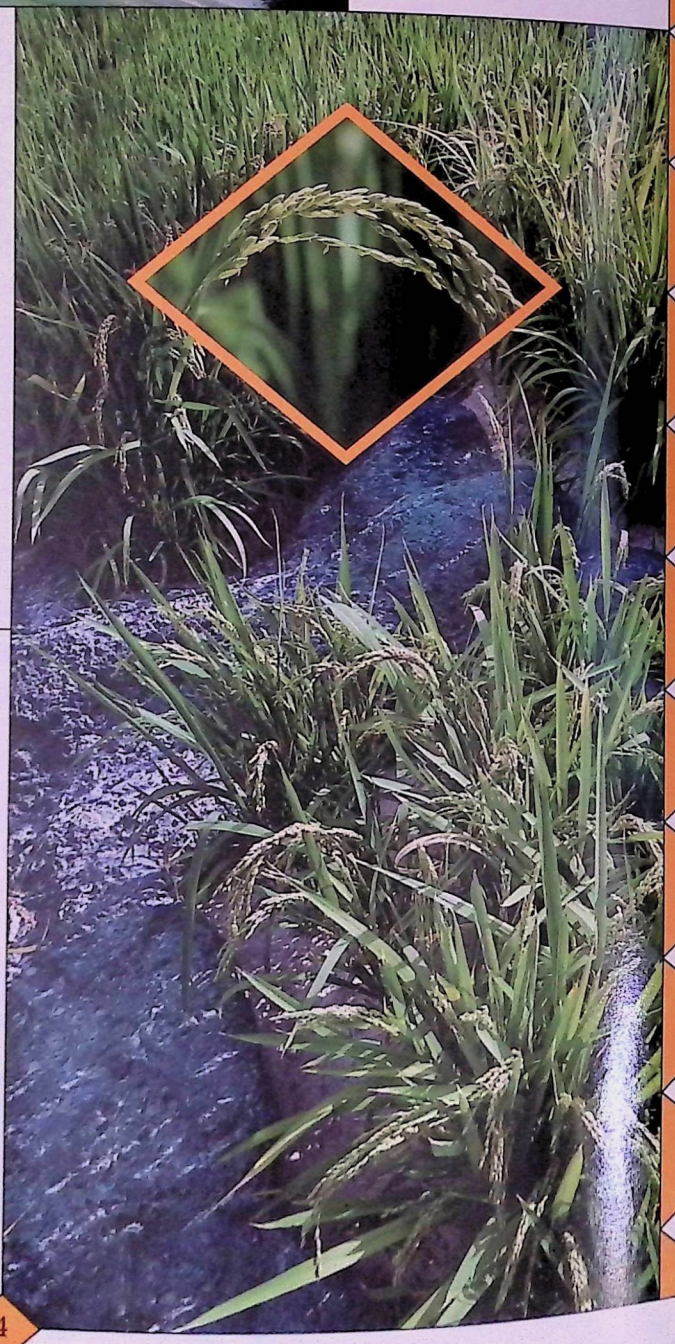
The banana is another tropic food staple. The main stem of the banana plant is actually underground. The large fruit bunches develop from pseudostems which continuously grow from the main stem, living only long enough to produce one fruit bunch each.

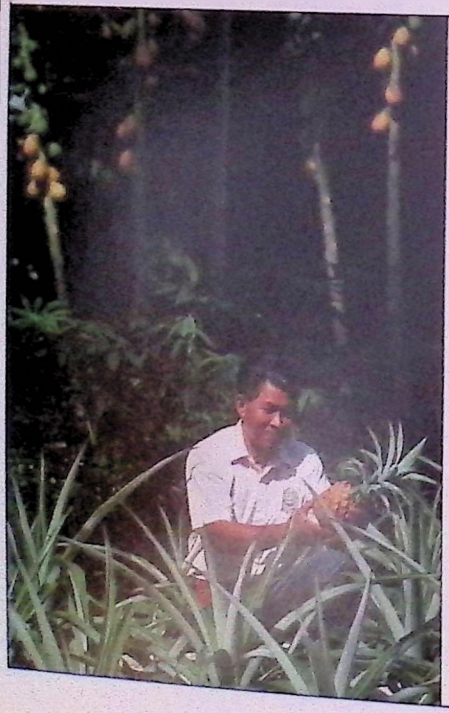
Two of the most interesting crops in the Tropics House are the vanilla orchid vine and small cacao trees, commercial sources of vanilla and chocolate. Unlike the grass and legume families, the huge orchid family has only this single edible member.

Papaya fruit is a popular breakfast treat in the tropics. Another delicious fruit, pineapple, is stimulated to flower by ethylene, a naturally occurring plant hormone that's also often used to ripen bananas.

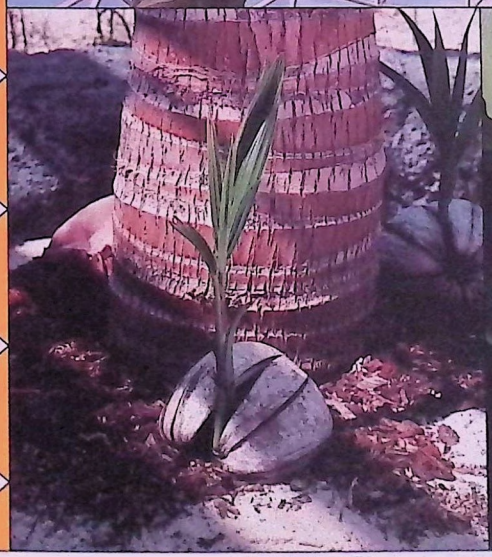
Sugarcane—a member of the grass family—produces 60 percent of the world's sugar crop.

Rice is a member of the grass family, the most important one for food. The rice at The Land grows in rocky terraces similar to those used in tropic climates.





Pineapple is stimulated to flower by ethylene, a naturally occurring plant hormone. Cassava, a tropical root crop, grows below with papayas in the background.



△ *The coconut* (left) *and peach palm are both members of the palm family, which has many economically important members. At 50 feet tall, the peach palm towers above The Land's other crops.*

◁ (Far left) *A coconut seed puts its roots down at The Land. The coconut tree bears one of the world's largest edible seeds, weighing about 2 lbs.*

◁ *The banana's underground main stem develops pseudostems which produce one fruit bunch each before dying.*

Aquacell

Some of the crops grown at The Land can swim—the fish and other aquatic life in the Aquacell. Aquaculture—the controlled cultivation and harvest of aquatic plants and animals—currently accounts for 10 percent of U.S. aquatic food production. The increasing cost of fishing natural waters coupled with the rising demand for seafood products suggests a bright future for aquaculture.

The Land's Aquacell is an experimental, high-technology production facility where animal scientists can compare growth rates of different species. Some residents include channel catfish, tilapia, paddlefish, sunshine bass, American eel and Malaysian prawn. The Land's staff carefully measures and records feed consumption, weight gains and factors affecting stress and disease. Many guests in The Land Grille Room order catfish and tilapia harvested fresh from the Aquacell, when available.

