UK CLINICAL RESEARCH COLLABORATION

igniting our potential

Centre of the Cell

Risk Factors of Disease Workshop

Introduction

These activities introduce the idea that there are certain factors, called risk factors, which can increase a person's likelihood of developing a disease. Pupils learn how scientists use research to determine what the risk factors are for various diseases.

Curriculum Links

KS3 Science
KS4 Science
SQA 5-14 Standard Environmental Studies
SQA Access, Intermediate and Higher: Biology and Biology Investigation

Keywords

Risks of disease
risk factors
lifestyle risks of disease
healthy lifestyles
family history
data analysis
making and reading graphs
determining correlation
designing a valid experiment
comparing experimental methodologies
how scientists work

Contents

Activities

Activity 1: Can you identify patients' risk of disease?

Background Information

There are several risk factors for disease. Risk factors are indications that someone may be more likely to develop a specific disease.

Risk factors only describe the characteristics that are associated with a higher likelihood of disease; they are not necessarily the cause of that disease.

Some risk factors are based on lifestyle habits, such as smoking, drinking, and not taking exercise. Other risk factors of disease may be linked to genetics: for example people with a family history of some cancers may be more likely to develop those cancers themselves.

Relevant Links

Risk factors of melanoma:
http://info.cancerresearchuk.org/cancerandresearch/cancers/melanoma/
http://www.cancerhelp.org.uk/help/default.asp?page=3006#relative

A website to estimate risks of disease:
http://www.yourdiseaserisk.wustl.edu/hccpquiz.pl?lang=english&func=show&page=estimating

Cancer Research UK guide to understanding risk:
http://info.cancerresearchuk.org/cancerandresearch/risk/

Cancer Research UK classroom activity on cancer risks of obesity:
http://www.upd8.org.uk/activity/93/Obesity-and-cancer.html

Teacher-led Activity (class in groups of 4-5)

Materials Needed

Patient Cards (page 8)

- Give each group one of each of the patient cards marked with a case study number and the letter A. (One for Ben Thomas, one for Michael Jones).

- Ask if either of the patients is healthy.

  Ben Thomas is healthy.

- Ask if either of the patients is unhealthy.

  Michael Jones is unhealthy.

- Ask the class if either patient is at risk of developing any diseases. If so, which ones?

  Michael Jones could be at risk for heart disease, diabetes, lung cancer. From this information, Ben Thomas appears to have low risk of these diseases.

- Ask if there is anything either patient could do to reduce their risks of disease.

  Stop smoking, exercise, eat a healthy diet.

- Now give each group one of each of the patient cards marked with a case study number and the letter B (one for Ben Thomas, one for Michael Jones).

- Now that you have given the pupils this extra information, ask them which disease they think each patient is at most risk of developing.

  Ben Thomas' father has HIV. Does this mean that he has an increased risk of HIV? No. HIV cannot be inherited. Ben could only catch HIV from his father if they engaged in risky activity such as sharing needles.

  *Ben Thomas' mother died of **melanoma**, a type of skin cancer. Having a close relative with melanoma could mean that Ben has an increased risk of developing melanoma himself. He can still do some things to reduce his risk or this disease, He should always wear sunscreen and be sure to check his skin for any moles that are irregular, and have them removed.*

  Michael Jones has no family history of disease that we know of, but his lifestyle puts him at risk for developing many diseases.

Follow-up Questions

- Ask the pupils what it means to say that someone has a risk factor?
  (If someone has a risk factor, then it means that there is something in their life that makes them at greater risk of developing a disease. Risk factors can be something which you can control, such as smoking, which is a risk factor for lung cancer. They can also be something which you cannot control, such as an inherited risk. Having risk factors does not make it certain that you will develop a disease, only more likely.)
- Ask the pupils if they think each patient is doing everything he can to reduce his risk.
- What risk factors for disease did each patient have?
- Can you lower your risk of disease?
- If a patient has a family history of a certain disease, can he or she take steps to reduce their own risk?
- Why should people go to health screenings when these are offered? Is this a good way to improve health?

Activity 2: Find the risk factors of disease

Background Information

There are several risk factors for colon cancer. This is a disease which happens when DNA-damaged cells in the colon (the large intestine) grow uncontrollably, forming cancerous tumours. Colon cancer usually affects people who are over 50, but younger people develop the disease on rare occasions.

