Fibre in your Diet

Contents: Information, questions and data analysis on the link between dietary fibre and disease.

Time: 1–2 periods

Intended use: GCSE Biology and Integrated Science. Links with work on diet, food, digestion and disease.

Aims:

- To complement and revise prior work on diet, food, digestion and disease.
- To develop awareness of possible links between disease and diet.
- To develop awareness of the different diets of people in different parts of the world.
- To develop awareness of the difficulty of using statistical evidence to prove a medical hypothesis.
- To provide an opportunity to practise reading, comprehension and data-handling skills.

Requirements: Students' worksheets No. 108.

The unit is in four parts:

Part 1 What is dietary fibre?
Part 2 Why is fibre good for you?
Part 3 How can you make sure of dietary fibre?
Part 4 Looking at the evidence.

Parts 1 and 2 give information only, but must be read before doing the exercises in Parts 3 and 4.

Part 3 Notes on some of the questions

Q.3 The ingredients of All-Bran are listed as wheat bran, sugar, salt, malt and vitamins.

Q.4 A hundred years ago the average British diet would have included less animal food and sugar, and more unrefined vegetable food.

Q.6 The National Advisory Committee on Nutritional Education (NACNE) recommended in 1983 that the average intake of dietary fibre should be increased from 20g per day to 30g per day. For most people this is easily done by increasing consumption of bread – particularly wholemeal bread, though even white bread is a good source of fibre. It is worth noting that NACNE also recommends that average fat intake should be reduced from 128g per day to 101g per day, and average sugar intake from 104g per day to 55g per day. Increased consumption of bread would help achieve both these reductions, by replacing sugar and fat as energy sources, though it must be borne in mind that most people eat butter or margarine with their bread.

Part 4 Notes on some of the questions

Q.7 It is not intended that students should carry out accurate calculations of percentages of fibre in the different diets. They should attempt an approximate classification of fibre content on the basis of amounts of cereals and other high-fibre foods eaten, bearing in mind that Western diets are likely to include more refined plant foods than in developing countries.

Q.9 The comparison of USA Blacks of African origin with Uganda is intended to make the point that frequency of bowel cancer does not seem to be linked to ethnic type. Further evidence for this was given by a study of Japanese migrants to the USA. The change to a Western diet was accompanied by an increase in the incidence of bowel cancer.

Q.10 The intention of questions 10 and 11 is to show that while evidence may appear compelling, other interpretations are often possible. Several other dietary links suggest themselves – for example, the proportion of meat, sugar or fat in the diet. However, the link to fibre is perhaps stronger in view of its specific action in the colon.

Q.11 Several other possible interpretations of the data suggest themselves. Other features of Western life-style, such as stress, urban living, exposure to industrial carcinogens, etc., might be involved.

Q.12 A larger sample of countries is needed to ensure no quirks are involved, though the survey from which the figures were taken in fact involved about forty countries, and showed the same pattern throughout.

Other references

The most vociferous proponent of the case for dietary fibre is Dr Denis Burkitt. He has written simply on the subject in the following article and book:

'Your health in your hands', *School Science Review* (December 1983).

Don't Forget Fibre in Your Diet (Martin Dunitz, 1979; 4th rev. edn, 1983).

Acknowledgments Figure 1 is reproduced by permission from *Science* by Graham Hill and John Holman (Nelson); Figure 3 and the data in Table 1 by permission from *Don't Forget Fibre in Your Diet* by Dr Denis Burkitt (Martin Dunitz).

FIBRE IN YOUR DIET

A hundred years ago in Britain, only six babies out of ten survived to become adults. The average life expectancy of a boy was 41 years. Today, a boy can expect to live to over 70 years of age.

Modern medicine and improved living conditions have helped wipe out most of the old 'killer diseases' like typhoid, smallpox and tuberculosis in Britain. The cause of death in the 1980s is likely to be from one of the so-called 'diseases of modern society', such as heart disease and cancer. Why is this? Why are these diseases so common in modern Western countries? Many people believe it has a lot to do with the modern diet. A feature of our diet that has attracted a lot of attention is dietary fibre.