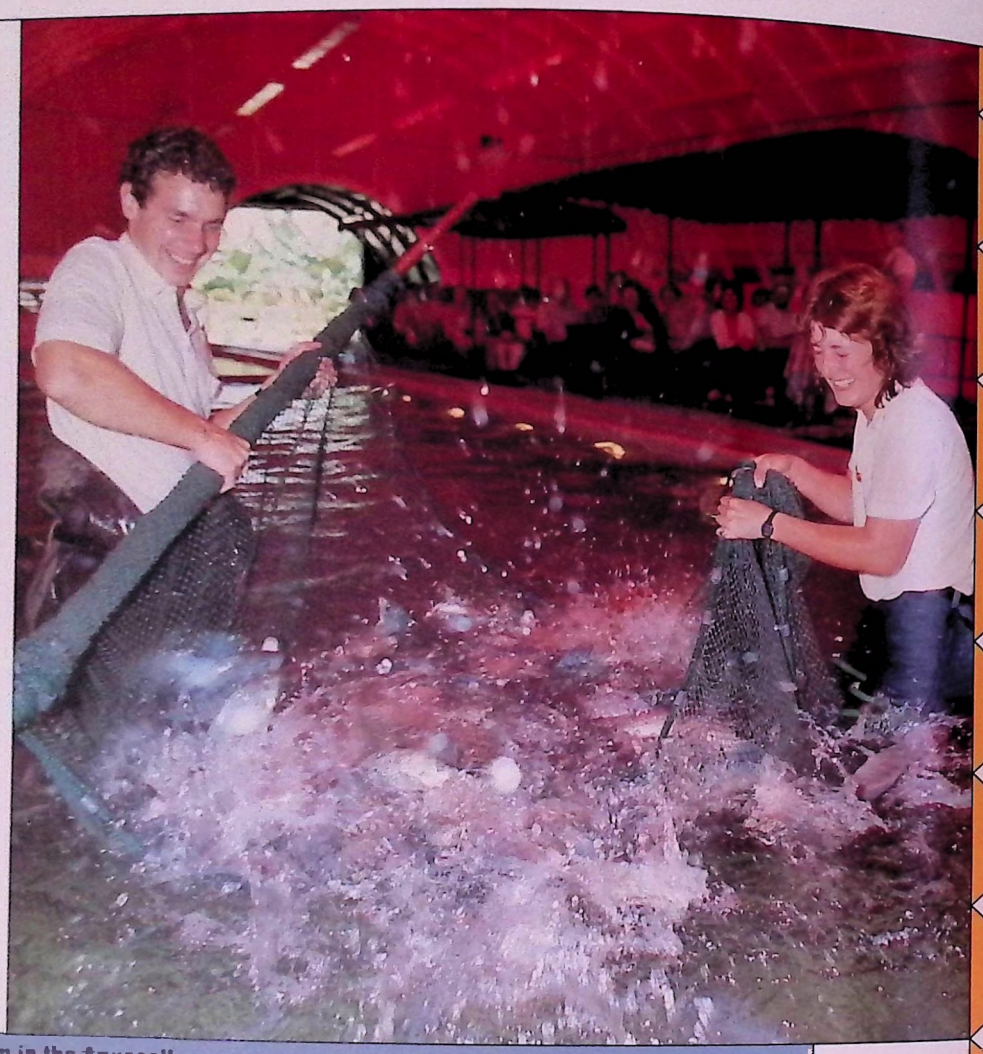
At home with the fish ◆ Aquaculture integrates the proper aquatic environment, food and health care to manage the animals' growth. Water quality is critical, because the water provides oxygen and removes life-threatening wastes. Aquacultural methods differ mainly in the manner and degree of control over water quality.

The Land's Aquacell uses a recirculating water system with four shallow tanks, two each of 5,000 and 8,000 gallons, and six cylindrical, 200-gallon acrylic tubes. Filtration equipment in an adjacent building cleans, oxygenates and maintains the recirculating water's desired temperature. This technology, called "closed system intensive culture," produces high yields while conserving water and land. Although yields can exceed 100 times those possible from earthen ponds, this intensive aquaculture requires more capital, energy and technical expertise.

Just as with any type of agriculture, it's essential to select the proper species for the environment. The best candidates must like crowded places, since the object is to produce

the largest harvest in the smallest amount of space. Other desirable characteristics include: adaptation to poor water quality, efficient use of inexpensive feeds, ability to reproduce in captivity, and marketability. Trout, catfish, oysters, clams, shrimp, seaweed and other species are examples of aquatic foods cultivated throughout the world.

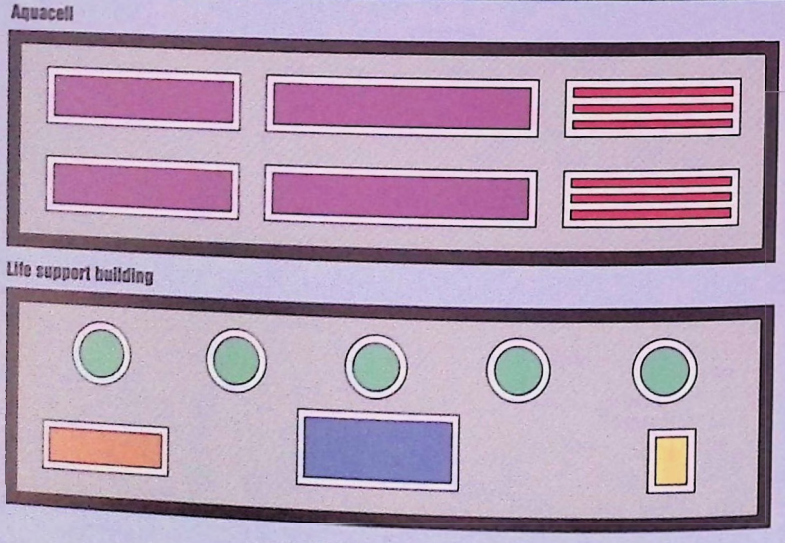
The red cover across The Land's Aquacell gives scientists some control over the light in the facility. Like people, fish are sensitive to light. By "darkening" the Aquacell, the fish may receive less visual stimulation, thereby reducing stress and conserving energy for growth.



Recirculating Water System in the Aquacell

- Raceways
- Aquatubes
- Sand filters
- Biological filter
- Ultraviolet light sterilizer
- Heat exchanger

Fish culture water flows from the raceways and aquatubes in the Aquacell to the Life Support Building. There, solid waste is removed by the sand filters and the biological filter removes chemical waste and oxygenates the water. The ultraviolet light sterilizer helps to limit the microbiological population in the water, and the heat exchanger maintains stable water temperature.



△ *Staff members harvest tilapia for The Land Grille Room, the pavilion's fine-dining restaurant.*

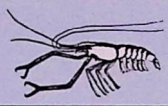
△ *One look at the paddlefish and you can see where its name originated! This fish is an excellent source of caviar.*

Fish At The Land

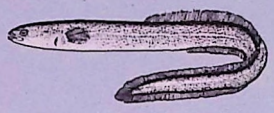
Channel catfish Native to North America. It is the leading farm-raised aquatic species in the United States, with most farms in Alabama, Arkansas, Louisiana and Mississippi. Farm fish are usually harvested at about 1.5 lbs., with maximum size at 60 lbs.

Paddlefish Native to the United States in the Mississippi and Missouri Rivers. Paddlefish is an excellent source of caviar. This fish grows up to 150 to 200 lbs. The paddle is thought to stabilize it while feeding.

Tilapia Tropical freshwater fish. It is highly suitable for intensive production with its adaptability, rapid growth and reproductive capacity. Tilapia has a fine white meat of excellent quality.