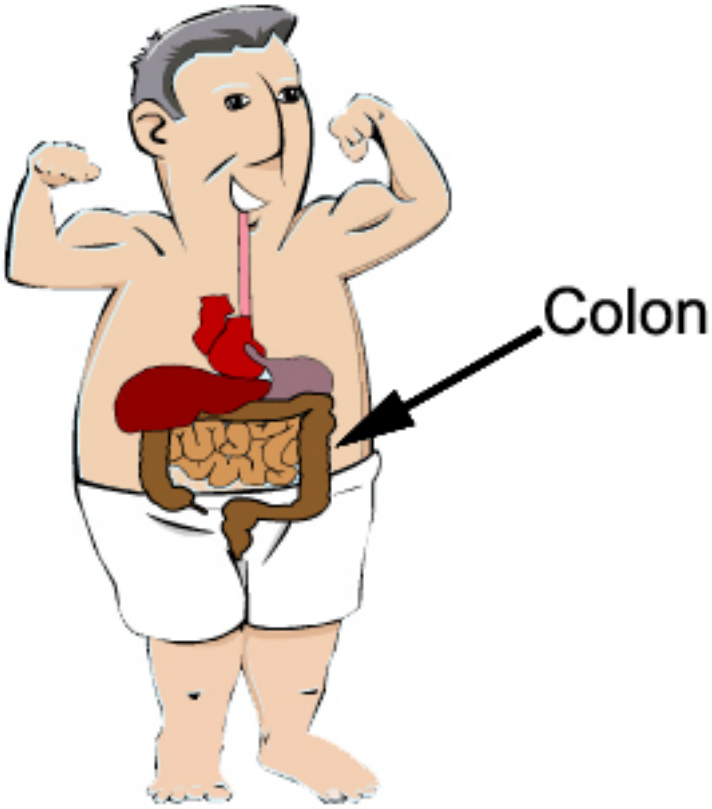
Below is an image of the colon, and its location in the body.
This image can also be found on page 12 in the Materials section for Whiteboard use.

Some of the risk factors for colon cancer are lifestyle-based, and some are linked to a patient's family history. But not all people who have risk factors for a disease will get that disease, and some people may have a disease without having had any sign of the known risk factors.

How do scientists determine potential risk factors for disease?

In this activity, pupils are asked to assess information about a group of fictional patients, some with colon cancer and some without. The pupils should be able to consider the data in the risk factor chart and figure out what the risk factors are.

NB. This data set has been manufactured for this activity so that the risk factors can be easily found within a small sample. It is not a true representation of actual data as that would require far more processing skill than can be done by eye in the classroom.



Relevant Links
LINK TBC to Centre of the Cell's What is Cancer Game

Cancer Research UK information on the risks of colon and bowel cancer:
http://info.cancerresearchuk.org/cancerandresearch/cancers/bowel/#risksandcauses

Teacher-led Activity (whole class)

Materials Needed

Risk Factor chart (page 24) – one copy for each pupil

Instructions

- Divide the class into groups of 4-5.
- The risk factor chart should be projected onto a whiteboard screen, if possible.
- All pupils should have a copy of the chart.
- Names of patients with colon cancer are highlighted yellow, and the potential risk factors they have are highlighted pink. In people without colon cancer, their potential risk factors are highlighted green.
- Ask the class how they will look for possible risk factors for colon cancer (They should look at the people who have colon cancer before those that don't).
- Pupils should create bar graphs, plotting the frequency of potential risk factors to compare people with and without colon cancer.
- Remind the class that some of the people who have the risk factors for colon cancer may not have the disease, and some of the people with the disease may not have all of the risk factors.
- Ask them how they will look for possible risk factors for colon cancer. Have one person in each group write down what they think the risk factors are and why.
- They need to find four risk factors:

> The risk factors for colon cancer are:
>
> - A diet high in red meat
> - A diet low in fruits and vegetables
> - Being over 50
> - Having close relatives who have had colon cancer

- After each group has time to deliberate, ask a spokesperson from each group to tell the class what their answers were and to explain the reasons.