Part 1 What is dietary fibre?

Fibre is only found in plant food. It is the parts of plant cells, mainly the cell walls, that cannot be digested by humans, though some bacteria can digest it. The table in Part 3 gives the amounts of fibre in different foods.

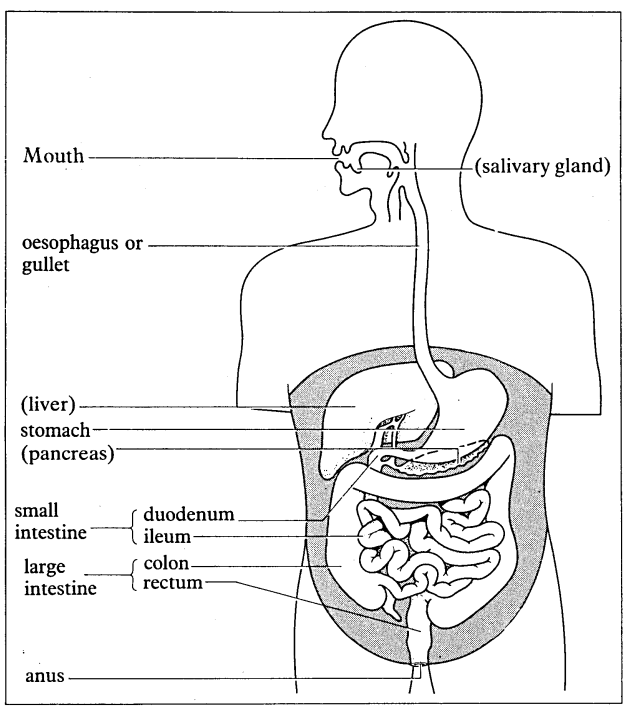

Figure 1 The main parts of the human digestive system

Figure 1 shows the main parts of the human digestive system. As food passes along the gut, it is broken down and absorbed into the bloodstream. By the time it reaches the colon, only fibre is left undigested. It passes out in the faeces, which also contain water and millions of bacteria.

People who eat a lot of fibre produce more faeces than people who do not. People in developing countries eating high-fibre, mostly vegetarian diets produce 300 to 500 grams of faeces daily. In developed Western countries where the diet contains less fibre, only 80 to 120 grams of faeces are produced daily. What is more, with the high fibre diet, it only takes about 30 hours for food to pass through the gut from mouth to anus. A typical Western diet low in fibre may take 70 hours to pass through the gut.

Part 2 Why is fibre good for you?

It has been claimed that fibre helps prevent many modern diseases. In some cases the evidence is good, but often it is difficult to prove that fibre helps prevent the disease. In any case, many doctors suspect that other features of the modern diet, such as eating too much fat and sugar, may help cause modern diseases.

Some diseases involving the gut

- *Constipation* There is no doubt that fibre prevents constipation, by keeping the contents of the gut moving. What is more, fibre keeps the faeces soft. With low-fibre diets, faeces become hard and difficult to pass out of the anus.
- *Appendicitis* The appendix is a small 'blind alley' leading off from the colon. Sometimes it becomes infected and inflamed: this is appendicitis. Often appendicitis is caused by a small, hard lump of faeces, which blocks the appendix (Figure 2). By softening the faeces, and making them move faster, fibre helps prevent this happening.

