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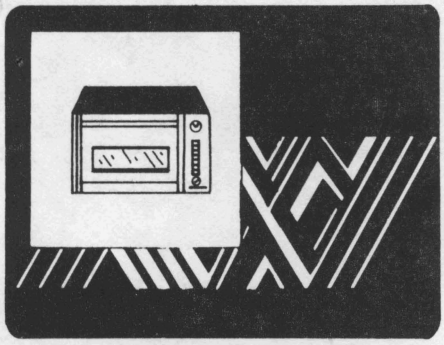

MICROWAVE BASICS HOME STUDY COURSE

Now you can unravel the mysteries of your microwave oven and expand its usefulness to you! Research studies have shown that most consumers use their microwave ovens for reheating and defrosting food. Participants in this home study course have reported significant changes in the way they used their microwave ovens after completing the course.

The *Microwave Home Study Course* contains information and experiments to help you learn about microwaving with your own oven. The course is designed for you to complete each lesson at your own pace. The eight lessons include:

- *Microwave Basics:* the oven, accessories, dishes and utensils.
- *Microwave Techniques:* techniques and factors influencing cooking, reheating and defrosting times.
- *Microwave Management:* meal planning and recipe conversion.
- *Microwaving Breads and Cereals.*
- *Microwaving Milk, Eggs and Cheese.*
- *Microwaving Vegetables and Fruits.*
- *Microwaving Meats.*
- *Microwaving Jam, Jelly and Candy — Plus Foods for Children to Cook.*

Your copy of the *Microwave Home Study Course* can be purchased by mailing a $3.00 check or money order to:

Texas Agricultural Extension Service
Department of Agricultural Communications (2112)
Reed McDonald Building, Bulletins — Room 101
Texas A&M University
College Station, TX 77843

Please make checks payable to Texas Agricultural Extension Service Account #20147.

Please send me _____ copies of *Microwave Basics* (B-1451). Enclosed is $3.00 for each copy ordered. Mail to:

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Address _____ County _____

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City _____ State _____ Zip Code _____

The Texas A&M University System
Texas Agricultural Extension Service
Zerle L. Carpenter, Director
College Station

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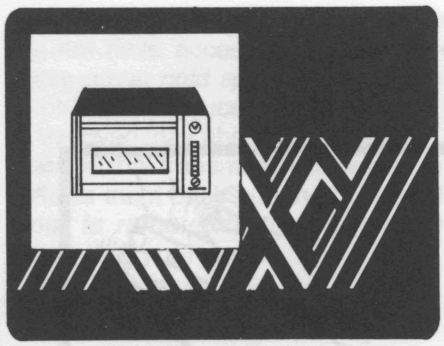

MICROWAVE BASICS

LESSON 1

Extension Family Resource Management Specialists
The Texas A&M University System

Welcome to the *Microwave Home Study Course.* There are eight lessons in this course. They contain information and experiments to help you learn about microwaving with your own oven.

This course is designed for you to complete at your own pace. Read each lesson once or twice before you begin the experiments. Feel free to substitute ingredients or use a recipe that you prefer so the foods will fit into your family's meal pattern. Don't buy special foods just to do the experiments.

If you need help, call or write to your county Extension agent.

After you complete this lesson, you will have a better understanding of:

- How microwaves work;
- Construction and function of oven parts and accessories;
- Characteristics of suitable cooking utensils;
- Safety and microwaving;
- Cleaning and maintenance.

CONTENTS

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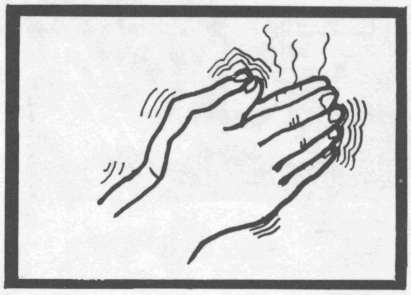
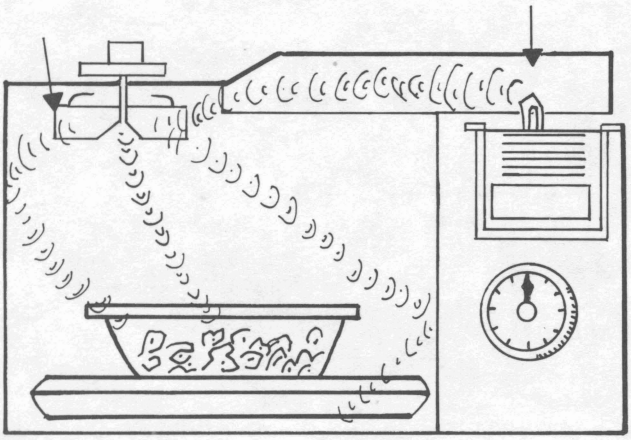


