

Atoms, elements, molecules, compounds and mixtures

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Chemistry for the gifted and talented
Atoms, elements, molecules, compounds and mixtures

Chemistry for the gifted and talented
Substances

Chemistry for the gifted and talented
Substances

Chemistry for the gifted and talented
Mixtures

Student worksheet: CDROM index 01SW

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Chemistry for the gifted and talented
Mixtures

Discussion of answers: CDROM index 01DA

Topics

Atoms, elements, molecules, compounds, mixtures, structure and different representations of bonds and atoms.

Level

More able 11–13 year old students.

Prior knowledge

The differences between elements, mixtures and compounds.

Rationale

This activity is designed to help students clarify the relationship between various parts of their knowledge in these topics and develop the skill of using Venn diagrams in organising their understanding.

Venn diagrams are a method of organising your thoughts like lists or mind maps. The particular advantage of Venn diagrams is that they clearly show the interconnection or overlap between categories. For example, a substance may be molecular and an element, or molecular and a compound. A reaction may be feasible and proceeds at room temperature, or feasible but not occur because of high activation energy. They also show where characteristics are mutually exclusive: this substance, if a compound, cannot be an element.

Different representations of atoms and molecules are used to show that there are several different ways that they can be visualised.

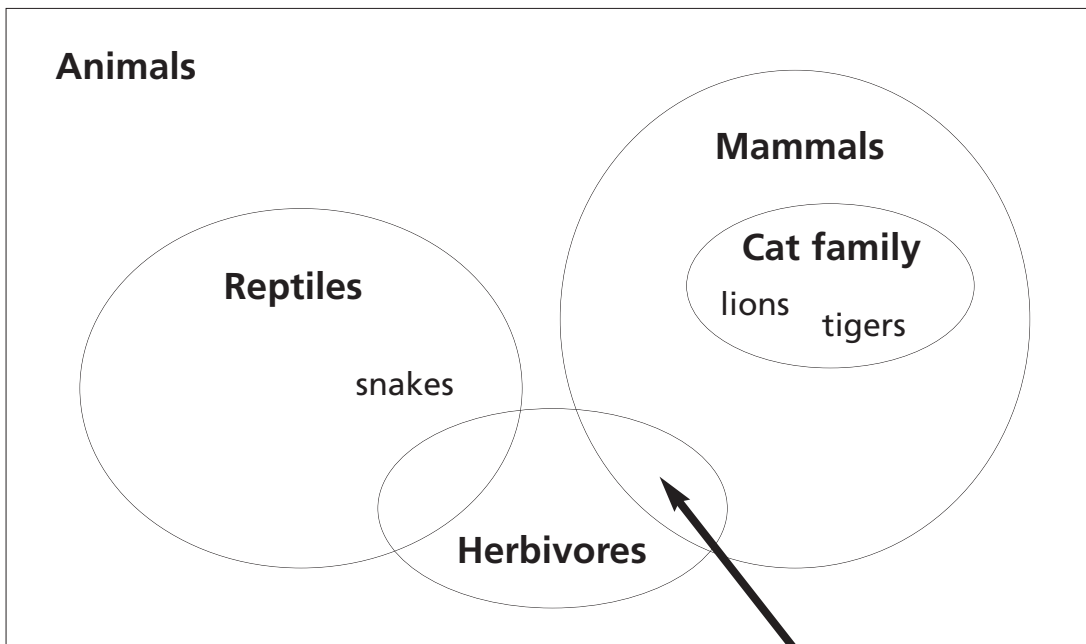
Use

The activity could be used as an extension activity for students at any stage after the main topics listed have been taught. It could be used as a follow up to a lesson on compounds and mixtures.

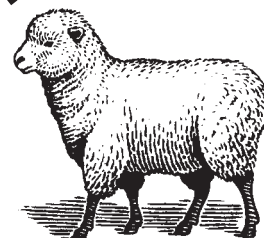
To extend the ideas here, students could be asked to think of other substances to be added to the diagram or to design a new Venn diagram for elements (with subsets: metals, non-metals, metalloids, gases, solids, liquids etc).

