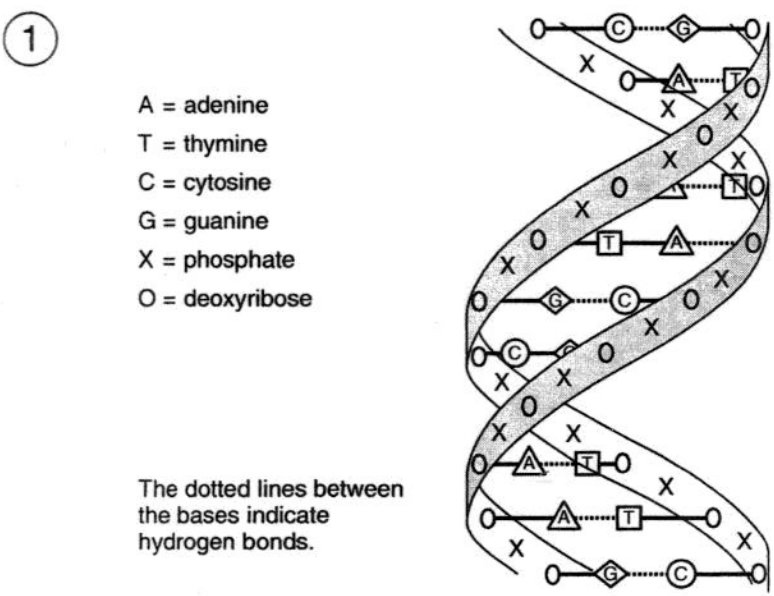
The Value Of DNA

Topic

DNA recovery

Introduction

Deoxyribonucleic acid (DNA) is present in the nuclei of cells of all living things. It consists of very long strands of nucleic acid, which are formed of alternating groups of a carbohydrate (called deoxyribose) and a phosphate group. One of four different bases – adenine, guanine, thymine, or cytosine – attaches itself to each carbohydrate unit. The bases on adjoining strands of nucleic acid link to each other via hydrogen bonds to form the two strands into the structure known as a double helix; the structure of DNA was discovered in 1953 by James Watson (1928–) and Francis Crick (1916–2004). The bases will only link in certain combinations – adenine with thymine, and guanine with cytosine. Each molecule of DNA contains millions of these base pairs. There is an almost infinite potential for different combinations of these base pairs, making it very unlikely that DNA from two people will share the same pattern (except for identical twins). This is very useful for forensic scientists because they can compare DNA found at a crime scene with that taken from a suspect. In this experiment, you will extract DNA from a selection of different materials. You will break down the cell structure of each material using salt, detergent, and mechanical force; this will release DNA from the cells. You will remove proteins adhering to the DNA using the enzyme papain, which is present in pineapple juice. You may be able to produce long strands of DNA, but you are more likely to find that the DNA has fractured into shorter lengths that clump together in a mass.



The structure of DNA

Time required

at least 1 hour for each extraction

Materials

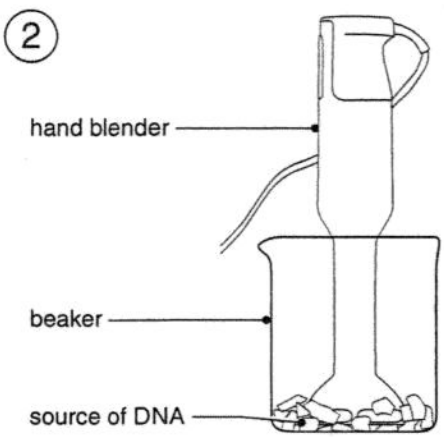
For each extraction:
20 g of a source of DNA (e.g., chopped chicken liver, peas, chopped onion, or yeast)
pinch of table salt
50 ml tap water
2 ml detergent
2 ml pineapple juice
10 ml isopropyl alcohol (propan-2-ol)
2 test tubes and stoppers
test tube rack
two 400 ml beakers
two 10 ml graduated cylinders
funnel (to fit into a 400 ml beaker)
filter paper
hand blender
2 eyedroppers
20 cm glass rod
watch or clock (measuring minutes)
safety glasses