I. How Microwaves Work

To understand how microwaves cook, it's important to know what they are. Microwaves are a form of high-frequency electromagnetic energy similar to that which powers a CB radio, AM-FM radio, a TV, or radar which detects speeding cars. In the oven, microwaves are transmitted into a small space. They travel in straight lines and bounce off the walls until they are absorbed by food.

Microwaves produce energy, not heat. They penetrate to a depth where they pass over the water molecules in food and cause them to vibrate at extremely high speed. The result is heat produced by friction. You can achieve a similar result by rubbing your palms together very briskly. Cooking occurs when this heat is transferred from the hot outer layers to the uncooked inner layers. Traditional methods of cooking rely on heat transferred to food by conduction or convection, much slower processes. Cooking by microwaves requires from one-half to one-tenth of the time required for conventional cooking.



II. The Microwave Oven

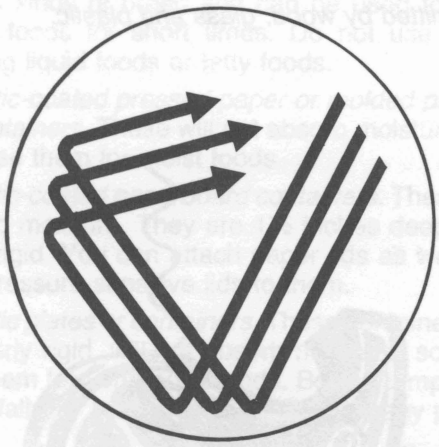
- *Electrical Requirements.* The oven is powered by a regular household electric source of 115 to 120 volts. A grounded 15 to 20-amp outlet is recommended. Household ovens draw from 1,200 to 1,800 watts, known as *input power.* If wattage is not indicated on the name plate, you can compute it by multiplying volts times amps. Dealers will often quote *output power* which ranges from 400 to 700 watts. This is the power available in the oven. The higher the output power, the more microwave activity and the faster food will cook. The *relative efficiency* (RE) of your oven can be figured by dividing the output wattage by the input wattage. (See Experiment No. 3.)

- *Magnetron.* The word *electronic* describes microwave ranges since they use a tube. The magnetron tube is the heart of the oven and should be treated with respect and care. It generates the microwaves needed for food preparation. The magnetron's importance to the microwave oven is similar to that of the picture tube to a television.

- *Wave guides.* Microwaves are passed toward the oven cavity after hitting a coupling device called a wave guide. From there, the energy strikes a device which distributes energy. The distributor is often called a fan or stirrer.

- *Stirrer.* This distributes microwaves within the oven cavity. The carousel on some models also acts as a distributor as it moves food through the path of microwaves. Microwaves bounce off surfaces at the same angle at which they strike. Since they travel

only in straight lines, it is likely that parts of the oven will not have access to microwave energy. We call these areas *cold spots* even though microwaves do not actually produce heat in the oven cavity. The floor of the oven may absorb microwaves; or it may be of a material that transmits microwaves to a surface which reflects them back into the bottom of the food. ***If the floor is removable for cleaning, return it before operating your oven.***



• *Seals.* Door seals, or energy trapping seals, keep microwave activity within the oven cavity. Door seals must comply with government specifications.

III. Accessories

• *Timer.* A timer should be well defined under the 1-minute designation. It is important to count seconds. Timers are available in manual and electronic-touch models. For specific details on setting by time, temperature or clock, consult your use and care manual.

• *Revolving turntables.* These are a form of distributor since they move food through the paths of microwaves. The center of the carousel may be a *hot* or *cold* spot depending on the pattern of microwave activity in your oven. You may need to rearrange food during cooking to avoid overdone or underdone spots.

