

Drug development

Introduction

Students review the stages in the development of a new drug and check their understanding of the reasons for each stage.

Resources

- student worksheets 1-3
- scissors
- glue

The activity

1. Get students into groups and give out worksheets 1 and 2.
2. Students cut up the table on worksheet 2.
3. Students discuss the order of phases in their group, then place the 13 stages on paper in the correct order.
4. Discuss the groups' decisions as a class, getting them to explain the reasons for each stage.
5. Check the correct order before students stick the stages in the left hand column of table on worksheet 1.
6. Give out worksheet 3, and follow the same procedure to get students to match reasons to the stages in their table.

With a large class this exercise could be made more active. One stage could be given to each student and they could all get in line in the correct order. A second set of students, each having one of the reasons, would then, in discussion, pair themselves up to one of the stages. Stages I-8, K-5, H-13, C-12 might all be left out to suit the numbers in the class. After all the activity they would have to be given a copy of completed worksheet 1 and asked some questions to give them an overview of the whole process.

Questions of the type, "Why would it matter if stage E was left out?" would serve to stimulate discussion and clarify any problems.

References

Specification 3.1.4.

Textbook pages 52-58

How Science Works

Bf Claims about large groups are usually based on measurements on a sample of the population (all the individuals in the group). The sample should be selected randomly. Failure to do this will introduce bias. The larger the sample, the more confidence we can have in any claim about the population.

Bk To test the effectiveness of a specific 'treatment', scientists compare a sample that is given the treatment with a control sample that is not. This is called a (clinical) trial. Participants should be allocated randomly to the treatment or control group. Because humans' expectations can influence how they report the outcome of a treatment it is important to take precautions to prevent this. In a 'blind' trial, each individual does not know if he/she is in the treatment sample or the control sample. The trial is 'double blind' if the person who measures the outcomes also does not know this.

Bl To assess the outcome of a trial, scientists compare the number of successful outcomes in the two groups. To judge that a treatment has 'worked', the difference must be big enough not to be attributable simply to normal variation.

Hc Society exercises controls on the development and application of science and technology. Official regulations apply to many kinds of scientific activity. Regulatory bodies are set up to implement these controls.

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Worksheet 1

Stage	Reason
D Extraction and purification of substance.	2 Isolation of the chemical being tested is important so that it is clear which chemical is the 'active ingredient' of a drug. Sometimes new drugs are synthesised by modifying the structure of an existing drug.
G In vitro testing.	10 The response of human tissues and enzymes to the drug is studied in glass containers to get as much information as possible before experimenting on living creatures.
F In-vivo testing.	6 A compound which appears not to harm live tissues will now be tested in living animals - most commonly rats and mice. Any effects on the animal's health are recorded.
I Approval for clinical trials by Medicines and Healthcare Products Regulatory Agency.	8 The MHRA will award a Clinical Trials Certificate if they consider the data from pre-clinical trials (in vitro and animal testing) show that the substance passes safety and quality standards. More information on MHRA site under 'our work' http://medicines.mhra.gov.uk/
B Application for drug trial to medical ethics committee.	7 Ethics committees advise on the recruitment of volunteers for the clinical trials and monitor issues affecting these volunteers such as the amount to pay them, risks to their health and informed consent.
A Phase I Short-term study on effect of drug on a small group of volunteer healthy humans. These volunteers may be given different doses. A doctor closely supervises them.	4 Confirms if the compound is being absorbed and excreted by the body in the way predicted by laboratory and animal tests. Effects of different doses are monitored.
K Review of phase I.	5 A review of the data collected is made by the MHRA. The agency recommends proceeding to Phase II trials.
E Phase II, study extended to trials on several hundred patients.	3 A small scale trial to find out whether the compound has the desired effect in patients with the disease.
L Phase III Several thousand patients are selected and placed randomly into two groups: one given the compound and a control group given either a placebo or the current standard treatment.	9 A large scale trial is necessary so that the results can be analysed statistically. If the medicine is effective, then the results will show a statistically significant improvement in the patients receiving the treatment compared with patients given the placebo or standard treatment. It is important that neither the patients nor the doctors know who is having the compound and who is in the control group.
J Data from the clinical trials are sent to Medicines and Healthcare Products Regulatory Agency who decide if drug shows a significant benefit to patients compared with control.	1 If the results show a statistically significant benefit for patients, the Medicines and Healthcare Products Regulatory Agency, MHRA, (an independent body of scientists and doctors) will recommend that the drug be licensed. Their role here is that of an independent body examining the trial data.
H Product Licence is granted for marketing the drug in the U.K.	13 This system of licensing new drugs allows the UK Government to ensure the safety of any drugs sold here.
M MHRA collects data on any side effects once drug is on the market. Phase IV.	11 Some side effects only show up when very large numbers of people use the drug over a long period of time. This ongoing monitoring will detect even rare side-effects.
C NICE carries out a careful cost-benefit evaluation of the drug for the NHS.	12 Some drugs may be effective and safe but this does not mean they are good value for money. NICE has to decide whether the new drugs have advantages over cheaper treatments that would justify the extra cost to the NHS.