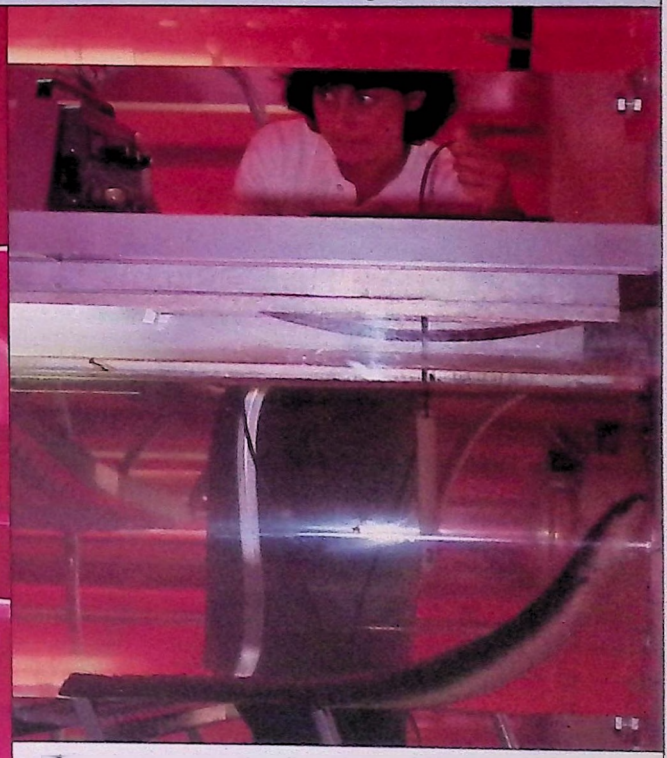


Freshwater shrimp Native to rivers of southeast Asia and Indonesia. It is an important commercial shrimp product in Hawaii and the Orient. Freshwater shrimp are raised in freshwater ponds at low densities because of their aggressive, cannibalistic nature.



American eel Found in the western Atlantic Ocean and its drainages throughout the eastern half of North America, extends into drainages of the Rio Grande, Mississippi and Missouri Rivers. It spawns in the Sargasso Sea in the middle of the Atlantic. The American eel is important for Oriental and European markets.

Sunshine bass Artificial hybrid of the striped bass, one of the most popular East Coast game and food fish. Sunshine bass has good potential for aquaculture because of its marketability and high quality.



◁ *It's feeding time for the tilapia in the aquatubes. Tilapia's adaptability makes it well-suited to aquaculture.*

△ *A member of The Land's staff checks the water temperature in the aquatube where American eels live.*

Desert House

One-third of the earth's land surface receives so little rainfall it is considered desert. However, the light intensity in the cloudless desert sky will often result in superior crop production, if water is provided. Sorghum and millet tolerate drought much better than some other food grasses like rice and corn, offering good crop choices for desert agriculture. Farmers are using water-conserving, computerized drip irrigation systems—similar to those in The Land's Desert House—to open the deserts for economic crops like cotton.

Getting to know the desert ◇ Plant species are becoming extinct at an alarming rate. Many unknown plants possess genes that are future sources of valuable traits like adaptability to harsh environments, pest resistance, and products like protein and gasoline.

Preserving potential crops for future use is important for the desert, as well as other climates. Many promising plants are well-adapted to this environment and are quite drought-tolerant. Three plants native to the U.S. Southwest are guayule, yielding a high-quality rubber; buffalo gourd, producing starchy roots and seeds rich in oil and protein; and jojoba, with seeds containing quality lubricating oil.

Fastest tree at The Land ◇ The rapid-growing *Leucaena* tree is quite drought-tolerant when established. Today, farmers are using it to reclaim eroding desert areas. The *Leucaena* also provides wood for cooking, as well as paper and furniture production.

Like the peanut, the *Leucaena* belongs to the versatile legume family. Many legume members develop a symbiotic relationship with a *Rhizobium* species of bacteria in their roots. The *Rhizobium* can "fix" nitrogen from the air and make it available to the plant, in exchange for sugars produced through photosynthesis. This allows the crop to thrive while slowly improving poor, nitrogen-deficient soils—another plus for the desert environment.

▲ *The Land's staff leads a guided 'Harvest Tour' of the growing areas. Here, guests see wood from the* Leucaena *tree up close.*

◀ *The* Leucaena *is one of the fastest-growing trees in the world.*

▼ *Guayule, a crop native to the U.S. Southwest, yields a high-quality rubber.*

▶ *Scientists are researching* Euphorbia lathyris, *a crop related to the poinsettia, as a future source of gasoline.*

▶ *Drip irrigation systems—similar to those used here at The Land—conserve water while making the desert a more hospitable climate for agriculture.*

△ *Salt-tolerant plants called halophytes may be important for desert production, especially along seacoasts that are marginal for agriculture.*

◁ *Sorghum is the world's fourth most important cereal crop. Because of its drought tolerance, sorghum offers a better choice for desert agriculture than some other food grasses.*

▽ *Using irrigation, cotton and other important economic crops can flourish in the desert. Many visitors to The Land have never seen cotton growing.*

'Salty' plants ◇ Deserts' low rainfall is often not enough to prevent surface salts from accumulating, making the soil useless for conventional agriculture. Halophytes, a group of salt-tolerant plants, may become important for production on salty desert soil. Some halophytes may even be irrigated with seawater, potentially opening up thousands of miles of desert seacoasts to agriculture. Today, scientists are studying halophytes that produce vegetable oil, starch, protein and forage for animals.

Production House

While The Land's exhibits entertain millions of visitors yearly, the pavilion is also a production facility. In the Production House, scientists use the latest techniques in controlled environment agriculture (CEA) to grow tons of tomatoes, cucumbers, lettuce, peppers, eggplants and other vegetables for The Land Grille Room and other EPCOT Center restaurants.

CEA permits environmental control for year-round food production. Fans draw air through wetted, paper pads for evaporative summer cooling. In the winter, heaters keep the greenhouses warm, along with insulation from the double-plastic sheet roofs and double-walled acrylic walls. Computers also help control the greenhouse environment.

Every inch counts ◇ CEA requires getting the most production out of the space available. Vining crops grow vertically up strings for agriculture in three dimensions. Researchers at The Land are evaluating new growing systems as well, like bags filled with different growing media and rockwool slabs. Rockwool is an inert insulation material that has recently proved excellent for growing plants.

Recipe for The Land Hydroponic Fertilizer Solution

Salt	Amount Dissolved (grams/liter)*	Essential Element **
$Ca(NO_3)_2 \cdot 4H_2O$, calcium nitrate	1.0500	calcium (Ca), nitrogen (N)
Chelated Fe 330 sequestrene	.0500	iron (Fe)
KNO_3, potassium nitrate	.5000	potassium (K), nitrogen (N)
KH_2PO_4, monopotassium phosphate	.1700	potassium (K), phosphorus (P)
$MgSO_4 \cdot 7H_2O$, magnesium sulfate	.5000	magnesium (Mg), sulfur (S)
H_3BO_3, boric acid	.0030	boron (B)
$CuCl_2 \cdot 2H_2O$, cupric chloride	.0007	copper (Cu), chlorine (Cl)
$(NH_4)_6Mo_7O_{24} \cdot 4H_2O$, Ammonium molybdate	.0005	molybdenum (Mo)
$ZnSO_4 \cdot 7H_2O$, zinc sulfate	.0020	zinc (Zn), sulfur (S)
$MnSO_4$, manganese sulfate	.0014	manganese (Mn), sulfur (S)

*453.59 grams = 1 pound 3.78 liters = 1 gallon **Carbon (C), oxygen (O), and hydrogen (H) are obtained from air and water.