Safety note

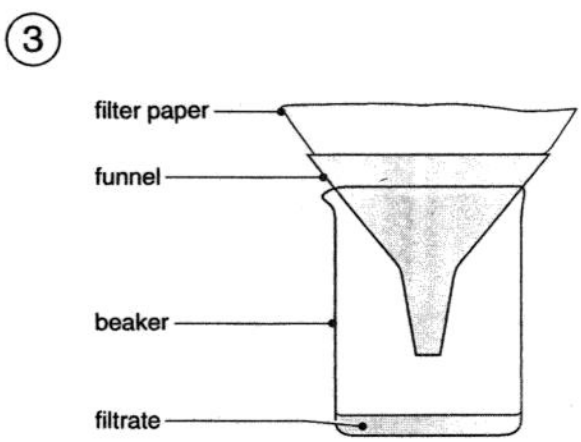
Isopropyl alcohol is poisonous and flammable. If using meat products such as chicken liver, wash hands carefully after use.

Procedure

1. Put on your safety glasses. Place the DNA source, the water, and the salt in a beaker. Blend for 30 seconds (see diagram 2 below).
2. Place the filter paper in the funnel and then put the funnel in the second beaker. Pour the contents of the first beaker into the filter paper and allow the filtrate to drip through into the second beaker (see diagram 3 below). This stage takes longer for some DNA sources than others, e.g., the onion mixture takes about 10 minutes, but the chicken liver mixture can take about 1 hour.
3. Pour 10 ml of the filtrate into a test tube.
4. Using an eyedropper, add about 2 ml of detergent to the test tube. Put a stopper in the neck of the test tube and shake well for 5 minutes. Leave to settle for 5 minutes.
5. Using an eyedropper, add about 2 ml of pineapple juice to the test tube. Stir very carefully with the glass rod.

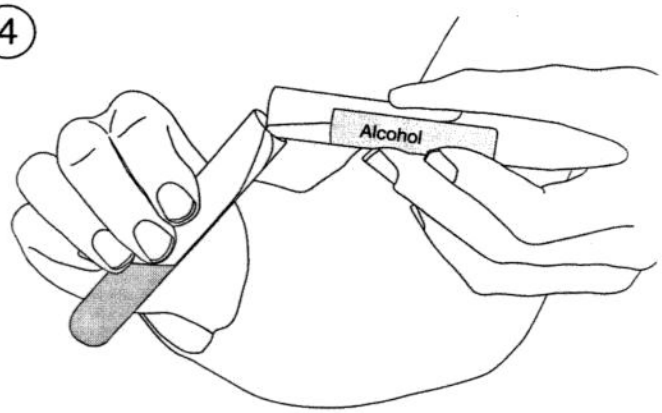


Blending the mixture



Filtering the mixture

6. Pour about 10 ml isopropyl alcohol into a second test tube (i.e., approximately the same volume as the contents of the first test tube). Then pour the isopropyl alcohol slowly and carefully from the second test tube into the first test tube (see diagram 4 opposite). The aim is to form a layer of isopropyl alcohol on top of the watery liquid.



Adding the isopropyl alcohol to the filtrate

7. Place both test tubes carefully in the rack and observe the first test tube. Draw the contents of the test tube in the data table below after 5, 10, and 30 minutes.

DATA TABLE

After 5 minutes	After 10 minutes	After 30 minutes

Analysis

1. Did whitish strands appear in the top (isopropyl alcohol) layer? What do you think these were?
2. If whitish strands appeared, can you wrap them around the glass rod? Or if this is not possible, can you move them around with the glass rod?
3. What happened to the contents of the first test tube?
4. If you performed this experiment using more than one DNA source, which produced the most DNA?

Want to know more?

See Section 10: Our Findings