Atoms, elements, molecules, compounds and mixtures

Venn diagrams can be used to show relationships between categories. For example, the Venn diagram below shows that mammals are never reptiles, all members of the cat family are mammals, some reptiles and mammals are herbivores but no members of the cat family are. It shows that snakes are reptiles, and lions and tigers are part of the cat family.



1. What does the arrow from the sheep show?



.....

.....

.....

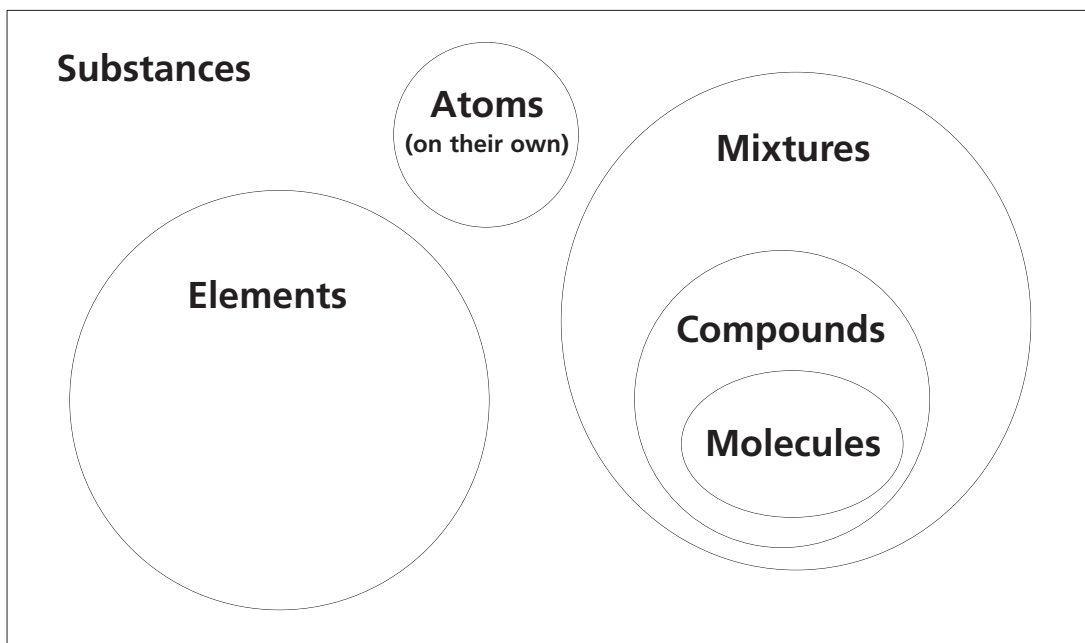
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A student tried to show the relationship between atoms (on their own), elements, compounds, mixtures and molecules. The student drew the following Venn diagram.



The student's Venn diagram contains several errors.

2. List the mistakes in the Venn diagram.

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.....

.....