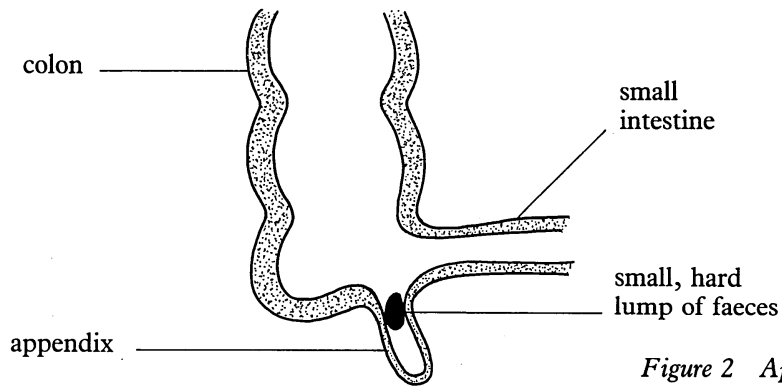

Figure 2 Appendicitis is often caused by a small, hard lump of faeces

- *Bowel cancer* Cancer of the bowel or colon is the commonest cause of cancer death apart from lung cancer. There is quite a lot of evidence that high-fibre diets help prevent bowel cancer (see Part 4). Many doctors believe that bowel cancer is caused by cancer-producing chemicals (**carcinogens**) made by bacteria in the colon. These carcinogens are present in the faeces. It is thought that fibre helps by increasing the bulk of the faeces, which dilutes the carcinogens. Fibre also makes the faeces move faster through the colon, so that the lining of the colon has less time in contact with the carcinogens.

Other diseases

- *Obesity* Many people in Western countries are overweight (obese). Fibre helps prevent obesity, because it makes you feel full after you have eaten. This helps stop overeating.
- *Diabetes* Some doctors believe fibre helps prevent diabetes, though there is not yet strong enough evidence to be sure.

Part 3 How can you make sure of dietary fibre?

Fibre comes only from plant foods. You cannot get any fibre from animal food such as meat, fish, eggs, cheese and milk.

