Who would have guessed when great-grandma set her menu by the foods’ colors that she was so right in helping to ensure her family’s health and well being?

Why Care about Colors?
The color molecules that form the more than 2,000 pigments in plant foods not only look scrumptious but also contain strong antioxidants, the health-promoting substances that neutralize the free radicals formed when cells burn oxygen for energy. Free radicals damage or destroy healthy cells. In general, the deeper the color of a fruit or vegetable, the more powerful its antioxidant action.

Plant pigments are a subset of the naturally occurring antioxidants in vegetables and fruits. Other phytochemicals (“phyto,” pronounced fight-o, means plant) besides antioxidants help protect against the damaging effects of toxic substances. Eating a variety of fruits and vegetables allows their different phytoneutrients to work together to help fight illnesses.

Functional foods or nutraceuticals are foods that provide health benefits beyond basic nutrition, such as helping to prevent disease. Fruits and vegetables are nature’s original functional foods. Taking dietary extracts or supplements is not the same; research to date has shown they do not substitute for eating fruits and vegetables.

Colors’ Health Claims
Fruits and vegetables provide a wide spectrum of healthful qualities, including vitamins and minerals. They are low in calories and sodium, high in water content and contain no cholesterol. Many are good sources of dietary fiber, which helps satisfy hunger and enhances bowel health. Most contain very little fat, and fruit has natural sweetness.

Consuming different colors of fruits and vegetables each day offers satisfying tastes and textures while increasing protection against disease. A diet rich in natural plant pigments protects against heart disease and cancer, slows the aging process, and strengthens mental capacity and the immune system. It also helps decrease the risk of high blood pressure, lung or pulmonary disease such as asthma, stroke, cataracts, age-related macular degeneration, constipation, urinary tract infections, diverticulosis, diabetes, obesity and wrinkling of the skin.

Fruits and vegetables offer an appetizing rainbow of colors. Since
each protects body tissues in its own way, the best way to power up your plate - and please your palate - is to eat a variety of colors and choices within each group. Five categories are listed: red, yellow/orange, green, blue/purple/black and white/tan/brown.

Color Category: Red

A variety of red fruits and vegetables helps maintain a healthy heart, memory function and urinary tract health, and lowers risk of some cancers. Both red and orange vegetables are sources of carotenoids.

• Beta carotene, an antioxidant pigment, is good for the eyes. It also reduces risk of cancer and cardiovascular disease.

• The red pigment lycopene gives its color to tomatoes and products such as tomato sauce, paste and catsup; guava; pink grapefruit and watermelon. It is a strong antioxidant that helps protect against prostate and other cancers. Cooked tomatoes have more lycopene than fresh ones.

• Anthocyanins – found in red-skinned apples, radishes, cherries and beets – decrease heart disease risk, help prevent hardening of blood vessels, lower blood pressure, help prevent cancer and help stop inflammation.

• Ellagic acid, found in berries and pomegranates, helps prevent cancer by neutralizing carcinogens found in tobacco smoke, processed foods and barbecued meats.

• The antioxidant vitamin C helps maintain skin, bones, teeth, gums, eyes, muscle, cartilage, blood vessels and the immune system, and increases iron absorption.

• Red and purple grapes, purple grape juice, red wine and mulberries contain the antioxidant resveratrol, which may help decrease risk of heart disease and stroke.

<table>
<thead>
<tr>
<th>Red fruit and vegetable choices include:</th>
<th>Red beans</th>
<th>Red cabbage</th>
<th>Red grapefruit</th>
<th>Red grapes</th>
<th>Red mulberries</th>
<th>Red onions</th>
<th>Red pears</th>
<th>Red peppers</th>
<th>Red-skinned potatoes</th>
<th>Rhubarb</th>
<th>Strawberries</th>
<th>Tomatoes</th>
<th>Watermelon</th>
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<td>Beets</td>
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</table>

Color Category: Orange/Yellow

The orange/yellow category helps maintain heart, vision and immune system health, and lowers risk of some cancers. Many fruits and vegetables in this group are high in vitamin C and folic acid.
• There are more than 600 kinds of orange-colored carotenoids, which help protect the skin and mucous membranes, maintain the immune system, reduce risk of blindness and stroke, and lower cholesterol levels. Their antioxidant properties also help protect against carcinogens. Perhaps the most well-known carotenoid is beta carotene, an antioxidant that converts into vitamin A.