△ *Fans draw air across these wetted, paper pads to cool the greenhouses during the Florida summer.*

△ (Top) *Because bees are not admitted to The Land, horticulturists must pollinate crops like this squash by hand.*

Agriculture without soil ◇ Today, CEA is moving towards hydroponics or soilless growing. Plants grow as well in hydroponic culture if the roots are provided with support, oxygen, water and 13 essential elements. In the Production House, bags or rockwool slabs—supplied with drip irrigation tubes—support some plants, while others grow on floating plastic boards. The thirsty roots receive aerated water containing the 13 essential elements normally absorbed from a soil solution, which is dissolved rocks and minerals in soil water. Advantages of hydroponics include better control over the root environment and root diseases.

▷ *One of The Land's student interns harvests red bell peppers, one of the vegetables served in the pavilion's restaurants.*

◁ (Far left) *Scientists at The Land are experimenting with different growing systems, such as these rockwool bags. Rockwool is an inert insulation material that provides support for plants. At The Land, hydroponic solution flows through drip irrigation tubes directly to the plant's roots.*

◁ *Guests who want a more in-depth look at the greenhouses can take the 'Harvest Tour' guided by The Land's staff.*

Creative House

Not only can crops grow without soil—they can even grow hanging in the air or on the moon's surface. The Land's Creative House shows guests an imaginative approach to tomorrow's agriculture.

Well-traveled plants ◇ In the Creative House, crops grow aeroponically, a variation of hydroponics where plant roots are sprayed with water and nutrients while growing in air. The solution drains out into a catch basin and is recirculated. Tomatoes, peppers and other crops hang on conveyors, circling at 12 feet per minute through a root spray box. Overhead nozzles direct solution at roots inside the traveling column pots, while excess solution drips down to fertilize watercress, miniature vegetables and other crops below.

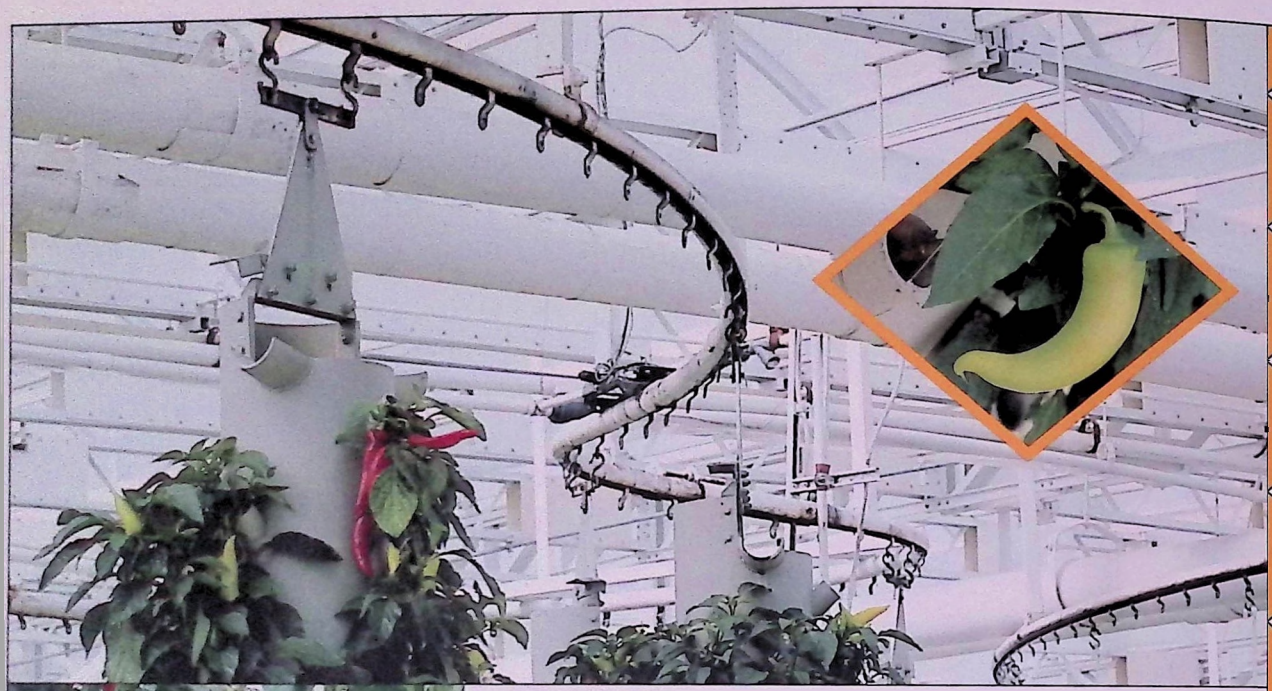
Lettuce grows on nearly vertical space-saving A-frames. The roots are sprayed on the inside with nutrient solution.

These techniques save space, always at a premium inside greenhouses. But the Creative House shows a different look at outer space, as well.

Pioneering space agriculture ◇ The Land's staff is working closely with NASA scientists from the Kennedy Space Center on agricultural research for space bioregenerative systems. In a spacecraft, the plants' roles will be to replenish oxygen and water as well as to produce food and recycle wastes. Many of the crops selected for study in the bioregenerative system are familiar ones like lettuce, wheat, soybeans, sweet and Irish potatoes, and sugar beets.

The Land's 9-foot-tall grow racks were designed by NASA and are the same as those used at its research facility at the Kennedy Space Center. Plants grow in a low-volume hydroponic solution, under high-pressure sodium vapor lights, with control available over such important nutrient system parameters as temperature, elemental composition and acidity. The Land scientists are studying how varying these parameters affects the incidence and severity of certain root diseases that will probably exist in space. In some cases, the staff deliberately introduces crop disease organisms into the system.

Scientific research at The Land may someday help to ensure healthy plants aboard a space station, lunar base or on the long voyage to Mars.



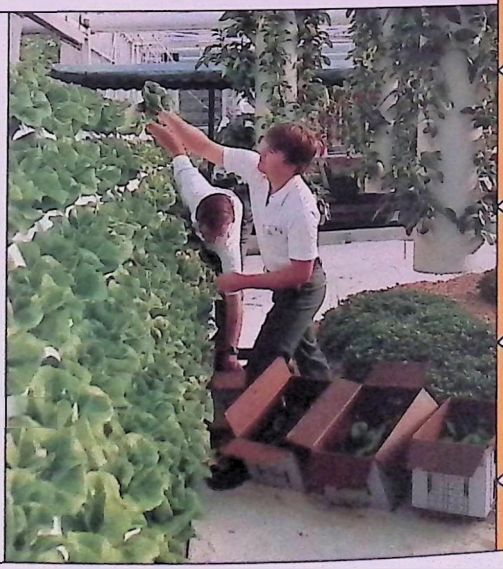
Farming on the moon ◇ In the 21st century, people may live in a self-sustaining moon base. They may obtain oxygen from ilmenite—a mineral found on the moon—for breathing and making water. Lunar soils may support crops, as well as supply them with some essential nutrients.