Discussion Points

- Does the class think this is a good way to look for colon cancer risk factors?
- Sample size: Is 30 people a large enough group to draw conclusions?
- Point out the correlation between the groups of people who eat lots of red meat and the people who don't eat a lot of fruit and vegetables. There is a strong correlation between these two factors. What further experimental work could be done to find out which one, if either, is a risk factor for colon cancer?
- Tell the class that the numbers for this activity have been manufactured to make the relationships between colon cancer and risk factors obvious to the eye. Ask them how scientists would determine that a relationship between colon cancer and a risk factor was statistically significant.

Activity 3: How do scientists determine what is a risk factor?

Background Information

From the previous activity, the class should have come up with a few ideas of what risk factors are associated with colon cancer. But are these valid associations, or just coincidence?

Scientists consider evidence for risk factors to decide which ones to investigate. Only then can they design their experiments and apply for funding for their research.

Scientists write grants to ask government research councils and charities for the money they need to do their experiments. They need to show these funding bodies that they are asking good questions; that their experiments will get accurate, unbiased results; and will not cause undue harm to anyone. Their proposals can include:

- An abstract or hypothesis (a description of what they are testing and why—this will also include evidence, such as previous research, to support the new study and to convince the funding body that this new study is a good idea.)
- A description of their methodology (How they are going to conduct their experiment, how long the experiment will run, etc.)
- A recruitment policy (Who will take part in the study? How will they be selected? How many people will be in the study?)
- An explanation of the methodology that will be used to analyse the results

Discuss these items included in proposals with the class.

- Why are the above items included?
- What makes for a good methodology?
- What would make a bad experiment? E.g.:
  - Overly small sample sizes are statistically invalid.
  - The study needs to compare similar populations.
  - The study needs to run long enough for effects to be evident. (Colon cancer can take 20-30 years to develop, hence the risk factor of being over 50. To understand how cancer develops over several years, please see the Centre of the Cell's What is Cancer? Interactive, found below in the relevant links section.)
  - Is it an unethical study that would cause harm to its participants?

Now it is time for the class to put these ideas into action.
In this activity, groups of students will act as the funding panel for a new colon cancer study. They will study four research proposals (found on pages 11 to 14) have to choose which of four lab teams should receive grant funding (money to pay for all of their costs to run the study). In groups, students should discuss which study they would like to award funding to.

Some reasons that grant funding committees reject applications are:

- Lack of hypothesis
- Good idea but too ambitious, lack of preliminary data
- Technically flawed
- Does not add sufficiently to existing knowledge
- The study is unethical

Ask the class to consider these criteria and the ideas discussed above when making their decision.

After the class has decided which project they would like to award funding to, ask them to explain the reasons why they made their choice to the rest of the class. The groups could also make recommendations as to how labs could improve their applications.

Class Activity: Small groups of 4-5
Materials Needed
A copy of the Research Proposals found on pages 11 to 14 for each group.

Materials

Glossary

Activity 1

Melanoma is a cancer of the melanocytes, the cells that produce pigmentation in the skin and eyes. When the DNA in these cells is damaged, they can grow uncontrollably, forming tumours. Some forms of melanoma are traced to defective genes, which can be inherited. One way to check for melanoma involves checking moles on the skin. The mnemonic ABCD helps to identify moles that could become cancerous:

- **A**symmetrical skin lesion.
- **B**order of the lesion is irregular.
- **C**olor: melanomas usually have multiple colors.
- **D**iameter: moles greater than 5mm are more likely to be melanomas than smaller moles. Moles with these characteristics should be examined by a dermatologist.

HIV is the virus that causes AIDS, a disease characterised by the failure of the immune system. It can be transmitted by the exchange of bodily fluids, including blood, semen, or breast milk. The HIV virus can be transmitted during unprotected sexual intercourse. It can be also transmitted when infected intravenous (injecting) drug users share needles.

An HIV-positive mother can pass the virus to her child at birth, though there is now medicine available to reduce the likelikood of a pregnant woman passing HIV on to her baby when she gives birth.

