

Chemical comparisons

Target level

This resource is a set of probes for use across the 11–19 age range.

Topic

These materials are designed to be open-ended. Although individual probes may be selected to match teaching topics, the materials may also be used to as a way of exploring the extent of students' ideas at various stages of a course.

Rationale

The materials ask students to suggest similarities and differences between various pairs of chemical systems presented as simple diagrams. This is one way of exploring a student's repertoire of chemical ideas - and although the focus is on what students can suggest, the exercise can provide evidence of glaring omissions as well as of alternative conceptions. The activity provides an opportunity for students to undertake a task with no single 'right' answer (although teachers will identify certain responses they would expect students to make at different ages), and thus provides scope for students to demonstrate creativity and lateral thinking. Students are also given the opportunity to indicate which responses they feel are important to chemistry to allow them to distinguish significant from trivial comparisons.

These ideas are discussed in Chapter 2 of the Teachers' notes.

Teachers may find their students providing only one or two responses. This is discussed in Chapter 7 of the Teachers' notes.

During piloting it was found that the probes revealed deeply held alternative conceptions, and revealed areas where students were confused. Students tended to find the activity challenging (perhaps indicating that students are more familiar with closed questions in science), but it provided a basis for valuable discussion. The activity was considered useful.

Instructions

The teacher should select one or more probes suitable for the age and knowledge base of the group. The probes may be set as individual work, or as the focus for group discussion. Probes 1–20 may be more suitable for pre-16 work.

Resources

- Student worksheets
 - Chemical comparisons

The worksheets invite comparison between:

1. Iron and sulfur
2. Water and sugar solution
3. Sea water and mercury
4. Particle models of gas and liquid
5. Particle model of liquid and particle model of solid
6. Salt crystal and sulfur crystal

RS•C

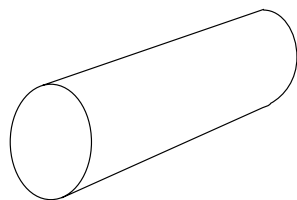
7. Ionic models of silver chloride and sodium chloride
8. Particle models of solid sodium chloride and sodium chloride solution
9. Bonding in carbon (diamond) and sulfur
10. Structural formulae of ethanoic acid and carbon dioxide
11. Formulae of sulfur and copper(II) sulfate
12. Electron shell model of fluorine and formula of hydrogen fluoride
13. Particle models of water and helium
14. Particle models of iron and sodium chloride
15. Models of bonding in carbon (diamond) and silver nitrate
16. Electron shell models of a sodium atom and a fluorine atom
17. Electron shell models of a hydrogen molecule and a hydrogen atom
18. Particle models of solid iodine and nitrogen gas
19. Particle models of iron and copper
20. Particle models of iodine and magnesium oxide
21. Electron cloud and electron shell models
22. Structural formula and electron cloud models
23. Different structural formulae (inorganic)
24. Different structural formulae (organic)
25. Electron cloud and structural formulae
26. Electron pair and free-radical mechanisms
27. Two electron cloud models
28. Reaction profiles for endothermic and exothermic reactions
29. Structural formulae of ketone and alkenal
30. Stereochemistry of PF_5 and CuCl_4^{2-}
31. Bonding of CF_4 and stereochemistry of CH_4
32. Structural formulae of halogenoalkanes
33. Electron shell diagrams for CF_4 and F_2
34. Displayed formulae for benzene and cyclohexene
35. Electron cloud diagrams for NH_3 and BCl_3
36. Structural formulae of ethanoic acid and ethanoic acid dimer

Feedback for students

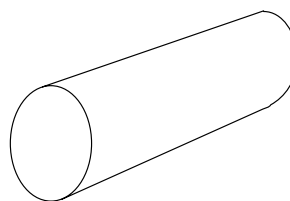
It may be useful to make OHP transparency copies of the probes used as a basis for discussing the comparisons with the class. Discussion should be based around sharing ideas rather than simply judging responses are correct or incorrect. It is suggested that all valid comparisons should be encouraged, but that those relating to key curriculum ideas should be emphasised.