• Oranges and some yellow vegetables – such as yellow peppers and corn – contain high amounts of the pigment lutein, which helps maintain vision.

• Orange fruits and vegetables, especially orange peppers, have high levels of zeaxanthin, another antioxidant pigment that helps maintain vision.

• Oranges, lemons, grapefruit and pineapple are rich sources of vitamin C and flavanones. Even the peel has limonoids, which help prevent cancer.

Yellow/orange choices include:

<table>
<thead>
<tr>
<th>Apricots</th>
<th>Orange peppers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butternut squash</td>
<td>Papayas</td>
</tr>
<tr>
<td>Cantaloupe</td>
<td>Peaches</td>
</tr>
<tr>
<td>Carrots</td>
<td>Persimmons</td>
</tr>
<tr>
<td>Grapefruit</td>
<td>Pineapples</td>
</tr>
<tr>
<td>Golden kiwifruit</td>
<td>Pumpkin</td>
</tr>
<tr>
<td>Lemons</td>
<td>Rutabagas</td>
</tr>
<tr>
<td>Mandarin oranges</td>
<td>Sweet corn</td>
</tr>
<tr>
<td>Mangoes</td>
<td>Sweet potatoes</td>
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<tr>
<td>Nectarines</td>
<td>Tangerines</td>
</tr>
<tr>
<td>Oranges</td>
<td>Yellow apples</td>
</tr>
</tbody>
</table>

Yellow beets Yellow summer squash
Yellow figs Yellow tomatoes
Yellow peppers Yellow watermelon
Yellow potatoes Yellow winter squash

**Color Category: Green**

Green fruits and vegetables help lower risk of some cancers, reduce risk of heart disease, maintain vision health, protect against birth defects and keep red blood cells, bones and teeth strong.

• The green pigment chlorophyll masks the orange-yellow carotenoid pigments in some green foods. Many green vegetables contain lutein and zeaxanthin, which help protect against vision loss.

• Strong-flavored green cruciferous vegetables – including bok choy, broccoli, Brussels sprouts and cabbage – contain sulforaphane, isothiocyanate and indoles. They have disease-fighting properties, especially against many kinds of cancer.

• The antioxidant glutathione, found in fruits and vegetables such as asparagus, avocados, spinach and broccoli, helps protect DNA and RNA from oxidative stress and strengthens the immune system.

• Folic acid, a B vitamin found in dark green leafy vegetables, helps reduce risk of heart disease and helps prevent birth defects.

• Iron, vitamin K, magnesium and calcium are found in many green vegetables. They help keep bones and
teeth strong and promote healthy blood.

Green choices include:
Artichokes  Green onions
Arugula     Green pears
Asparagus   Green peppers
Avocados    Honeydew melon
Bok choy    Kale
Broccoflower Kiwifruit
Broccoli    Leafy greens
Broccoli rabe Leeks
Brussels sprouts Lettuce
Celery      Lima beans
Chayote squash Limes
Chinese cabbage Mustard greens
Chives      Okra
Collard greens Parsley
Cucumbers   Peas
Culinary herbs Spinach
Edamame     Sprouts
Endive      Sugar snap peas
Green apples Swiss chard
Green beans  Turnip greens
Green cabbage Watercress
Green grapes Zucchini

**Color Category: Blue/Purple/Black**

Blue, purple and even black fruits and vegetables provide antioxidants that help lower risk of some cancers, promote healthy aging, and improve urinary tract health, memory function and heart health.