Soil comes from the mechanical disintegration and chemical decomposition of minerals. Four billion years of meteorites have ground down lunar minerals, and transformed up to 50 percent of surface samples to glass. Chemical decomposition has never occurred because the moon lacks water and plants, whose roots play a role in altering minerals.

△ (Top) *Using aeroponics—a variation of hydroponics where crops grow in air—plants circle the Creative House on long conveyors. These peppers grow in hollow column pots that are sprayed inside with nutrient solution.*

◁ *Hanging in air, the crop roots are misted with water and nutrients as they pass through the spray box.*

▷ *Lettuce grows on A-frames, as the roots are sprayed from the inside with hydroponic solution.*



◁ *These grow racks in NASA's research facility at the Kennedy Space Center are the same as those at The Land. Plants grow in a low-volume hydroponic solution, with precise control over important nutrient system parameters.*

The Apollo astronauts returned lunar soil samples to Earth, but quantities are too small to support agricultural research. The Land's scientists are conducting basic research which will lead to development of an accurate lunar soil simulant. Future studies will focus on essential plant nutrient availability and methods for adding deficient nutrients.

The lunar soil simulant at The Land starts from a basaltic rock collected near Duluth, Minn., with a similar mineral composition to the moon. The rock is ground to correct particle sizes. Part of the sample is glassified by a plasma torch at temperatures greater than 1000°C. The glassified material is more soluble, making nutrients more quickly available to plants. Research in The Land's lunar soils exhibit focuses on the availability of essential plant nutrients, methods for adding deficient nutrients, and the influence of growing wheat and soybeans on soil development.

On a lunar base, people may someday dine on moon-grown salads as they watch Earth hang in the sky.

△ *Based on results from lab analysis, a soil chemist at The Land adds nutrients to the lunar soil simulant.*

△ *NASA conducts research for space bioregenerative systems inside a special growth chamber.*

Tools & Technology

Farming is an ancient pursuit, and many of the foods we grow today were cultivated by our ancestors as well. But scientific research is creating a new kind of agriculture, one where genetic engineering and computers help grow high-quality crops. The Land's staff uses such state-of-the-art technologies to manage the greenhouses. Much of the research takes place in the show greenhouses, but some work is performed behind the scenes as well. The results are evident in the lush greenhouse displays.

Plants under glass ◇ Many agricultural crops like the pineapples, bananas, sweet potatoes and strawberries at The Land are asexually propagated clones not grown from seed. The staff propagates these crops by tissue culture—a biotechnology defined as the regeneration of whole plants from tiny pieces and even single cells of a maternal plant—to ensure vigorous, disease-free plants. These tiny pieces of maternal tissue are dissected under a microscope and placed in a sterile, complete growing media—a hydroponic solution, plus key vitamins, sugar and hormones. The "hormone recipe" is specific for each crop and can stimulate the tissue to produce literally thousands of tiny new plantlets.

The Land biotechnology laboratory developed by Kraft and Disney, in cooperation with the Agricultural Research Service of the U.S. Department of Agriculture, houses thousands of plantlets that will eventually be used in the growing areas.

Tissue culture, important for propagation, also forms the basis for genetic engineering, which holds enormous promise for agriculture. Scientists will be able to incorporate key characteristics like salt and drought tolerance, pest resistance, and improved plant growth into crops. Disease-free animals with enhanced meat, bone and fat ratios will also be developed.

Computerized agriculture ◇ Computers provide important management tools at The Land. They continuously monitor temperatures, relative humidities, solar light intensities and other environmental parameters. The Land's staff uses this data in computer programs to schedule crops and optimize pest management as well as other operations.

Scientists at The Land are working with the Environmental Research Laboratory at the University of Arizona in Tucson to develop artificial intelligence systems that will actually control the greenhouse environment someday. Using historical information, computers will set the best temperature and humidity settings after considering the different requirements of The Land's hundreds of crops, insects and microorganisms.

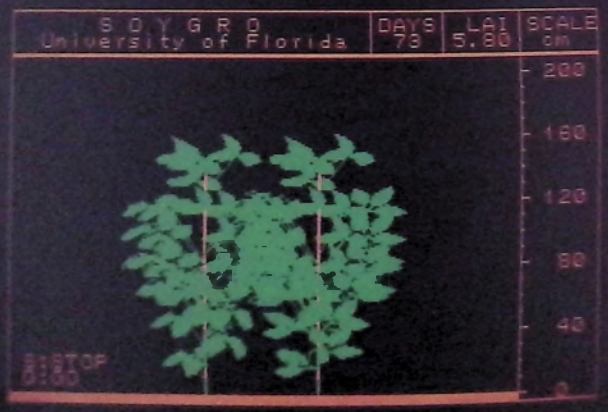
The pavilion's scientific staff is also looking at other advanced research, such as infrared imaging cameras to detect and interpret plant stresses. This tool could have many future applications, including highly accurate automatic irrigation control.

△ *Both the plantlets from the biotechnology laboratory and germinating seedlings get their start in the support greenhouses until they are ready for the pavilion's growing areas.*

△ *An entomologist observes the results of her research on whitefly, a serious insect pest problem. At The Land, the staff examines all plantings regularly for pests.*

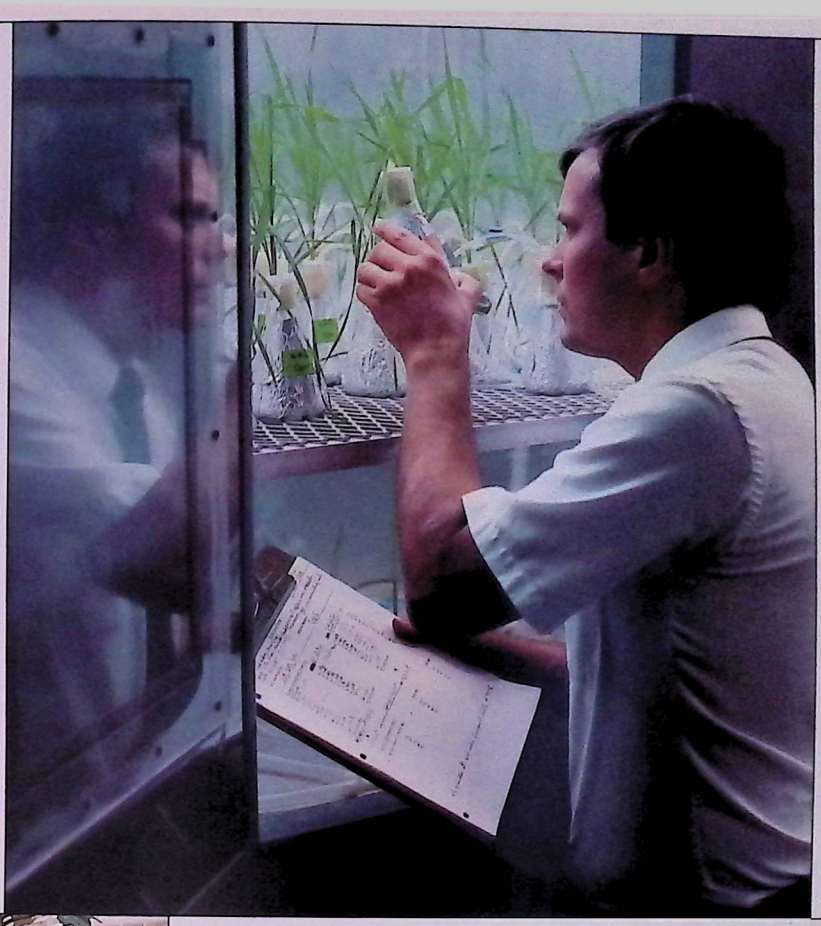
▽ *Computer models—like this soybean model developed by the University of Florida—are increasingly used at The Land and throughout agriculture today.*