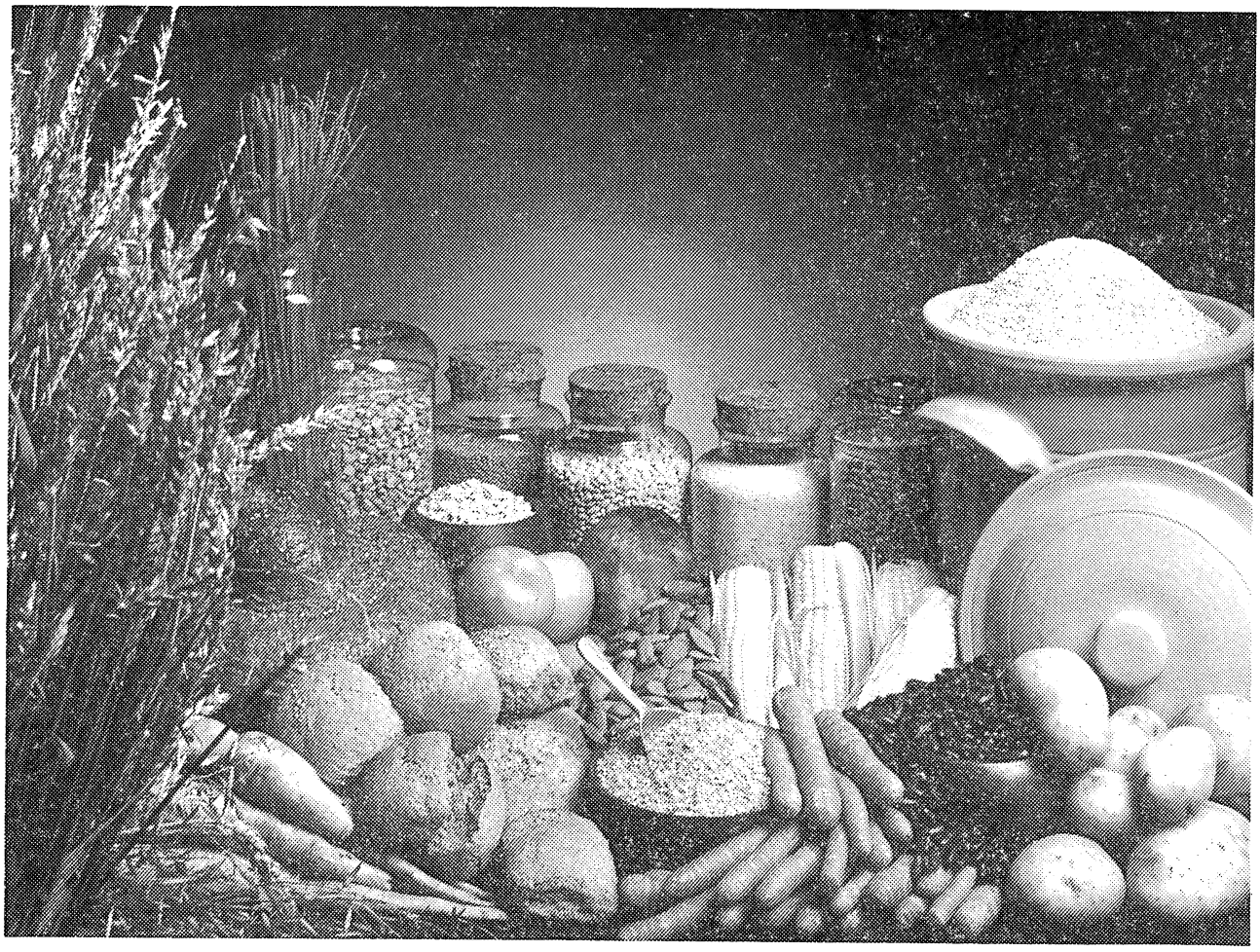

Figure 3 A selection of high-fibre foods

Cereals like wheat are a particularly good source of fibre. Bran, which is the outer part of the wheat grain, is nearly half fibre. When wheat is ground into flour, the bran is often removed – this gives white flour. If the bran is not removed, you get wholemeal flour. In general, the more a food is refined, the more fibre is removed. For example, *sugar cane* contains a lot of fibre, but *sugar* contains none at all.

Table 1 on the next page gives the fibre content of different foods. Look at the table, then answer questions 1 to 6.

Table 1 Dietary fibre values of food, expressed as a percentage by mass

Cereals	%
Wheat bran (miller's bran)	44.0
Wholemeal flour (100% unrefined)	9.6
Brown flour (85% refined)	7.5
White flour (72% refined)	3.0
Soya flour (low fat)	14.3
Sweetcorn, canned	5.7
Corn-on-the-cob, boiled	4.7
Rice, white polished, boiled	0.8
brown, unpolished, boiled	5.5
Bread	
Wholemeal	8.5
Brown	5.1
Hovis (UK)	4.6
White	2.7
Breakfast cereals	
All-Bran	28.3
Bran Buds	26.2
Puffed Wheat	15.4
Bran Flakes	14.7
Sultana Bran	12.8
Weetabix	12.7
Shredded Wheat	12.3
Muesli	7.4
Grapenuts	7.0
Sugar Puffs	6.1
Country Store	5.1
Cornflakes	2.0
Special K	1.6
Rice Krispies	1.0
Porridge	0.8
Biscuits	
Ry-King Fibre Plus	28.0
Crispbread rye (Ryvita)	11.7