Record # 9891 A

Patient Name: Michael Jones

DOB: 20/12/1955

Date of visit: July 9th 2008

Health check results:

Blood pressure is high
Blood glucose is just above normal
High cholesterol
Overweight

Lifestyle:

Stressful job working 70 hours a week
Smoker
Drinks heavily at weekends
Does not exercise

Record # 9895 A

Patient Name: Ben Thomas

DOB: 04/06/1969

Date of visit: July 9th 2008

Health check results:

Blood pressure is normal
Blood glucose is normal
Normal cholesterol
Normal weight

Lifestyle:

Stressful job but works part-time
Gave up smoking 10 years ago
Drinks occasionally
Exercises regularly

Record # 9891 B

Patient Name: Michael Jones

DOB: 20/12/1955

Date of visit: July 9th 2008

Family History:

All family members are healthy

Record # 9895 B

Patient Name: Ben Thomas

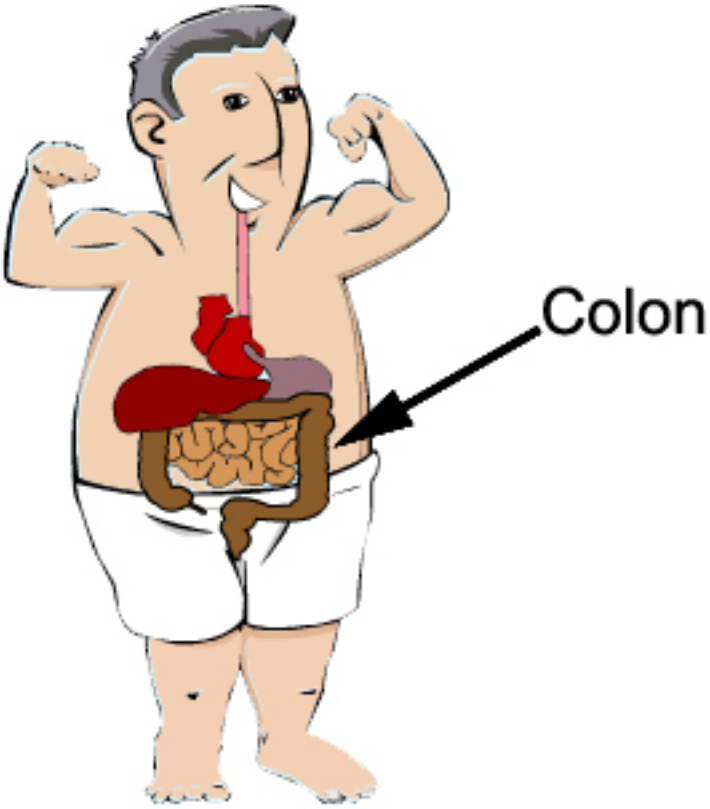
DOB: 04/06/1969

Date of visit: July 9th 2008

Family History:

Father is HIV-positive
Mother died of melanoma

Activity 2
Where is your colon?



Activities 2 and 3

Glossary

A **Colonoscopy** is a procedure that allows doctors to examine the inside of the colon. After making sure that a patient's large intestine is empty of solid matter (faeces), the patient is sedated and an **endoscope** is inserted into the patient's anus. This endoscope can be used to image the inside of the colon or to remove **polyps** or take biopsies (tissue samples) for further examination.

Polyps are abnormal growths in the colon which can sometimes develop into colon cancer. They can be flat or mushroom shaped. If they are discovered during a colonoscopy and left alone, then the patient's risk of cancer increases. If polyps are found and removed, then the risk returns to normal. However, if polyps are discovered, they are almost always removed, returning a patient's risk of colon cancer to baseline.

Lab A

HYPOTHESIS

The data in the chart in activity 2 suggest that eating a diet high in red meat may increase the risk for colon cancer. To prove this, we will study the diets of people from a city in the UK that is known for its meat consumption, and the diets of people from a city in India where most people keep a vegetarian diet.

METHODOLOGY

All participants will keep food diaries throughout the study, and will be screened for colon cancer yearly.

NUMBER OF PEOPLE IN EACH GROUP:

500,000 people in each town.

RECRUITMENT POLICY

500,000 people in each city will be invited to join the study. They must be healthy volunteers, male or female, over the age of 18. Volunteers will be given a colonoscopy before the start of the study to ensure that they do not currently have colon cancer.

Volunteers will be recruited by word of mouth, by their GPs, and by radio and newspaper advertising. All volunteers will be free to leave the study at any time.

HOW LONG THE STUDY WILL RUN

Ten years.