Scientists vs. pests ◇ While some scientists at The Land are growing vigorous plants through tissue culture, others are busy ensuring that the current crops in the show remain healthy. The Land's staff uses a strategy called integrated pest management (IPM) to manage insects and diseases to avoid economic damage with minimal

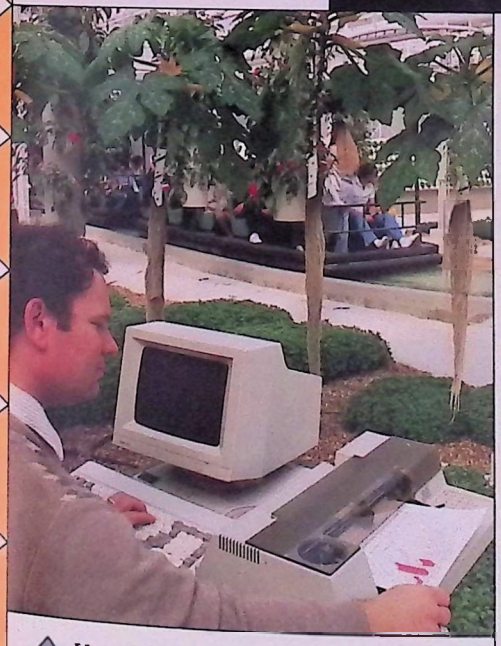


negative impact on the environment.

IPM emerged as a response to the limitations of total reliance on pesticides. The need became apparent when insects acquired resistance to commonly used insecticides. More frequent applications of higher doses only resulted in increased resistance. Use of broad-spectrum chemicals—those which destroy most varieties of pests—also eliminated beneficial insects, as well. This, in turn, caused major outbreaks of pests that had previously been kept in check. As these problems multiplied, it



Behind the scenes, a plant pathologist uses a growth chamber to precisely define the environmental conditions for disease research—leading to applications that may improve The Land's exhibits as well as overall agriculture.



Using computers, scientists can predict development of crops and other organisms like insects under changing conditions.

became clear that more than one control method was necessary. At The Land, IPM focuses on the selection of compatible combinations of cultural, mechanical, physical, biological and chemical methods to manage insect and disease pests.

Prevent pests before they happen ◇ In any IPM program, sound plant culture and excluding pests are the best kinds of medicine. Selection of disease-resistant plant cultivars, when available, gives crops a fighting chance. The cucumbers growing in the pavilion were chosen specifically for their resistance to powdery mildew, a disease which can destroy crops in just a few days.

Since a "pests keep out" sign would do little good, all persons entering the greenhouse growing areas must first step into a dilute bleach solution to avoid introducing soil-borne plant diseases. Other mechanical control methods to bar pests from the growing areas include plastic screens that prevent large insects, like moths and grasshoppers, from entering a greenhouse.

Inside, sticky foam tape on papaya tree trunks prevents pests from crawling up to feed on the leaves. Insects are often attracted to the color yellow, and yellow tape coated with glue can catch small flying insects. In addition, selective pruning and the careful

destruction of crop refuse are ways of limiting the spread of pests by cultural methods.

During steam pasteurization of the sand—a frequent sight on The Land's boat ride—plant pathologists raise the sand's temperature to 180°F for one to three hours to eliminate 99 percent of plant diseases and certain developmental stages of insects.

Insects on patrol ◇ Sometimes it takes one insect to control another. For example, introducing ladybugs can control aphids in crops. Entomologists at The Land rear tiny parasitic wasps for controlling insects like the vegetable leafminer, a pest whose larvae tunnel through and devour crop leaves. The wasps lay their eggs inside the leafminer larvae, and the resulting immature wasps feed on and kill the leafminers. Using biological controls, scientists try to re-establish a natural predator-prey balance in the greenhouses. Some of this method's advantages include prolonged effectiveness, the ability to target specific pests, and avoiding chemical resistance.

Team approach ◇ Although pesticides can effectively achieve short-term pest reductions, they do not provide a long-term decrease in pest density. Chemical and biological controls, when used together, can be more effective than either method alone. Some beneficial insects won't effectively hunt on certain leaf types. Other pests have developed resistance to pesticides. For all these reasons, IPM is very complex.

▲ *The staff purchases the tiny wasp* Encarsia formosa *on yellow tags, releasing them in the greenhouse to control whitefly pests.*

◀ *Ladybugs devour insect pests like aphids.*

▼ *The Land's scientists rear and study a tiny wasp,* Opius dissitus, *to control the vegetable leafminer. Magnified here, the wasp is laying an egg in a doomed leafminer larva. The immature wasp will then eat the leafminer larva.*

Usually there's more than one pest present on a crop, so controls for each must be compatible. In addition, crop ecology is dynamic, and the balance between organisms constantly changes. As a function of managing the greenhouses, scientists examine crops and computer printouts of environmental conditions, before making decisions on which the show's quality and productivity depend.

Backstage facilities include the support greenhouse, laboratories, small greenhouses for IPM research, and a computer room.

Pest Management Tips for Home Gardeners

The integrated pest management techniques (IPM) used in The Land can help home gardeners keep pesky insects at bay as well.

When planning a garden, ask the County Agricultural Extension Office for information about the area's major insect and disease pests. This office also has insect, weed and plant disease diagnostic services. Whenever possible, use disease-resistant crop varieties. If none are available—and the crop has severe pest problems—gardeners can substitute another crop.

The Land scientists recommend that home gardeners plan their IPM program for anticipated pests. Gardeners should use cultural and mechanical controls throughout the season. At night, cover a small plot with cheesecloth or other barrier to prevent moths from laying their eggs on plants. To reduce leaf disease problems, avoid overhead watering; and use trickle or furrow irrigation wherever possible.

Home gardeners can use microwaves to pasteurize potting soils on a small scale. Put 2 lbs. of soil in a microwaveable container, add 1 cup water, mix so the soil is moist but not completely saturated. Make sure that there is no metal in the soil. Put in the microwave for 7½ minutes at full power. The soil will be quite hot, but 99 percent of the root pathogens will be killed using this method.

Many insects are attracted to the color yellow. Placing yellow sticky traps near crops can help determine what pests are present.

All garden equipment can transfer disease organisms among plants. When pruning, periodically dip the shears into a 10-percent bleach solution to avoid transferring diseases. After each use, clean all tools; and re-oil pruning shears or the bleach will encourage rust.

Gardeners should learn to identify both pest and beneficial insects, as well as plant disease symptoms. During the growing season, estimate pest severity with weekly inspections of plant foliage. Large insects can often be removed by hand. If diseased plants are found, pull and discard them—but not in a mulch bin or compost pile.

Most fruit and vegetable plants can tolerate some leaf-feeding damage without a loss in yield. For example, caterpillars could consume up to 20 percent of a tomato plant's foliage before there would be yield reduction.

Home gardeners, like scientists at The Land, can obtain beneficial insects from garden supply catalogs. Beneficial organisms—like the bacterium *Bacillus thuringiensis* which kills caterpillars—are available as well. To have good control of pests, introduce the biological control when you first observe them. After releasing the insects, monitor them for effectiveness during weekly inspections.