Chemical comparisons

The two diagrams below show things you might study in chemistry. Think about how the things shown in the diagrams are similar and how they are different:



Iron



Sulfur

List the similarities and differences you can think of below.

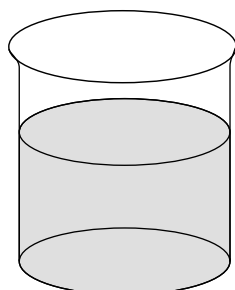
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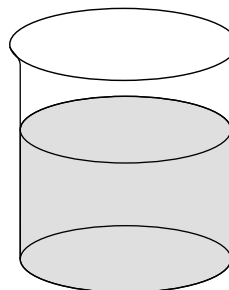
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Water



Sugar solution

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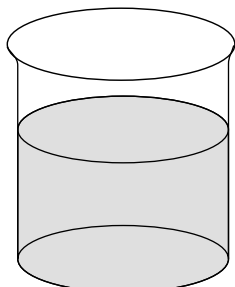
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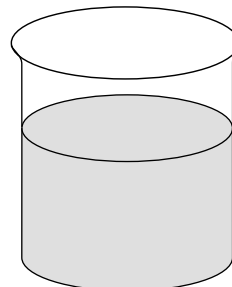
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Sea water



Mercury

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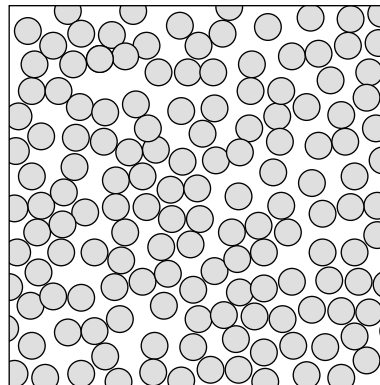
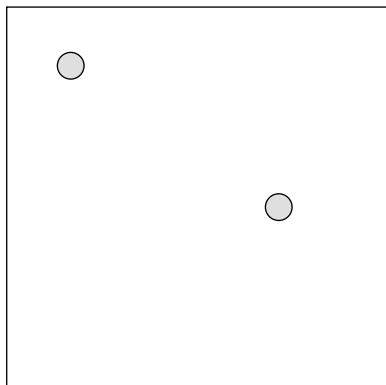
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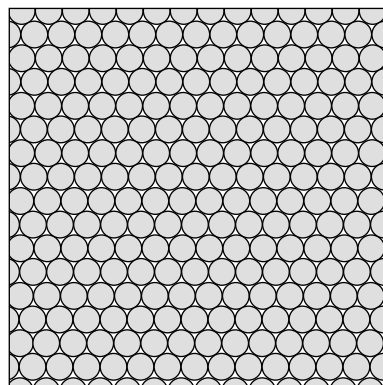
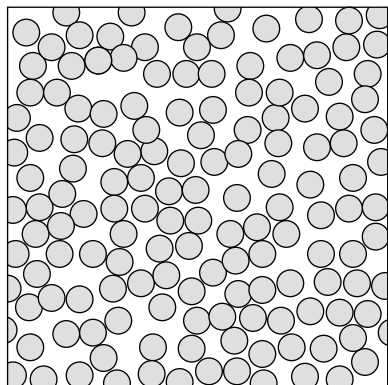
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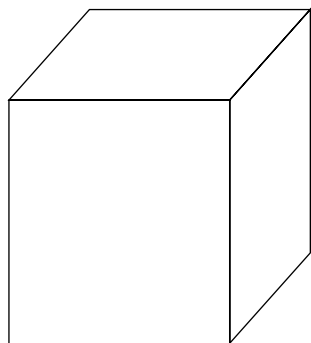
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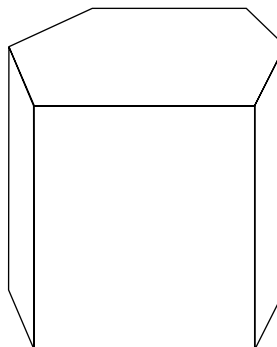
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Salt crystal