• *Probes.* A temperature-sensing probe is a power shut-off device that permits microwaves to be produced until a preselected temperature is reached. Then the power shuts down and stays off until it is needed to bring food up to the set temperature. If your oven has a thermometer readout, you can observe this. Place a probe so it is not touching a bone and not shielded by a bone. Bones distort microwave patterns.

Caution: Never allow the temperature-sensing end of the probe to touch the interior walls or oven door while the oven is operating. Do not force it into frozen foods. Follow your manufacturer's instructions.

• *Power levels.* Power levels are not alike on all ovens. Most ovens have variable power settings ranging simply from *off, on* and *low,* to a range of *6, 8* or higher. *Defrost* setting, *medium* or *half power,* is the halfway point if an oven has graduated settings. To determine power of setting on your oven, divide full power by number of settings.

Example: A 600-watt oven with four settings will have 600 watts full power, 450 watts at three-fourths power (second setting), 300 watts at half-power (third setting), and 150 watts at one-fourth power (last setting before off). If your oven has no *defrost* setting, you may do this manually at one-third or one-half power by cycling the oven on and off. Defrosting by this method, or with the power level setting for defrost, yields the best results. Otherwise, cooking will be uneven. Additional defrosting information will be in later lessons.

• *Browning elements.* A browning element looks like the broiler unit in a conventional electric range. The input wattage is much less and they do not function the same way, so you may find ovens with a browning element to be slower. Microwave-cooked foods brown best and quickest *after* microwave cooking. The heat from the element browns and crisps the exposed surface. Food which cooks 20 minutes or longer without use of a browning element will have natural browning in the microwave oven.

Caution: Do not use paper or plastic products in the oven while using the browning element because of fire danger. Browning will be discussed in more detail in Lesson 7, "Microwaving Meats, Fish and Poultry."

• *Cookbooks.* Rely on the cookbook which accompanied your oven. Terminology is not standard among manufacturers, but understanding available power levels should help you translate recipes from different sources.

• *Thermometers.* Some thermometers are designed specifically for use in a microwave and are available at a reasonable cost. Do not use conventional meat and candy thermometers in the oven because the microwaves may damage them or make their reading inaccurate. To measure food temperature with a conventional meat thermometer, remove the food from the oven; insert the thermometer into the thickest portion and let it stand for a few minutes to register the internal temperature. If more cooking is needed, remove thermometer and return food to oven.

• *Browning dishes.* These are designed with a special coating on the bottom which attracts microwave energy. When preheated, they can be used to fry eggs and to brown meat. The feet or rim keep the dish from touching the oven floor. Use only dishes manufactured for your oven. Use hot pads to handle the browning dishes and place them on a hot mat for serving. Clean them carefully; abrasives may damage the dish and decrease its efficiency. Do not use these dishes in a conventional oven as the special coating will distort expected results.

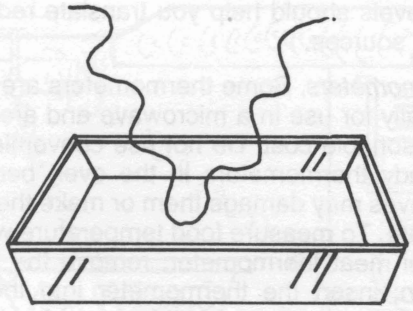
IV. Dishes and Utensils

Microwaves have three characteristics which allow them to be used in cooking: they are *reflected, transmitted* or *absorbed.* Since microwaves are *reflected* by metal, you cannot use standard utensils made of stainless steel, iron and aluminum.

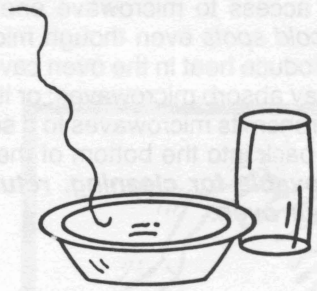
Shallow metal containers, such as TV dinner trays, may be used this way: remove foil from the top of the container and slip food back into original box, *or* wrap food container in waxed paper or plastic wrap and place in the oven. Before cooking in any metal container, consult the manufacturer's use and care manual. You could invalidate your warranty.