When pesticides are necessary, choose one that is appropriate for a specific pest. All pesticides list directions for safe and effective use on the label; consult this information before any applications. Since insecticides can "burn" crops it is advisable to try it for the first time late in the day on only a few plants. If no damage occurs, treat the entire crop.

Remember that most pesticides will kill beneficial insects as well as the targeted pest. Spot spraying only heavily damaged plants will help reduce pest populations while allowing beneficial insects to stay in the garden.

People entering The Land's growing area must first step into a dilute bleach solution to prevent introduction of soil-borne plant diseases.

(Opposite page) *Powdery mildew—shown here on cantaloupe—is one of many diseases that concern The Land's staff. Currently, scientists can choose disease-resistant crops or use fungicides to control it.*

△ (Upper left) *Sometimes, entomologists use vacuums to remove pests for identification and density count.*

△ *A student intern applies pest management techniques for the home gardener as part of The Land's work/study Agricultural Student Program. Kraft co-sponsors the six-month program for top agricultural college students.*

Pavilion Dining

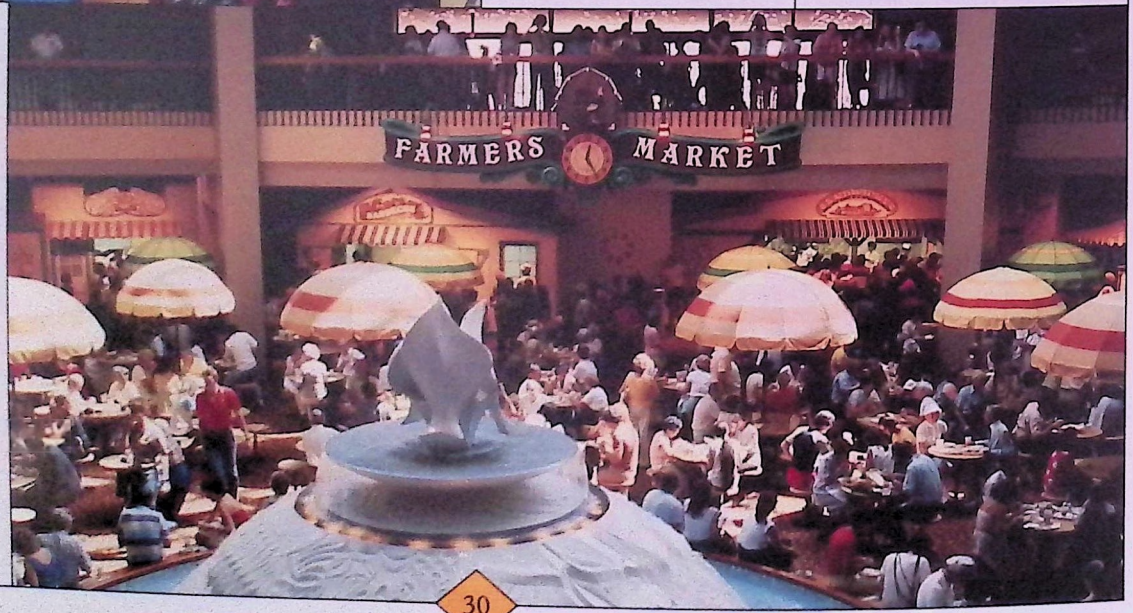
At the Land, guests may choose from two different dining experiences. Food service focuses on good nutrition through the Farmers Market, an informal, Americana plaza containing eight fast-food booths, and The Land Grille Room, which provides a fine-dining experience highlighting fresh, American cuisine. Each is open for breakfast, lunch and dinner.

Visitors to the Farmers Market can purchase a variety of wholesome, nutritious meals and snacks, many made from Kraft products.

The Land Grille Room overlooks scenes from the "Listen to The Land" boat ride. The menu highlights beef, chicken and seafood freshly prepared with an American flair. Guests may enjoy a salad prepared from The Land's greenhouse harvest, or a combination tilapia and catfish platter fresh from the Aquacell.

Young or old, fast-food aficionados or formal restaurant connoisseurs, all visitors to The Land are sure to find their dining experiences one of the most enjoyable aspects of their trip to EPCOT Center.

△ *Above the Farmers Market, hot air balloons represent the various food groups. The Land Grille Room is the pavilion's fine-dining restaurant.*



▷ *The Farmers Market offers visitors nutritious meals and snacks, many made with Kraft products.*

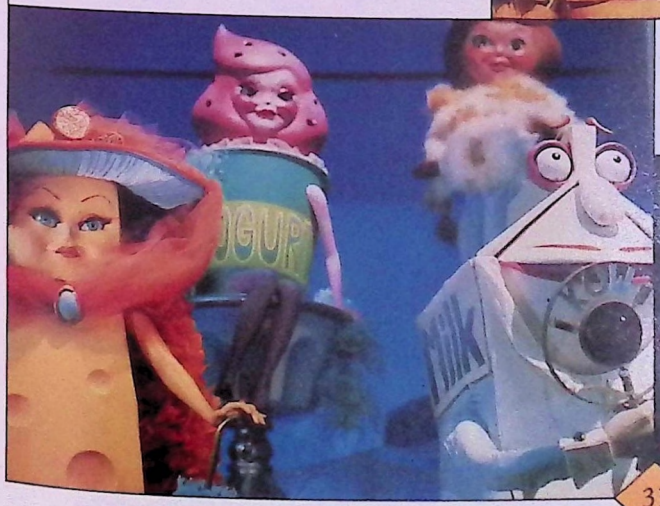
Kitchen Kabaret

The Kitchen Kabaret stars a unique cast with a special message about the benefits of a balanced diet. The original revue is family entertainment with a generous helping of hints about structuring meals around all of the basic food groups. Both are parts of the Kraft tradition.

Foodstuffs themselves come to life, through the Disney magic of Audio-Animatronics. Headliners include Bonnie Appetit, the mistress of ceremonies; the Kitchen Krackpots, a condiment and utensil band; Mr. Dairy Goods and the Stars of the Milky Way—Miss Cheese, Miss Yogurt and Miss Ice Cream; the Cereal Sisters; the Colander Combo; the Fiesta Fruit; and the Hamm n' Eggz comedy team.

This succession of characters sings the praises of each food group. The Kabaret finale assembles all the cast, reminding the audience of the importance of a balanced diet.

▽ *'Veggie fruit fruit' sing the Fiesta Fruit and Colander Combo in one of the most popular numbers. Mr. Broccoli is a children's favorite.*



◁ *Mr. Dairy Goods croons with the Stars of the Milky Way, from left: Miss Cheese, Miss Yogurt and Miss Ice Cream.*

▽ *The comedy team of Hamm 'n Eggz tells of the important protein group.*

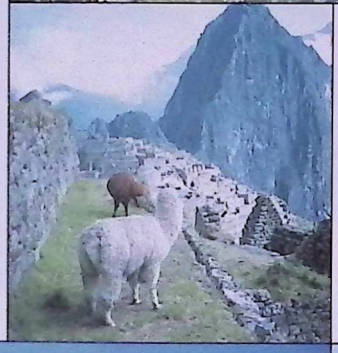
Symbiosis

"Nothing in the universe exists alone," says the narrator of "Symbiosis," the wide-screen film shown in The Land's Harvest Theater.