TEST FOR COLON CANCER

All study participants will undergo a colonoscopy once a year.

Lab B

HYPOTHESIS

There appears to be a correlation between eating a diet high in red meat, eating a diet low in fruit and vegetables, and an increased risk of colon cancer. We want to find out which, if any, of these factors increases the risk of colon cancer.

METHODOLOGY

This is a large-scale study involving four groups of people: one group eats a diet high in red meat and low in fruit and vegetables, one group eats a diet high in both red meat and fruit and vegetables, one group eats a diet low in both red meat and vegetables, and the fourth group eats a diet low in red meat and high in fruit and vegetables.

NUMBER OF PEOPLE IN EACH GROUP:

5863. This number was calculated by a statistician, based on the frequency of the disease. This is the number of participants necessary to show any significant differences in outcome.

RECRUITMENT POLICY

They must be healthy volunteers, male or female, over the age of 18. Volunteers will be given a colonoscopy before the start of the study to ensure that they do not currently have colon cancer.

Volunteers will be recruited by word of mouth, by their GPs, and by radio and newspaper advertising. All volunteers will be free to leave the study at any time.

Volunteers will be asked to fill out a questionnaire about their dietary habits and then put into the appropriate group.

All volunteers will give their complete medical history to the study organisers at the start of the study so this can be taken into consideration when analysing the data later.

For ethical reasons, all volunteers will be given information about healthy dietary habits and colon cancer at the start of the study.

HOW LONG THE STUDY WILL RUN

This study will run for the lifetime of all participants.

TEST FOR COLON CANCER

Volunteers will have yearly colonoscopies to check for signs of colon cancer.

Lab C

HYPOTHESIS

Living in a city causes colon cancer.

METHODOLOGY

100 000 colon cancer patients and survivors will complete a questionnaire describing where they lived before they were diagnosed with colon cancer.

RECRUITMENT POLICY

Colon cancer patients and survivors will be recruited through word of mouth by doctors, through colon cancer support charity organisations, and radio and newspaper advertising. They will be recruited from areas all over the UK.

Volunteers may be male or female, but must be over the age of 18 and must have been previously diagnosed with colon cancer.

HOW LONG THE STUDY WILL RUN

Questionnaires will be taken until a statistically significant number (100 0000) is reached. This should take 5-10 years.

TEST FOR COLON CANCER

All participants will have been previously diagnosed with colon cancer.

Lab D

HYPOTHESIS

Does the amount of red meat in the diet affect the risk of colon cancer? The chart above suggests that eating a high amount of red meat may be linked to an increased risk of colon cancer. Does it follow that a diet with a low amount of red meat should be linked to a lower risk of colon cancer?

METHODOLOGY

This study will follow three groups of people: One will eat a diet high in red meat (5x or more per week); one will eat a diet with moderate amounts of red meat (1-3 x per week) and one will eat a diet with no red meat at all. Participants will keep food diaries tracking red meat consumption and be monitored for colon cancer yearly.

NUMBER OF PEOPLE IN EACH GROUP:

8986. This number was calculated by a statistician, based on the frequency of the disease. This is the number of participants necessary to show any significant differences in outcome.

RECRUITMENT POLICY

They must be healthy volunteers, male or female, over the age of 18. Volunteers will be given a colonoscopy before the start of the study to ensure that they do not currently have colon cancer.

Volunteers will be recruited by word of mouth, by their GPs, and by radio and newspaper advertising. All volunteers will be free to leave the study at any time.

Volunteers will be asked to fill out a questionnaire about their dietary habits and then put into the appropriate group.

All volunteers will give their complete medical history to the study organisers at the start of the study so this can be taken into consideration when analysing the data later.

For ethical reasons, all volunteers will be given information about healthy dietary habits and colon cancer at the start of the study.

HOW LONG THE STUDY WILL RUN

For the lifetime of all participants.

TEST FOR COLON CANCER

Volunteers will have yearly colonoscopies to check for signs of colon cancer.

Activity 3
Teachers' Notes on Research Proposals

In the following pages are some pros and cons of each lab's proposal. Lab D has the most workable experiment, and a good case can be made for Lab B, although Lab B would have a better chance of winning the grant money if their volunteers kept food diaries, or otherwise monitored their diets.