Microwaves are *transmitted* by glass, ceramic, paper, wood and many forms of plastic. Many companies are designing microwave-safe reusable containers. If you're not sure, try this *dish test:* Put 1 cup of water into a glass measuring cup. Set this into the oven. Place the dish to be tested in another part of the oven. Microwave for 1 minute. The water should be warm; the test dish should not. If the dish is warm, do not use it.

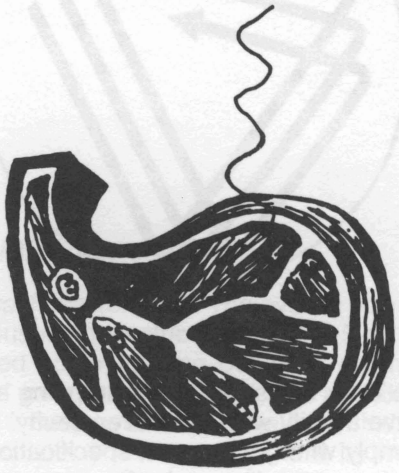
Food *absorbs* microwave energy. This is how it cooks. Some plastics also absorb and must be used carefully. Melamine plasticware may char. Some ceramics absorb enough energy to lengthen cooking time. Your choice of microwave cookware will depend on what food you are heating, whether it is dry, moist or liquid; and to what temperature it must be heated. Before you buy special utensils and tools, look around to see what you have.



Reflected off metal.



Transmitted by wood, glass and plastic.



Absorbed by food.

• *Reusable dishes.* Most *glass and ceramic* dishes with metal trim should not be used. Grease glass cake pans as in conventional cooking. Lining them with paper will add volume to cakes. Use a 4-cup or 2-cup measuring container in preparing white sauce, pie fillings, gravy. It makes a handy bacon cooker, too. Simply lay a wooden skewer across the top, drape the bacon over this, and cook. The cup catches the drippings for later use.

Most *pottery or china* can be used if it has no metal trim. You can use pottery and china to heat refrigerated foods, but do not freeze foods in it since it may crack during fast changes of temperature.

Plastic dishware varies considerably in ability to withstand high temperatures. All can be used to thaw foods and most can be used to heat foods to serving temperature. ***Note:*** Plastic has so many variations, it is listed with both reusable and disposable dishes. Labeling should indicate possibility of uses and microwave limitations.

Caution: Boiling temperatures, especially for fat or sugar foods, will distort many plastics. Use wood for only brief periods to warm snacks or breads.

- *Disposable dishes.*

•*Plastic pouches.* Use special heat sealer units or cooking bags fastened with rubber bands or string. Do not fasten them with metal ties. Pierce the pouch before heating.

•*Pressed paper or molded pulp plates or containers.* Since these absorb moisture, they are good for heating all kinds of bread and can be used for heating moist foods for short times. Do not use them for heating liquid foods or fatty foods.

•*Plastic-coated pressed paper or molded pulp plates or containers.* These will not absorb moisture, so you can use them for moist foods.

•*Plastic-coated paperboard containers.* These will not absorb moisture. They are 1½ inches deep and are fairly rigid. You can attach paper lids as well as film and pressure-sensitive lids to them.

•*Plastic plates or containers.* These containers, which are fairly rigid, will not absorb moisture, so you can use them for very moist foods. Boiling temperatures, especially for fatty foods, will distort many plastics.

- *Size and Shape.* Depth is important. Shallow dishes expose more food to microwave energy and cook it faster. Avoid baking dishes with sloping sides. They cause the edges of food to overcook before the center is done. Round dishes are preferred because they eliminate overcooked corners. Ring-shaped pans are good for foods which cannot be stirred during cooking. Energy can penetrate from all sides and the center. Food cooks faster and more evenly.

- *Covers.* Covers prevent drying and spattering. Use plastic film, glass or moisture-retaining material for most foods except bread, breaded products or crisp foods. (You can leave these foods uncovered or cover them with a paper towel to prevent spattering.) If you use plastic film when heating foods to temperatures that can build up steam, pierce the film before heating so steam can escape. You can use waxed paper to loosely cover foods. It will not retain steam, but it will protect the oven from spatters. Use small amounts of foil for shielding (preventing certain parts of a food item from burning) especially on corners of rectangular cakes and on the wings and joints of poultry.