- Blue pigments include anthocyanins and other flavonoids, while red-violet pigments include the betacyanins.
- Blueberries have the highest antioxidant action of any fruit.
- Anthocyanin flavonoids, which are particularly high in bilberries and blueberries, and the pigments in spinach and other deeply colored fruits and vegetables have been shown to help protect against age-related memory loss.
- Blueberries and cranberries help protect against bladder infections and possibly ulcers and gum diseases. Substances known as condensed tannins in the berries prevent undesirable bacteria from attaching to cells and organs.

Blue/purple/black choices include:
Blueberries  Plums
Black beans  Purple asparagus
Blackberries Purple Belgian endive
Black currants Purple cabbage
Black mulberries Purple carrots
Black salsify Purple figs
Blueberries  Purple-fleshed potatoes
Boysenberries Purple grapes
Dried plums/ Prunes
Prunes
Eggplant
Elderberries Raisins

**Color Category: White/Tan/Brown**

White, tan and brown fruits and vegetables (and we are talking “original brown,” not “brown because they are too old” here!)
contain few vivid pigments, but help maintain heart health and lower cancer risk. They provide health-promoting phytochemicals. Folic acid, fiber, potassium, selenium and vitamin C are found in many of the fruits and vegetables in this color group.

- Many of these vegetables make up for their lack of color with a strong taste that comes from sulfur compounds that protect DNA, help lower cholesterol and maintain healthy immune systems.
- Parsnips contain polyacetylenes. Onions, apples and pears contain powerful polyphenols such as the pigment quercitin, a compound that protects against heart disease. Both of these phytochemicals also have anticancer properties.
- Allicin, found in the garlic and onion family, helps destroy cancer cells.
- Saponins, also found in onions and garlic, help stimulate the immune system and lower circulating levels of fats. They also inhibit enzymes involved in cancer proliferation.
- Pears and mushrooms contain flavonoid antioxidants that protect cell membranes.
- Phytoestrogens, such as genistein in soy products, help protect against breast cancer.
- Isoflavone phytochemicals - found in dried beans, peanuts, lentils, soy and other legumes - help reduce risk of heart disease and colon, prostate and stomach cancer.

**White/tan/brown choices include:**
- Bananas
- Black-eyed peas
- Brown pears
- Cauliflower
- Dates
- Figs
- Garbanzo beans or Chick peas
- Garlic
- Ginger
- Great northern beans
- Jerusalem artichoke
- Jicama

**Make a Colorful Diet Common**

Brightly colored fruits and vegetables are definitely not boring! Many are portable and require little preparation, making them natural “convenience foods.” For the most nutrients per calorie, choose the ones without added salt, sugar, syrup or sauces. Before use, thoroughly rinse all fresh fruits and vegetables under cool, running water.

When putting more colors on your plate, select a variety of fresh, frozen, dried and canned fruits and vegetables, or modest portions of juices. (Juices offer less fiber than other forms of preparation, so it is easy to get surprisingly more calories from them.)
The number of fruit and vegetable servings depends on your calorie needs. One serving is a medium piece of fruit, 1 cup raw, leafy vegetables, 1/2 cup fruit or vegetables (raw, cooked, canned or frozen), 1/4 cup dried fruit, or 3/4 cup (6 ounces) 100% juice. (The serving size for toddlers and preschoolers is about one tablespoon for each year of age.)

You have a delicious opportunity to help ensure your better health by eating “5 to 9 the Color Way.” To help remind yourself and family members to eat them, store fruits and vegetables where you will see them often. For example, put a mixture of fresh fruits and small containers of dried fruits, 100% juices and canned fruits in a bowl on the kitchen table or near the door. Place cut-up, ready-to-eat vegetables and fruits in see-through containers in a prominent place in your refrigerator.