Digestive, plain	5.5
Energen crispbread	4.9
Shortbread	2.1
Nuts	
Almonds	14.3
Coconut, fresh	13.6
Brazil	9.0
Peanuts	8.1
Hazel	6.1
Vegetables	
Spinach, boiled	6.3
Spring greens, boiled	3.8
Spring onions	3.1
Broccoli tops, boiled	2.9
Brussel sprouts, boiled	2.9
Aubergines, raw	2.5
Cabbage, boiled	1.8
Cauliflower, boiled	1.8
Celery, raw	1.8
Lettuce	1.5
Onions, boiled	1.3
Asparagus, cooked	0.8
Marrow, boiled	0.6
Cucumber, raw	0.4
Root vegetables	
Horseradish, raw	8.3
Yam, boiled	3.9
Carrots, boiled	3.0
raw	2.9
Parsnips, boiled	2.5
Beetroots, boiled	2.5
Potatoes, baked in skins (flesh only)	2.5
Turnip, boiled	2.2
Potatoes, boiled (new)	2.0
Legumes	
Peas, frozen, boiled	12.0
Kidney beans, cooked	7.4
Beans, haricot (whole beans), boiled	7.4
baked and canned in tomato sauce	7.3
Peas, canned	6.3
fresh, boiled	5.2
Broad beans, boiled	5.1
Butter beans, cooked	5.1
Lentils, split, boiled	3.7
Runner beans, boiled	3.4
Fruits	
Dates, dried	8.7
Prunes, stewed	7.4
Raspberries	7.4
Blackberries	7.3
Raisins	6.8
Cranberries	4.2
Bananas	3.4
Pears, fresh, eating	3.3
Strawberries	2.2
Plums, raw, eating	2.1
Apples	2.0
Oranges	2.0
Cherries	1.7
Apricots, stewed	1.6
Tomatoes, raw	1.5
Peaches	1.4
Pineapple, fresh	1.2
Grapes	0.9
Melon (honeydew)	0.9
Grapefruit	0.6
Puddings	
Apple crumble	2.5
Fruit pie	2.4
Rhubarb stewed – no sugar	2.4
Christmas pudding	2.0
Sponge	1.2