V. Oven Cleaning

You do not need to buy special cleaners for your oven, but you must clean it regularly. Because foods do not burn on the oven surfaces, you may not realize they need cleaning. There are good reasons for routine cleaning: food soil can spoil and contaminate items you prepare; food-soil buildup can interfere with the door seal; microwaves are attracted to food and do not discriminate between soil and tonight's roast, so excessive soil can slow cooking time.

Simply wipe your oven promptly with a paper towel, or clean it with a mild detergent in warm water and a soft sponge or cloth. Wipe frequently around the door seals and door to remove food particles. Grease around the door seal can allow excessive radiation leakage. If food particles stick to the sides or bottom of the oven, boil a cup of water in it. The steam from the boiling water will loosen the dried particles so they can be wiped easily. Use a nylon scrubber, if necessary, but do not use abrasive cleaners or commercial oven cleaners.

The glass shelf in some microwave ovens may be lifted, removed and washed with warm water and detergent. Do not operate the oven unless the shelf is in place. To remove stains from the ceramic oven floors, scrub the surface with baking soda or a special ceramic glass cleaner. Remove odors by boiling one part lemon juice to three parts water in a measuring cup in the oven, or by placing a small dish of baking soda in the oven and leaving the door ajar. Removing food from the oven immeditely after cooking will help avoid odor problems.

VI. Safety

The Bureau of Radiological Health, a unit of the Food and Drug Administration, has established maximum levels of allowable radiation leakage in microwave ovens. Any unit leaving the manufacturer may emit no more than 1 milliwatt of radiation per centimeter at a distance of 5 centimeters from the oven's surface. Look for the approval label stating that the oven meets the safety standards.

Amana® has permission to omit this label, but complies with the safety requirement. Maximum allowable leakage, over the appliance's lifetime, is 5 milliwatts per square centimeter at a distance of 5 centimeters from the surface of the oven.

If you are concerned that your oven is not working properly, or that it may have excessive leakage, contact a service technician.

Items in a microwave oven can get hot enough to char, smoke, or even burst into flame, especially if you're handling small loads such as when drying herbs or freshening crackers. A cup of water in the corner of your oven will absorb excess microwave energy. Burning can occur when heat from food transfers to the container. Handle foods high in fat or sugar carefully since they get hot very rapidly.

Be careful when removing any covering or lid. Steam builds up in the container and can cause burns. Always tilt the lid away from you or poke a hole in a plastic film covering. Plastic sacks or pouches must be pierced to prevent steam buildup and burns.

Certain foods also have a natural membrane or sac which can permit steam buildup. Pierce the skin of potatoes and the sac surrounding an egg yolk before microwaving.

EXPERIMENTS

Microwaves are a form of energy which produce heat when they are absorbed by food. When the power level is changed, cooking time is either shortened or lengthened. Size, shape and composition of containers affects cooking results, as does the pattern of microwaves in your oven.

Experiment 1—Your Oven

Review the section on accessories. Complete the following information about your oven. This will acquaint you with your unit and give you a good record to use if you need to call your dealer.

1. Brand _____

2. Model _____

3. Exterior height _____

   width _____

   depth _____

4. Cavity height _____

   width _____

   depth _____

   cubic feet _____

5. Weight _____

6. Cost _____

7. Name plate data:

   volts _____ volts

   amperes _____ amps

   frequency _____ MHz

8. Output power _____
   (Will range from 400 to 700 watts)

9. Input power _____
   (Will range from 1,000 to 1,800 watts; volts × amps)

10. Approval symbols or seals
    (Sketch them.)

11. Power levels (Name the settings; estimate output wattage of each.) The top setting is 100 percent of output and each lower setting decreases by the fraction represented by the total number of settings. Review the section on power levels.

Setting No.	Setting Name	Output Wattage

	Yes	No
12. Browning element?	___	___
13. Temperature probe?	___	___
14. Clock?	___	___

15. Timer:

____ manual ____ electronic

Number of minutes? ____

Number of seconds marked under 3 minutes? ____

Under 1 minute? ____ Under 30 seconds? ____

16. Is outlet grounded? Yes ___ No ___

17. Is oven on separate circuit? Yes ___ No ___

Sketch the location of fuse or breaker on service panel. (This exercise will help you locate a trouble spot quickly and to assist a repair person.) Locate the fuse or breaker for this circuit.