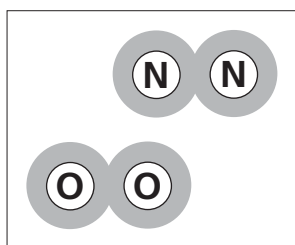
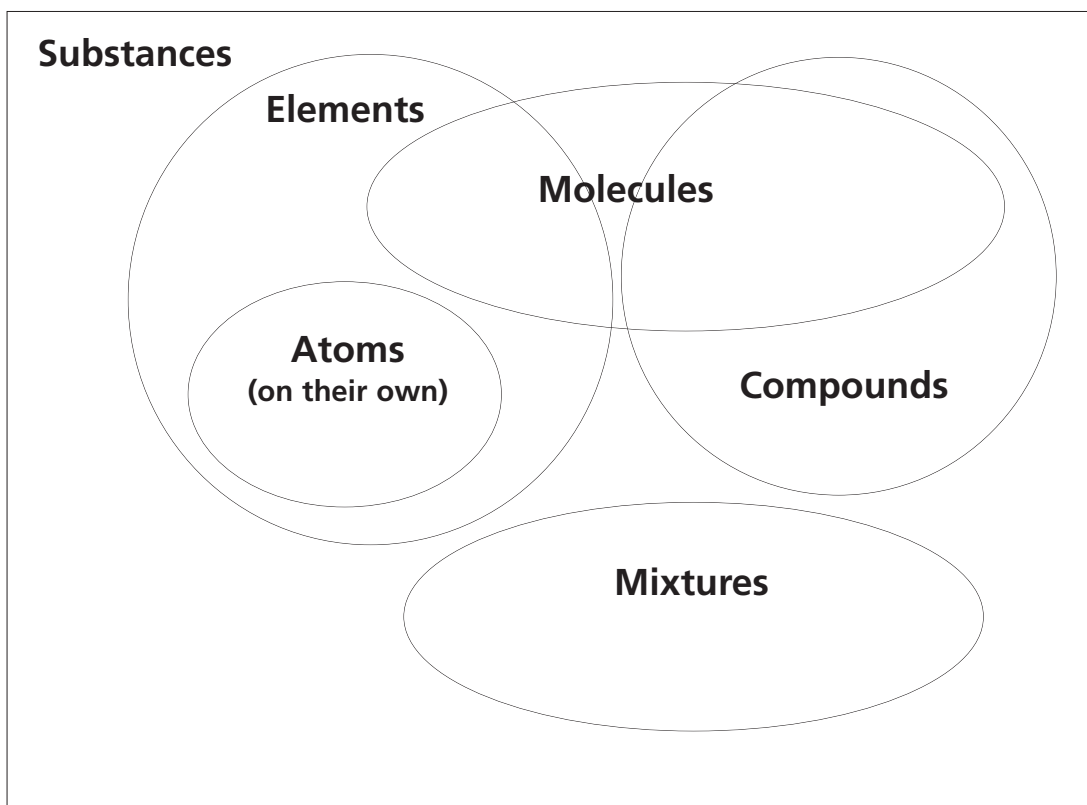
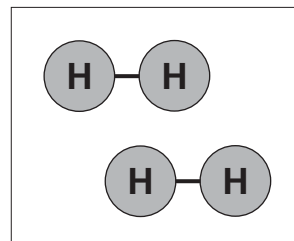
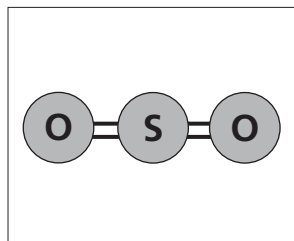
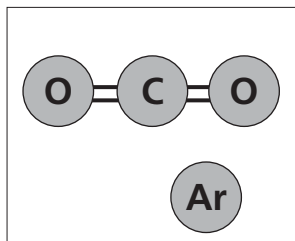
3. Design your own version to show the true relationship between these categories.

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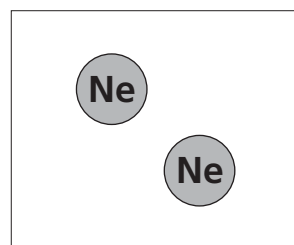


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4. Write in the names of all the substances at the bottom right of the page into the region of this Venn diagram where they belong. Draw arrows from the drawings in boxes to show to which category they belong. Some examples have been done.

