Subject: **Chemistry**

Topic: **Separating mixtures**

Application: **Clean water technology**

Using the worksheet and podcast resources

This worksheet is based on the Inventive podcast.

It supports Gatsby Benchmark 4: Careers in the curriculum by introducing a career and role model. The worksheets are based on topics in the KS3 curriculum.

The short audio clips can be used to provide context to the worksheet and could be played during a lesson.

A QR code on the student sheet links directly to the podcast.

KS3 National Curriculum statements

Chemistry

- Mixtures, including dissolving.
- Simple techniques for separating mixtures.

Audio clips from Inventive podcast

Available from: *nustem.uk/inventive/#askwar (or scan QR code)*

- **Askwar Clip 1:** Askwar talks about life growing up in a Tanzanian village;
- **Askwar Clip 2:** Askwar talks about his education route, up to starting his company;
- **Askwar Clip 3:** Trevor summarising how the filter works.

Other resources

Askwar's career poster

More information about Askwar

Meet the engineer

Askwar Hilonga
Chemical engineer

Chemical Engineer Askwar Hilonga grew up in Tanzania in a very poor community which suffers from waterborne diseases. Askwar wanted to help his community so he set up a company to design and build water filters that use nanotechnology (technology on a scale of billionths of a metre). Askwar's filters are made to absorb different materials depending on what is contaminating the water.

Scan the QR code

to access all the resources and the full podcast from: *nustem.uk/inventive/#askwar*

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Know

1a. A mixture is two or more substances mixed together that can be separated and keep their properties.
1b. Filtration, Evaporation, Distillation, Chromatography.

2.

Process	**Mixture contains**	**What we get**	**What we lose**
Filtration	Solid mixed in a liquid	Pure liquid and solid (residue)	-
Evaporation	*Solid dissolved in a liquid*	Solid	Liquid (solute)
Distillation	Mixture of liquids	Pure liquids	-
Chromatography	Solid dissolved in a liquid	Separated solids	Liquid (solute)

Apply

3. (a) Chromatography **(b)** Distillation **(c)** Filtration **(d)** Evaporation

4. Dirty water in Tanzania contains solid contaminants.
Filtration uses a barrier that water passes through and doesn't need resources like fuel or electricity to work. You need fuel/electricity to heat water to boiling point for distillation and these are limited in Tanzania. Filtration removes solid contaminants from pure water; distillation separates two different liquids.

Extend

6a. 1000
6b. 500-1000 nanometres
6c. Yes - it will be trapped in the hollow fibre membrane
6d. Some will. 0.004 - 0.1 micrometers is equal to 4-100 nanometres so the hollow fibre membrane will catch the larger ones.

7. *Advantages of clean water* - people live longer healthier lives and can work/go to school; no need to boil water; can use local water supplies (instead of going further to a safer supply); less need for medicines. Poorest people suffer most at the moment.
Advantages of nanotechnology - portable; cheap, simple and easy to maintain; doesn't use fuel or electricity; is designed to filter out local contaminants;

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Separating mixtures

Mixtures can be separated using different methods:

- *filtration;*
- *evaporation;*
- *distillation;*
- *chromatography.*

We use **filtration** for mixtures containing a liquid mixed with a substance that doesn't dissolve (insoluble substance). A filter is a barrier that lets some substances through and traps others in the filter. Different filters can trap particles of different sizes.

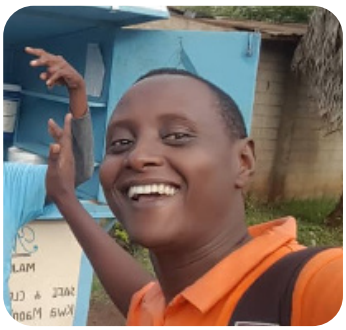
We use **distillation** for mixtures of liquids with different boiling points. When we heat the mixture, the liquid with the lowest boiling point turns into a gas first, leaving the other liquids behind.

We use **evaporation** for mixtures that contain a solid dissolved in a liquid. When the mixture is gently heated, the liquid evaporates (turns into a gas) leaving the solid behind.

We use **chromatography** for mixtures that contain substances dissolved in a liquid. Chromatography separates solids dissolved in a liquid that travel at different speeds when the liquid moves.

Nanotechnology is science on a very small scale, billionths of a metre.

Meet the engineer



Askwar Hilonga

Chemical Engineer

Chemical Engineer Askwar Hilonga grew up in Tanzania in a very poor community which suffers from waterborne diseases. Askwar wanted to help his community so he set up a company to design and build water filters that use nanotechnology (technology on a scale of billionths of a metre). Askwar's water filters absorb different chemicals, depending on what is contaminating the water.

Link to Askwar' story

Know

1a. What is a mixture?

1b. Write down four methods for separating mixtures

2. Complete this table:

Process	Mixture contains	What we get	What we lose
	Solid mixed in a liquid	Pure liquid and solid (residue)	-
Evaporation		Solid	Liquid (solute)
Distillation	Mixture of liquids	Pure liquids	-
Chromatography	Solid dissolved in a liquid	Separated solids	Liquid (solute)

Apply

3. Here are four ways to separate mixtures: *filtration, evaporation, distillation* and *chromatography*

Choose the best method to separate each of these mixtures:

a) Drug testing to identify different chemicals in the sample

b) Collecting drinkable water from sea water

c) Collecting flakes of gold from rivers and streams (gold panning)

d) Collecting salt from sea water

4. A nanofilter uses nanotechnology to remove almost all contaminants from water.

Suggest two reasons why it is better for communities in Tanzania to filter dirty water instead of distilling it.

Extend

5. Askwar's filtration system is designed so water drains through 3 different filters into a collection bucket. The three filters are:

- **Slow sand filter:** traps particles bigger than 1000 nanometres (like soil, organic matter, microorganisms).
- **Nanofilter:** its surface is designed so different chemical contaminants will stick to it.
- **Hollow fibre membrane:** a sieve with very small holes that trap anything bigger than 100 nanometres.

5a. A nanometre is a billionth of a metre (a billion = 1000 x 1000 x 1000). A micrometer is a millionth of a metre (a million = 1000 x 1000). How many nanometers are in a micrometer?

5b. The average bacterium is about 0.5-1.0 micrometres across.

What size is this in nanometers?

5c. Ultrasmall bacteria are about 240 nm across.

Will they be trapped in this filter system? Explain your answer.

5d. Viruses are about 0.004 - 0.1 micrometers across.

Will they be trapped in this filter system? Explain your answer.