Lab A (Teachers' Notes)

Hypothesis:
The data in the chart in activity 2 suggest that eating a diet high in red meat may increase the risk for colon cancer. To prove this, we will study the diets of people from a city in the UK that is known for its meat consumption, and the diets of people from a city in India where most people keep a vegetarian diet.

Pros:	**Cons:**
• It is a good idea to compare meat-eating volunteers to vegetarians to test this hypothesis.	• This study does not compare like for like. There are probably several other cultural and lifestyle factors that are different between the Indian and UK populations in this study which could account for differences in colon cancer risk. • This study does not take into consideration that there may be vegetarians in the meat-eating UK city, and meat-eaters in the Indian city. This could affect the results.

Methodology:
All participants will keep food diaries throughout the study, and will be screened for colon cancer yearly.

Pros:	**Cons:**
• Regular, free colon cancer screening provided by this study could detect any polyps or colon cancer earlier than if the volunteers had not agreed to participate in the study.	• How reliable are the participants of the study? They may not keep accurate food diaries. • Colon cancer screening is invasive and can be uncomfortable. Volunteers may drop out of the study, or be reluctant to participate in the study because of this.

Number of people in each group:
500,000 people in each town.

Pros:	**Cons:**
• This is a very large sample that could yield a good deal of information.	• This study is very large. The number of participants will generate mountains of data which may be difficult for researchers to handle. • Is it necessary to study this many people? A statistician should have been consulted to determine how many volunteers need to participate to produce significant results.

Recruitment policy:
500,000 people in each city will be invited to join the study. They must be healthy volunteers, male or female, over the age of 18. Volunteers will be given a colonoscopy before the start of the study to ensure that they do not currently have colon cancer.

Volunteers will be recruited by word of mouth, by their GPs, and by radio and newspaper advertising. All volunteers will be free to leave the study at any time.

Pros:	Cons:
• The colonoscopy at the start of the study is a good idea—this ensures that volunteers do not already have colon cancer. • The volunteers should be free to leave the study at any time—this shows that they are not coerced, and suggests that this is an ethical study.	• This is a very large study and it may be difficult to recruit such large numbers of volunteers.

How long the study will run:
Ten years

Pros:	Cons:
• Ten years is long enough for colon cancer to develop and for changes in the colon to be observed.	• If younger people (40 and under) are participating in this study, they are unlikely to develop colon cancer during the duration of the study, as it is more likely to affect people who are 50 and older.

Test for colon cancer:
All study participants will undergo a colonoscopy once a year.

Pros:	Cons:
• This is a good test for colon cancer, and can provide evidence of the disease at an early stage.	• A colonoscopy is a time-consuming and invasive procedure. Volunteers may not want to participate, or may drop out of the study as a result. • Colonoscopies also pose a small risk of perforation of the bowel. Is this acceptable? • If most colon cancers appear after age 50, is this really a necessary test to perform on patients younger than 50?

Lab B (Teachers' Notes)

Hypothesis:
There appears to be a correlation between eating a diet high in red meat, eating a diet low in fruit and vegetables, and an increased risk of colon cancer. We want to find out which, if any, of these factors increases the risk of colon cancer.

Pros:	**Cons:**
• Unpicking the correlation between these two factors is a good idea, as it builds on previous research and seeks clarification.	• None

Methodology:
This is a large-scale study involving four groups of people: one group eats a diet high in red meat and low in fruit and vegetables, one group eats a diet high in both red meat and fruit and vegetables, one group eats a diet low in both red meat and vegetables, and the fourth group eats a diet low in red meat and high in fruit and vegetables.

Pros:	**Cons:**
• This is a good systematic comparison that isolates both variables (meat eating and fruit and vegetables) and compares people with each behaviour to people with both and people who do neither.	• The participants are not keeping food diaries, so there is no way to determine whether their dietary habits have changed from the start of the study.

Number of people in each group:
5863. This number was calculated by a statistician, based on the frequency of the disease. This is the number of participants necessary to show any significant differences in outcome.

Pros:	**Cons:**
• A statistician has calculated that this is a large enough number of volunteers to show statistically significant results.	• It may be difficult to recruit this many volunteers.

Recruitment policy:
They must be healthy volunteers, male or female, over the age of 18. Volunteers will be given a colonoscopy before the start of the study to ensure that they do not currently have colon cancer.