<table>
<thead>
<tr>
<th>Recommended Number of Servings for:</th>
<th>Fruits</th>
<th>Vegetables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Young children, sedentary women, older adults</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Older children, teen girls, active women, most men</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Teen boys, active men, very active women</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

5 or More the Easy Way

Fill in the blanks below for your own on-the-go examples of appetizing and easy ways to include fruits and vegetables throughout your day:

- Grab some fruit for breakfast:
- Snack on fruit or vegetables in the morning:
- Add vegetables (maybe in soup or a salad?) to lunch:
- Snack on dried fruit in the afternoon:
- Choose two or more vegetables at dinner:
- Drink 100 percent juice for a snack in the evening:

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In either case, credit Mary L. Meck Higgins, Color Me Healthy: Enjoying Fruits and Vegetables, August 2004
Summary
Five to nine servings of a variety of colorful fruits and vegetables—red, yellow, orange, green, blue, purple, black, white, tan and brown—are recommended each day. Eating a rainbow of fruits and vegetables makes meals look and taste great and improves the immune system, slows aging and reduces risk for heart disease, cancer and other illnesses. Many kinds of fresh, canned, frozen, dried and juiced fruits and vegetables can be conveniently included throughout each day.

For More Resources about Fruits and Vegetables
The Web site www.oznet.ksu.edu/humannutrition/freshfruitsandvegetables.htm includes: a cookbook that suggests ways to select, store and prepare fresh fruits and vegetables; nutrition and food safety information; posters and activities; and links to other sites.

The author thanks reviewer Julie Garden-Robinson, PhD, LRD, Food and Nutrition Specialist and Assistant Professor, North Dakota State University Extension Service, Fargo, N.D.

Participant Survey for Color Me Healthy: Enjoying Fruits and Vegetables
Please help us improve our programs and materials by answering the following questions.

Date________________ Your County ________________________

Are you: Male___ Female___

Are you: White, non-Hispanic___ White, Hispanic___ African-American/Black___
Native American___ Asian-American___ Other___

Your age category: Teen___ 19-40 yrs.___ 41-59 yrs.___ 60 yrs and over___

1. Did you learn anything today that you did not know or that surprised you?
   Yes_____ No_____ Please specify:

2. After today, how often will you eat more than one kind of vegetable or fruit per day? (Circle one)

   Never 1 2 3 4 5
   Often

3. Before today, how often did you eat more than one kind of vegetable or fruit per day? (Circle one)

   Never 1 2 3 4 5
   Often

continued on page 8
4. After today, how many servings of fruits and vegetables will you eat per day? ____
   Examples of a serving are: 1 medium banana, apple or orange
   3/4 cup juice 1/2 cup cooked vegetable
   1/2 cup canned fruit 1 cup tossed lettuce salad

5. Before today, how many servings of fruits and vegetables did you eat per day?_____

6. Before today, how important was it to you to eat a variety of fruits and vegetables
daily? (Circle one)
   Very Important Somewhat Important Neither Important Somewhat Important
   Unimportant Very Important Important Nor Unimportant Unimportant

7. After today, how important will it be to you to eat a variety of fruits and vegetables
daily? (Circle one)
   Very Important Somewhat Important Neither Important Somewhat Important
   Unimportant Very Important Important Nor Unimportant Unimportant

8. If you do not eat fruits and vegetables, please explain why not:

9. Do you intend to eat more fruits and vegetables in the future? Yes_____ No_____
   Please specify why or why not:

   Thank you for your time!

Leaders, please return surveys to: Dr. Mary Meck Higgins, Department of Human
Nutrition, 202 Justin Hall, Manhattan KS 66506

Suggested References for Further Reading:
• 5 a day the color way, available at www.5aday.com
• Hyson, D. 2002. The health benefits of fruits and vegetables. Produce for
  Better Health Foundation, available at
  www.5aday.com/html/research/summaries.php
• VanDuyn, MAS, and Pivonka, E. 2000. Overview of the health benefits of
  fruit and vegetable consumption for the dietetics professional: Selected