Look carefully at the figures in Table 1, then answer these questions:

1 *Why does wholemeal flour have more fibre than white flour?*

2 *What is the difference between white rice and brown rice? Why does brown rice contain more fibre?*

3 *Is All-Bran really all bran? Explain your answer.*

4 *The British diet of a hundred years ago included more fibre than it does today. Suggest a reason why.*

5 *Think about your own diet – the food you normally eat. Would you describe it as being high, medium or low in fibre?*

6 *What would be the simplest way to increase the amount of fibre in your own diet?*

Part 4 Looking at the evidence

Trying to find evidence for the causes of diseases is always difficult, because there are so many factors that can vary. In this section we will look at some of the evidence linking bowel cancer to lack of dietary fibre. First, look back at the section on bowel cancer in Part 2, and read it again.

Now read through the information given below, and answer the questions.

1 Bowel cancer in different parts of the world

The chart in Figure 4 compares the number of cases of bowel cancer among men aged 35–64 in different parts of the world. The figures were collected in the 1960s.

Table 2 shows the diet of the countries shown in the chart. These figures were also collected in the 1960s.

Answer questions 7 to 12.

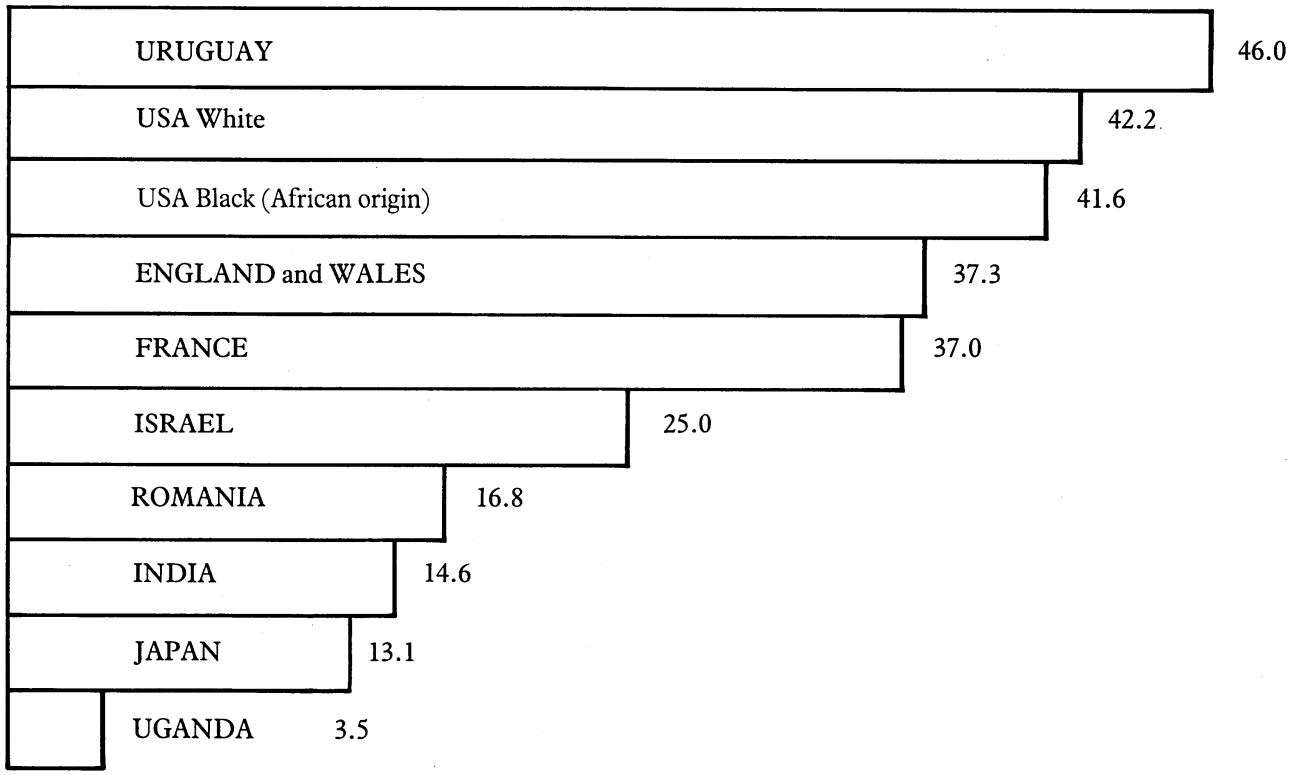

Figure 4 Numbers of men aged 35–64 per 100 000 suffering from bowel cancer per year

Questions

7 *Using Table 1 and Table 2 together, roughly classify each of the countries in Table 2 as having (a) high-fibre; (b) medium-fibre; (c) low-fibre diets. Bear in mind that in developed countries, cereals and other vegetable foods are likely to be eaten in a refined form.*

8 *Now look at the chart in Figure 4 showing numbers of cases of bowel cancer. Does there seem to be any link between the amount of fibre in the diet and the amount of bowel cancer in the country?*

9 *Compare the rate of bowel cancer between Uganda and USA Blacks of African origin. What does this tell you?*

10 *Is the link with dietary fibre the* only *possible explanation for the differences in bowel cancer rates? Are there any other items in the different diets that might explain the differences?*

11 *Are there any other factors* apart from diet *that might explain the differences?*

12 *This comparison looks at only nine different countries. Explain why it would be necessary to look at more countries before drawing any firm conclusion. What kind of countries would you choose?*

Table 2 Percentages of different types of food eaten in different countries.

Country	Cereals	Starchy root vegetables	Nuts	Vegetables	Fruit	Sugar	Meat	Eggs	Fish	Milk
England and Wales	17	21	1	13	12	11	16	3	2	4
France	18	18	1	26	12	5	14	2	1	3
India	63	5	10	1	8	8	2	–	1	2
Israel	19	6	2	18	23	5	22	3	1	1
Japan	36	17	4	22	6	4	2	1	7	1
Romania	44	15	2	14	10	3	8	2	–	2
Uganda	10	76	4	4	1	2	2	–	1	1
Uruguay	20	19	1	10	17	8	22	2	1	2
USA	13	10	1	20	20	8	19	4	1	4

After doing this exercise, you will probably have realized that these figures give *some* evidence for a link between fibre and bowel cancer. However, it is very difficult to *prove* the link, because there are so many variable factors. Of course, these figures are not the only evidence available – doctors have done many other studies. For example, doctors in Israel found that colon cancer patients ate significantly less fibre-containing food than average. But in spite of all the evidence, there is still plenty of room for doubt. At present, therefore, most doctors *suspect* the link is there, but they cannot be sure.