Volunteers will be recruited by word of mouth, by their GPs, and by radio and newspaper advertising. All volunteers will be free to leave the study at any time.

Volunteers will be asked to fill out a questionnaire about their dietary habits and then put into the appropriate group.

All volunteers will give their complete medical history to the study organisers at the start of the study so this can be taken into consideration when analysing the data later.

For ethical reasons, all volunteers will be given information about healthy dietary habits and colon cancer at the start of the study

Pros:	**Cons:**
• The colonoscopy at the start of the study is a good idea—this ensures that volunteers do not already have colon cancer. • The volunteers should be free to leave the study at any time—this shows that they are not coerced, and suggests that this is an ethical study.	• While it is necessary to give participants information about how diet may affect the risk of colon cancer (otherwise the study would not be ethical), this could cause volunteers to change their dietary habits, and this could affect the study.

How long the study will run:
This study will run for the lifetime of all participants.

Pros:	**Cons:**
• Colon cancer takes many years to develop and does not often appear until patients are over 50. Tracking volunteers for a lifetime is a good way to test whether a lifetime's dietary choices have an impact on colon cancer risk.	• This study will run for a long time and final results will not be known for decades.

Test for colon cancer:
Volunteers will have yearly colonoscopies to check for signs of colon cancer.

Pros:	**Cons:**
• This is a good test for colon cancer, and can provide evidence of the disease at an early stage.	• A colonoscopy is a time-consuming and invasive procedure. Volunteers may not want to participate, or may drop out of the study as a result. • Colonoscopies also pose a small risk of perforation of the bowel. Is this acceptable? • If most colon cancers appear after age 50, is this really a necessary test to perform on patients younger than 50?

Lab C (Teachers' Notes)

Hypothesis:
Living in a city causes colon cancer.

Pros:	**Cons:**
• None	• This hypothesis is not supported by any previous data in the chart from activity two. The data in that chart suggest that there is no connection between living in a city and colon cancer risk.

Methodology:
100 000 colon cancer patients and survivors will complete a questionnaire describing where they lived before they were diagnosed with colon cancer.

Pros:	**Cons:**
• A questionnaire is easy to administer, especially for this many participants.	• This study does not compare patients with colon cancer to people without colon cancer, so it shows nothing about the differences between the two groups. • By asking a group of colon cancer patients and survivors to fill in a questionnaire after the fact, they may be biased or remember selective facts.

Recruitment policy:
Colon cancer patients and survivors will be recruited through word of mouth by doctors, through colon cancer support charity organisations, and radio and newspaper advertising. They will be recruited from areas all over the UK.

Volunteers may be male or female, but must be over the age of 18 and must have been previously diagnosed with colon cancer.

Pros:	**Cons:**
• This study should not be difficult to recruit for. There are several organisations involved with colon cancer patients that can provide volunteers. • Recruitment will be easier, as it will be done over several years (see below).	• This group does not include any people who have not have colon cancer for comparison. This is a biased sample.

How long the study will run: Questionnaires will be taken until a statistically significant number (100 000) is reached. This should take 5-10 years.	
Pros: • None	**Cons:** • There may be differences between volunteers who participate at the beginning and end of the study; something may happen in the intervening 5-10 years which could affect the results.

Test for colon cancer: All participants will have been previously diagnosed with colon cancer.	
Pros: • The colon cancer status of all participants will be known at the start of the study.	**Cons:** • By limiting the study to people who have been diagnosed with colon cancer, there is no healthy group available for meaningful comparison.

Lab D (Teachers' Notes)

Hypothesis:
Does the amount of red meat in the diet affect the risk of colon cancer? The chart above suggests that eating a high amount of red meat may be linked to an increased risk of colon cancer. Does it follow that a diet with a low amount of red meat should be linked to a lower risk of colon cancer?

Pros:	Cons:
• Comparing diets with different levels of red meat to measure their effects on colon cancer risk is a good experiment as it builds on previous research (the table from activity 2) and seeks clarification.	• None

Methodology:
This study will follow three groups of people: One will eat a diet high in red meat (5x or more per week); one will eat a diet with moderate amounts of red meat (1-3 x per week) and one will eat a diet with no red meat at all. Participants will keep food diaries tracking red meat consumption and be monitored for colon cancer yearly.

