Development of the Germ Theory of Disease

Introduction

This activity could be used as a summary at the end of the topic or as a revision exercise. It provides useful summary notes for exam revision when complete. You may decide to fill in more or less of the boxes for the students depending on their time and interest.

There is much more detail here than students would be expected to actually remember. The aim is to provide an overview and to show how the scientists they will have studied in more detail fit into a general scheme.

The activity demonstrates effectively how science develops by gradual building on earlier knowledge as much as by total theory change.

Teaching Approach

It could be used as a paired class activity or as homework. Questions 3 - 5 would form the basis for an useful class discussion as part of the summary or revision of the topic and are probably better discussed than attempted individually by most groups.

References

Textbook
Chapter 1

Specification
9.1 Infectious diseases

12.1 f,h,j
12.5 c
13.9 The germ theory of disease

Method

Use small group discussion because

- Students enjoy it
- It allows active involvement by everyone
- One loud or quicker thinking student cannot dominate the class
- The shy and less articulate are more able to contribute
- Students learn from each other
- Everyone gets more practice at expressing their ideas
- A two way discussion is almost always more creative than individual thoughts
- Social skills are practiced in a “safe” environment
- It helps individuals clarify arguments for a topic where there are no “right answers”.

The chronology of some of the most important advances in the work against infectious disease

Year	Scientist	Development	Significance
1794	Jenner	Demonstrates that vaccination with cowpox protected against smallpox	The first vaccine
1840	Henle	Suggests that microparasites cause fermentation, putrefaction and disease	Early idea of germs
1847	Ignaz Semmelweiss	Shows that childbirth fever was caused by something transmitted by health workers and could be prevented by hygiene	Evidence of contagion, use of control group
1854	Florence Nightingale	Insists on cleanliness in hospitals	Reduction in number of fatal infections acquired in hospital
1854	John Snow	Careful epidemiological work shows correlation between cholera cases and water supply	Evidence against miasma theory and for transmission of germs in water
1861	Pasteur	Shows that living organisms only grow from other living organisms. They do not arise spontaneously.	Evidence for contagion and against miasma theory and spontaneous generation of germs
1865	Joseph Lister	Uses antiseptics to reduce deaths after surgery	An important practical application of Pasteur's ideas to save lives
1876	Robert Koch	Isolates a bacillus and showed that it caused anthrax	Very first **direct evidence** of a microbe causing a disease
1879	Pasteur	Discovers how to weaken chicken cholera so that it could be used as a vaccine without causing infection	First technique for production of a vaccine by deliberately weakening a bacterium. Idea of preventative medical care.
1882	Robert Koch	Discovers the TB bacillus	Further confirmation of the bacterial cause of disease
1883	Robert Koch	Discovers the cholera bacillus	Confirmation of Snow's work by discovery of the causative agent
1885	Louis Pasteur	First trial of rabies vaccine in a child	Showed that human vaccines could be made by systematic weakening of the microbe

1909	Paul Ehrlich	Develops the first specific antibacterial drug	Earlier treatments had had serious side-effects on the patient
1928	Alexander Fleming	Discovers penicillin, the first antibiotic	The start of the introduction of bacteria-specific medicines which have saved millions of lives
1921	Calmette & Guerin	Produce BCG vaccine against TB	Application of Pasteur's approach to a vaccine against a disease which killed many
1935	Wendell Stanley	The first virus isolated (TMV virus which infected tobacco plants)	Bacteria could be seen under a microscope but the cause of viral diseases had only been guessed at until this time.

3.*The graph shows death rates from TB over this period. Which of the developments above seem to have had a direct effect in reducing deaths from TB?*

General emphasis on contagion and cleanliness may have contributed to the fall 1850 - 1940 although this would be impossible to test. The introduction in 1948 of a cure for TB, the antibiotic streptomycin, and the prevention of TB with universal BCG vaccination in the 1950s were both effective in reducing the already relatively low death rates to almost zero.