People's creative partnership with nature is the theme of the Walt Disney Productions' 18-minute film, which features awesome views of the world and of the changes humans have made to it.

"Symbiosis" explores the delicate balance between technological progress and environmental integrity, while recognizing that these two goals are not necessarily mutually exclusive. Even before the ancient Egyptians built the Great Pyramids, people were changing their world. Motivated by the most basic need—survival—they will continue to do so. The Harvest Theater's film makes visitors aware of their responsibilities to protect the land, water and air.

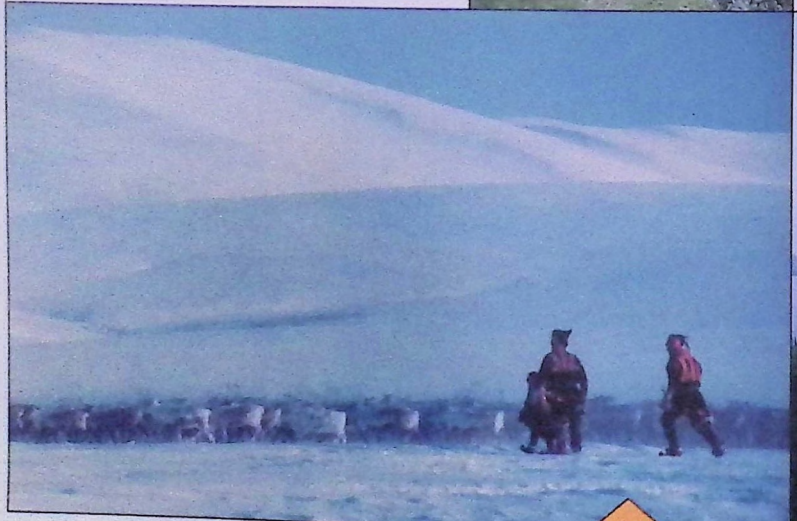
◁ *The Ifugao Indians transplant rice shoots in the flooded fields of these Philippine mountainside terraces.*



◁ *'Symbiosis' shows people's attempts to adapt Earth to their needs, such as in the Andes Mountains of Peru.*

▽ (Lower left) *A family herds reindeer across the Arctic slopes.*

▽ *The windmills of Holland show the creative partnership between humans and nature.*

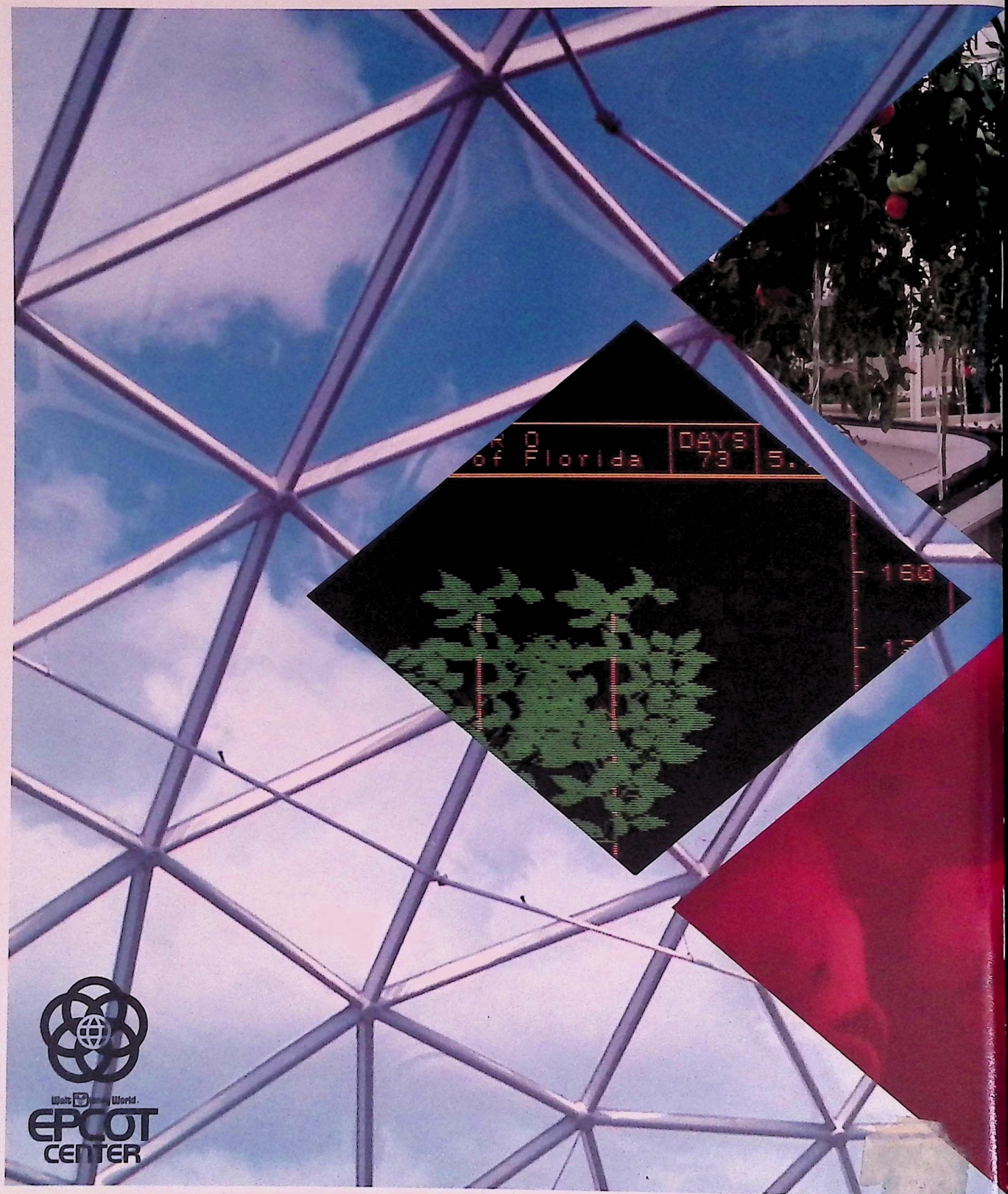


The Land,
presented by Kraft,
is the only show in the
world designed around food pro-
duction and agricultural research. The
pavilion was created to foster a spirit of hope
based on sound accomplishment, and to illustrate that,
while no one has all the answers, the future is bright because
there are alternatives to present techniques and unlimited opportunities.

As part of the pavilion's educational focus, Kraft co-sponsors the Agricultural Student Program. During the six-month work/study program, approximately eight top students from agricultural universities work in The Land's greenhouses, conduct walking tours for the guests, attend an agriculture discussion course and complete a special project.

The pavilion represents Kraft's faith in and commitment to a future in which people and businesses can flourish in a creative and confident environment. In keeping with that philosophy, The Land's exhibits will be ever-changing, reflecting the newest frontiers in agricultural research. From irrigation techniques on earth to plants grown in outer space, The Land is a unique demonstration of people's effective use of their environment and their provisions for future generations.

Editor: Kathy S. Knuth, Kraft, Inc. **Scientific information:** Dr. Henry Robitaille, agricultural manager for The Land, and the pavilion's scientific staff.
Special photography: NASA for the photos on page 21; the Agricultural Engineering Department of the University of Florida's Institute of Food and Agricultural Sciences for the computer photos on page 24 and back cover; The Land scientific staff for supplementary photography.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