Drug development

Introduction

Modern drugs have to be carefully tested for both safety and efficacy. The rights of those involved in the testing must be considered, as well as the reliability of the test results. This activity allows you to review what you have learned about how new drugs are developed.

The activity

In this activity you are given a list of the procedures that need to take place, from the discovery of a new substance to be tested, to the marketing of a drug passed as safe for prescription. You have to put these procedures in the right order and then to match a reason to each stage.

1. Cut up the table on worksheet 2.
2. Discuss in your group to decide on the correct order for these stages. Place the 13 stages on paper in the order in which they would take place.
3. When you have decided on the order check that you have the correct order.
4. Stick the stages in the left hand column of the table in worksheet 1.
5. Now discuss the reasons for each stage and place the cut up 'reasons for development' from worksheet 3 in the correct position in the second column. Discuss with your group, and check before you stick these in.

Worksheet 2 Stages in the development of a new drug

A Phase I Short-term study on effect of drug on a small group of volunteer healthy humans. These volunteers may be given different doses. A doctor closely supervises them.	B Application for drug trial to medical ethics committee
C NICE carries out a careful cost-benefit evaluation of the drug for the NHS.	D Extraction and purification of substance.
E Phase II , study extended to trials on several hundred patients.	F In-vivo testing.
G In vitro testing	H Product Licence is granted for marketing the drug in the U.K.
I Approval for clinical trials by Medicines and Healthcare Products Regulatory Agency.	J Data from the clinical trials are sent to Medicines and Healthcare Products Regulatory Agency who decide if drug shows a significant benefit to patients compared with control.
K Review of phase I	L Phase III A group of several thousand patients are selected and placed randomly into two groups: the group given the compound and a control group given either a placebo or the current standard treatment.
M MHRA collects data on any side effects once drug is on the market. Phase IV.	

Worksheet 3 **Reasons for development**

1 If the results show a statistically significant benefit for patients, the Medicines and Healthcare Products Regulatory Agency, MHRA, (an independent body of scientists and doctors) will recommend that the drug be licensed. Their role here is that of an independent body examining the trial data.
2 Isolation of the chemical being tested is important so that it is clear which chemical is the 'active ingredient' of a drug. Sometimes new drugs are synthesised starting with the structure of an existing drug.
3 Results will indicate if the compound has the desired effect in patients with the disease.
4 Confirms if the compound is being absorbed and excreted by the body in the way predicted by Lab tests. Effects of different doses are monitored.
5 A review of the data collected is made by the UK Medicines and Healthcare Products Regulatory Agency. The agency recommends proceeding to Phase II trials.
6 A compound which appears not to harm live tissues will now be tested in living animals – most commonly rats and mice. Any effects on all aspects of the animal's health are recorded.
7 Ethics committees advise on the recruitment of volunteers for the clinical trials, and monitor issues such as the payment of volunteers, risk to volunteers, informed consent of volunteers.
8 The MHRA will award a Clinical Trials Certificate if they consider the data from pre-clinical trials (in vitro and animal testing) show that the substance passes safety and quality standards. More information on MHRA site under 'our work' http://medicines.mhra.gov.uk/
9 A large scale trial is necessary so that the results can be analysed statistically. If the medicine is effective, then the results will show a statistically significant improvement in the patients receiving the treatment compared with patients given the placebo or standard treatment. It is important that neither the patients nor the doctors know who is having the compound and who is in the control group.
10 The response of human tissues and enzymes to the drug is studied in glass containers before experimenting on living creatures.
11 Some side effects only show up when very large numbers of people use the drug over a long period of time. This ongoing monitoring will detect even rare side-effects.
12 Some drugs may be effective and safe but this does not mean they are good value for money. NICE has to decide whether the new drugs have advantages over cheaper treatments that would justify the extra cost to the NHS.
13 This system of licensing new drugs allows the UK Government to ensure the safety of any drugs sold here.