4. *Suggest some reasons why death rates started falling long before the discovery of the TB bacterium.*

Less over-crowded housing, better general hygiene and better nutrition and general health are believed to be the main reasons.

TB contagion in populations is due to droplet infection (coughing and sneezing), so TB is more easily spread in dense populations. The disease is more likely to be serious in individuals with poor nutrition, or where the individual's immune system has been challenged by other infectious diseases.

5. *Pasteur is usually credited with the discovery of the germ theory of disease. Do you think this is justified, given how many other scientists had already been developing the foundations on which he built?*

All scientific breakthroughs depend on the earlier work of others. Many had suggested the existence of microbes and had demonstrated that predictions based on the idea of germs were confirmed by experiments. However Pasteur was one of the first to provide conclusive evidence of the causative mechanism because of his exceptional experimental skills and imagination.

He was also very good at getting publicity and making sure he got the credit for anything he was involved in, often at the expense of others. So although his contribution was of major significance he does not deserve all the credit.

Development of the Germ Theory of Disease

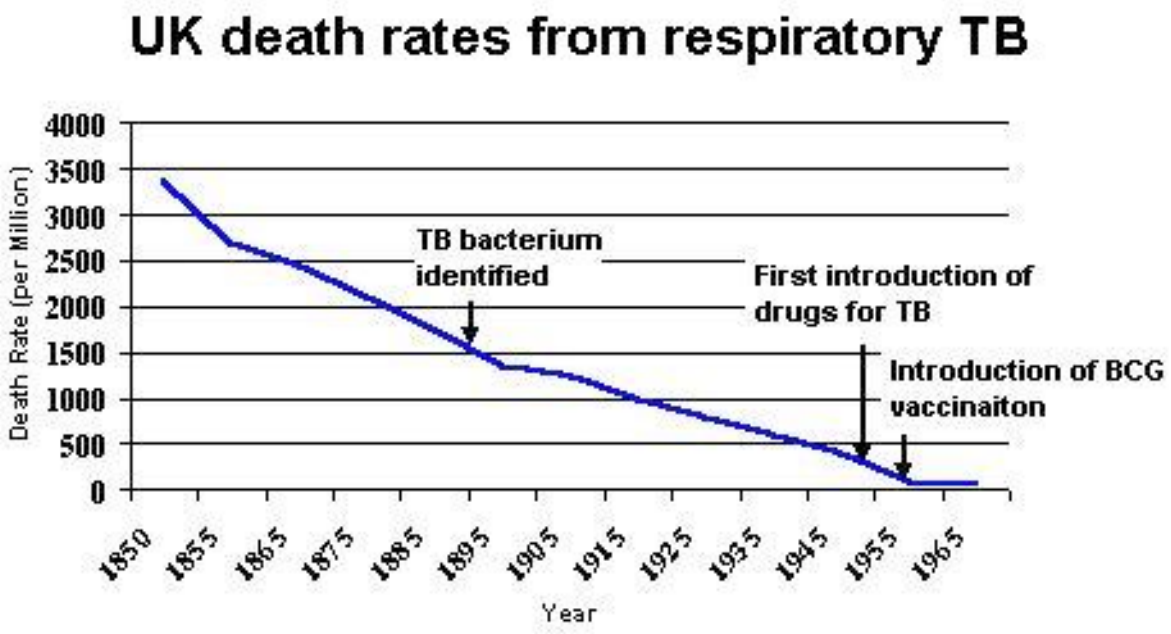
1. Use your text book to complete the table below with date, name of scientist or description of the development.

2. Think about how the development helped the advance of scientific understanding or directly improved human health and fill in the fourth column.

3. The graph below shows death rates from TB over this period. Which of the developments described in the table seem to have had a direct effect in reducing deaths from TB?

4. Suggest some reasons why death rates started falling long before the discovery of the TB bacterium.

5. Pasteur is usually credited with the discovery of the germ theory of disease. Do you think this is justified, given how many other scientists had already been developing the foundations on which he built?



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