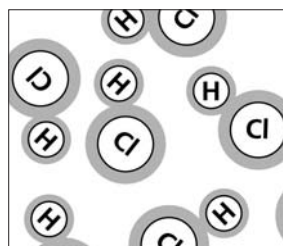
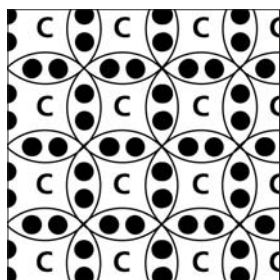
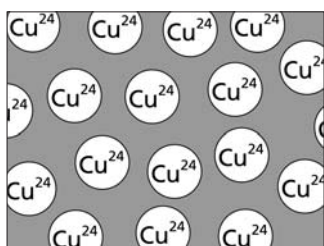
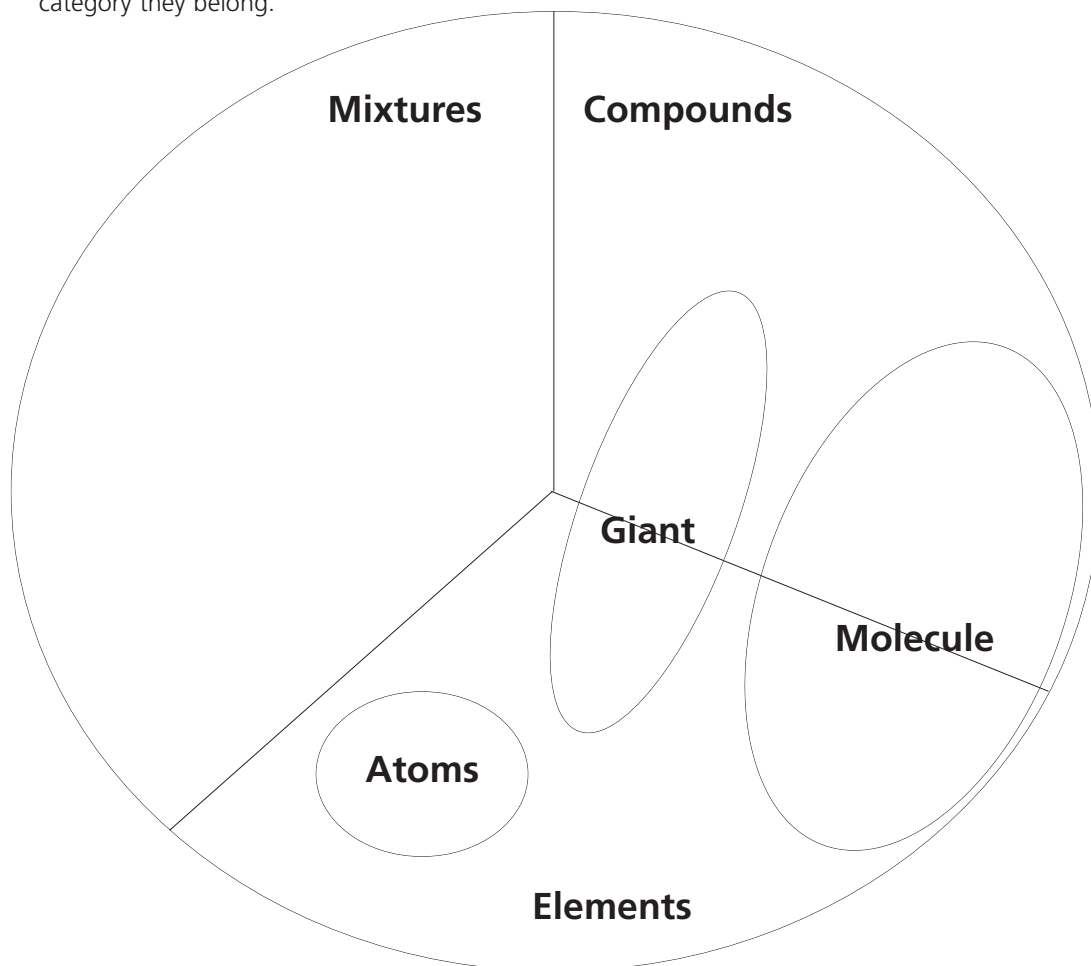


- | | |
|------------------------------|-------------------------------------------------|
| Air | Water (H ₂ O) |
| Ammonia (NH ₃) | Oxygen (O ₂) |
| Crude oil | Chlorine (Cl ₂) |
| Helium gas (He) | Nitrogen (N ₂) |
| Phosphorus (P ₄) | Sulfuric Acid (H ₂ SO ₄) |



continued on page 4

5. A student drew a Venn diagram in a different style and incorporated a category for giant structures. Write in the names of all the substances at the bottom of the page into the region of the diagram where they belong. Draw arrows from the drawings in boxes to show to which category they belong.