Experiment 2—Wattage

Review the section on the microwave oven and accessories. Calculate the output wattage of your oven:

1. Fill a 4-cup glass measure with tap water. Take the temperature with a meat or candy thermometer. _____ degrees.

2. Using the highest setting, heat the water 2 minutes in your microwave oven. The temperature is _____ degrees.

3. Subtract the first temperature from the second. _____ degrees.

4. Multiply this figure by 18.5. 18.5 × _____ = _____

5. This figure is the actual wattage output. Does this agree with the figure quoted by the manufacturer? Yes ___ No___

Did you get the same answer as in Experiment 1, No. 8? Yes ___ No___

If this answer is lower, extend cooking times; if it is higher, shorten cooking times.

Many things could have affected your answer. Review these if you are concerned about low output power:

- low voltage;
- use of a heavily loaded circuit;
- wrong size container;
- read thermometer wrong or figured incorrectly;
- inaccurate thermometer.

Consistently low answers or a very slow oven may prompt you to contact your dealer whose name, address and phone are: _____

_____

_____

Experiment 3—Electrical Requirements

Review the section on electrical requirements of the microwave oven. Compute the relative efficiency (RE) of your oven.

1. Output power
(See Experiment 1, answer 8) _____

2. Output power
(See Experiment 2, answer 4) _____

3. Input power
(volts multiplied by amps) _____

4. Divide output power
(no. 1 above) by input
power (no. 3 above) _____ % RE

5. Divide output power
(no. 2 above) by input
power (no. 3 above) _____ % RE

Your answer represents the percent of available power (input) actually at work in the oven (output). Conventional ranges have an RE from 8 to 30 percent. Was your reading better for: ___ no. 4 above, or ___ no. 5 above.

Can you explain why? _____

_____

_____

Experiment 4—Dishes and Utensils

Review the section about dishes and utensils, or consult your instruction manual.
Dish Test: Pour 1 cup of water into a glass measuring cup; set this in the oven. Place the dish to be tested into the oven at another location. Microwave on high for 1 minute. The water should be warm; the test dish should not. If it is, do not use it for microwave cooking.

1. Test five dishes or containers you want to use. Describe the dish and the results. (Use the chart on the top of page 8.)

2. What does *your* use and care manual say about aluminum foil and TV dinner trays?

_____

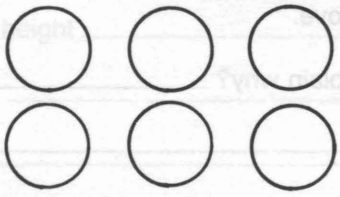
_____

Type of Dish	Results

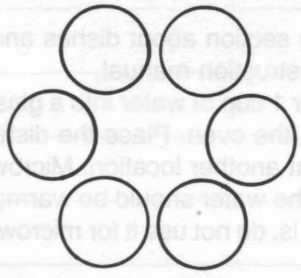
Experiment 5—Heating Pattern of Your Oven

Review sections on the microwave oven and accessories.

1. Place six marshmallows on saltine crackers. If you don't have marshmallows, see note*. Place as in diagram. If your oven has a turntable, place them in a circle. Heat 10 seconds; observe and number each circle: 1—not melted; 2—slightly melted; or 3—very melted.



For most ovens, use this pattern



For ovens with turntable, use this pattern

2. Heat 5 more seconds, observe, and number the ones which are melted.

3. Heat 5 more seconds, observe, and number.

4. What does this tell you about placement of food in your oven? _____

_____

Can you tell where the fastest cooking takes place? Yes___ No ___

What should you do to compensate for this? _____

_____

NOTE: If you don't have marshmallows, cut three slices of bread in half and arrange as shown. Sprinkle these lightly with grated cheddar cheese. Heat according to directions above and number as explained. You can also wet a sheet of brown paper and place it on the floor of the oven. The quickest drying spots represent the most microwave activity.

You should be better acquainted with the parts and accessories of your oven as a result of these experiments. Now you know how to arrange food to avoid *hot* and *cold* spots and how to vary the power levels to suit your family's needs and tastes.

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