Pros:	Cons:
• This study tests a single potential risk factor, at different doses. This is a good test to determine whether risk of colon cancer is higher when the risk factor (amount of red meat in the diet) is greater. If the risk of colon cancer is greater when the level of red meat in the diet is higher, then eating red meat is more likely to be a risk factor for colon cancer.	• If eating red meat often is a risk factor for colon cancer, then the scientists organising the study must offer the red-meat-eating participants what information they have about a healthy diet and colon cancer risk, otherwise they are potentially causing harm to these volunteers.

Number of people in each group:
8986. This number was calculated by a statistician, based on the frequency of the disease. This is the number of participants necessary to show any significant differences in outcome.

Pros:	Cons:
• A statistician has calculated that this is a large enough number of volunteers to show statistically significant results.	• It may be difficult to recruit this many volunteers.

Recruitment policy:
They must be healthy volunteers, male or female, over the age of 18. Volunteers will be given a colonoscopy before the start of the study to ensure that they do not currently have colon cancer.

Volunteers will be recruited by word of mouth, by their GPs, and by radio and newspaper advertising. All volunteers will be free to leave the study at any time.

Volunteers will be asked to fill out a questionnaire about their dietary habits and then put into the appropriate group.

All volunteers will give their complete medical history to the study organisers at the start of the study so this can be taken into consideration when analysing the data later.

For ethical reasons, all volunteers will be given information about healthy dietary habits and colon cancer at the start of the study

Pros:	**Cons:**
• The colonoscopy at the start of the study is a good idea—this ensures that volunteers do not already have colon cancer. • The volunteers should be free to leave the study at any time—this shows that they are not coerced, and suggests that this is an ethical study.	• While it is necessary to give participants information about how diet may affect the risk of colon cancer (otherwise the study would not be ethical), this could cause volunteers to change their dietary habits, and this could affect the study.

How long the study will run:
For the lifetime of all participants.

Pros:	**Cons:**
• Colon cancer takes many years to develop and does not often appear until patients are over 50. Tracking volunteers for a lifetime is a good way to test whether a lifetime's dietary choices have an impact on colon cancer risk.	• This study will run for a long time and final results will not be known for decades.

Test for colon cancer:
Volunteers will have yearly colonoscopies to check for signs of colon cancer.

Pros:	**Cons:**
• This is a good test for colon cancer, and can provide evidence of the disease at an early stage.	• A colonoscopy is a time-consuming and invasive procedure. Volunteers may not want to participate, or may drop out of the study as a result. • Colonoscopies also pose a small risk of perforation of the bowel. Is this acceptable? • If most colon cancers appear after age 50, is this really a necessary test to perform on patients younger than 50?

Activity 2: Risks of colon cancer chart

	Diet high in red meat	Diet low in fruit and vegetables	Diet high in dairy products	Does very little exercise	Sits down a lot	Has asthma	Lives in a city	Diet high in sweets	Has had polyps (growths) in the colon removed	Is older than 50	Has close relatives who have had colon cancer
Abdul	x		x	x			x				x
Bakri		x	x		x	x	x	x			
Fakhar	x	x	x	x	x	x	x			x	x
Hasib	x			x		x		x	x	x	
Yasmin	x	x	x	x	x		x	x			
Shakirah	x	x	x			x		x		x	
Fatima			x			x					x
Mina		x	x		x			x			
Ruby	x	x	x	x			x	x		x	x
Maria			x		x					x	
Katie	x	x			x		x	x			
Adrian			x	x						x	x
Tim	x	x		x	x	x	x			x	x
Emily			x		x						x
Mark			x		x		x		x	x	
Maureen			x		x						x
Harshad	x		x		x		x	x			x
Abby	x	x		x	x						x
Ruarih	x		x		x		x		x	x	
James	x		x		x			x			
Ellie	x	x	x	x	x	x		x		x	
Nico										x	x
Matthew			x		x			x			x
Lionel					x			x		x	x
Ahmed	x	x	x			x	x				
Luca	x		x		x		x		x	x	
Jamal	x	x	x	x	x	x	x			x	x
Ashley	x	x									x
Julie	x		x	x			x	x			x
Jade	x				x	x		x	x	x	