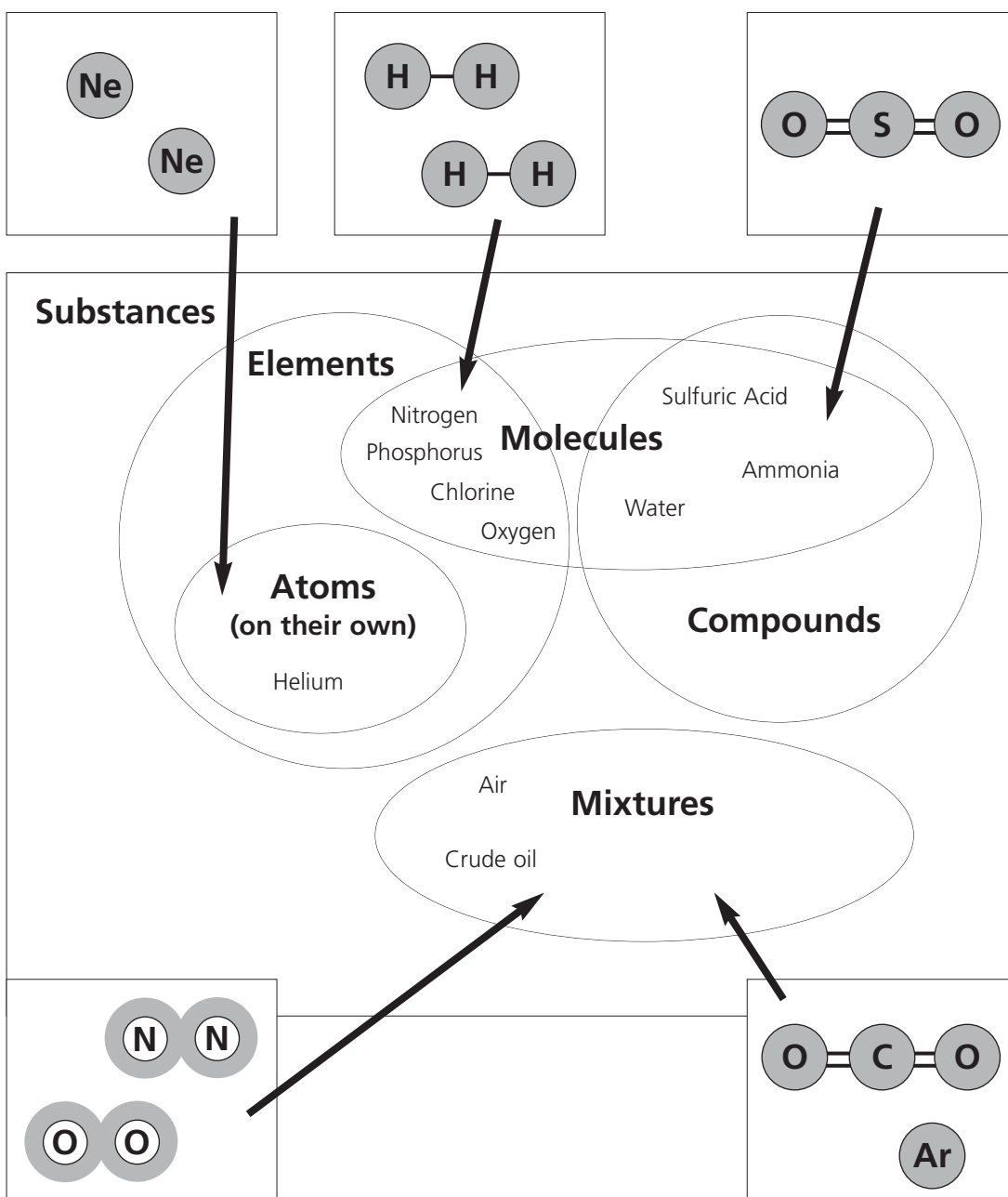
Iron
 Sand (SiO_2)
 Diamond
 Ethanol ($\text{C}_2\text{H}_5\text{OH}$)
 Sodium chloride (NaCl)
 Limestone (CaCO_3)
 Bromine (Br_2)
 Diesel
 Vegetable Oil

Diamond and HCl drawings:

Chemical misconception: *Diagnosis and cure*, Spot the bonding available at www.chemsoc.org/networks/irannet/miscon2.htm

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- The arrow shows that the sheep is a herbivore a mammal and not a member of the cat family.
- The problems with the student's Venn diagram are:
 - atoms on their own are all elements;
 - compounds are **not** mixtures; and
 - not all molecules are compounds, some are elements – eg O₂.
- The Venn diagram in question 4 is a good answer to question 3
- The answers are shown below. Can you think of more examples to test your friends where they should go on the diagram?



continued on page 2



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5. The substances with giant structures tend to have melting points. The answers are shown below. Can you think of more examples to test your friends where they should go on the diagram?