Sulfur crystal

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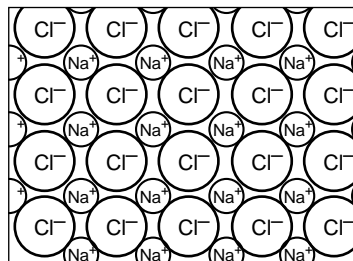
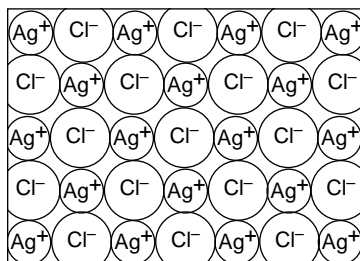
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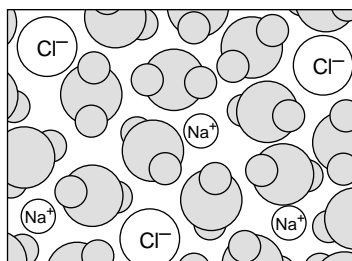
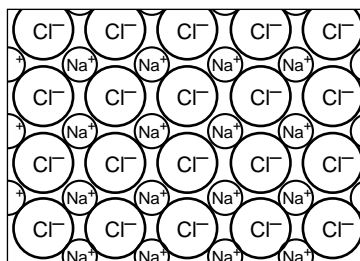
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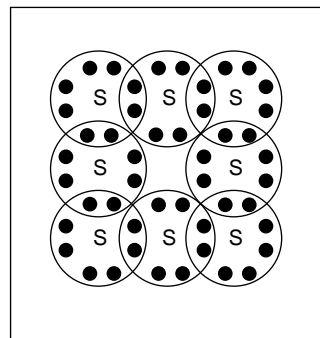
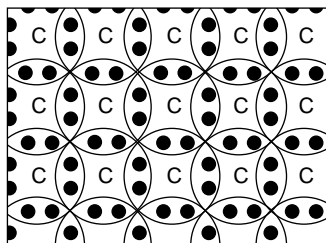
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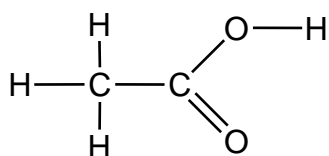
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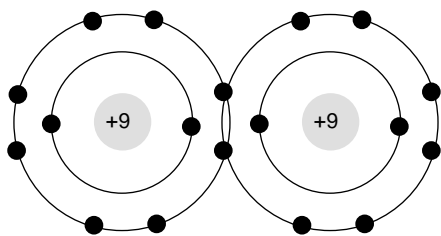
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Fluorine molecule



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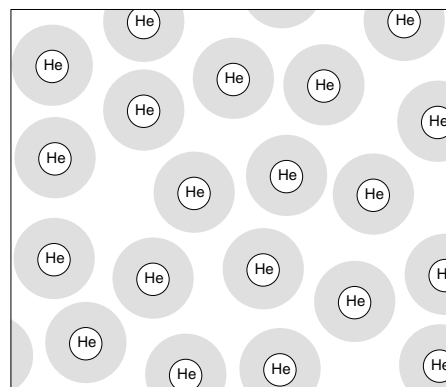
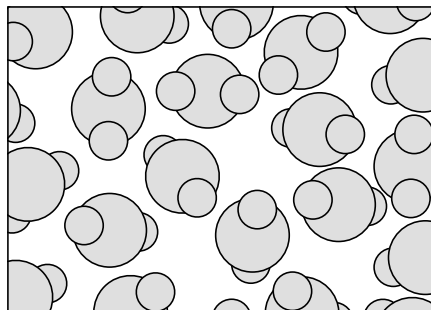
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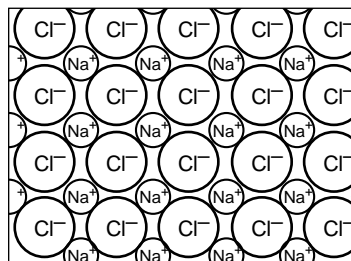
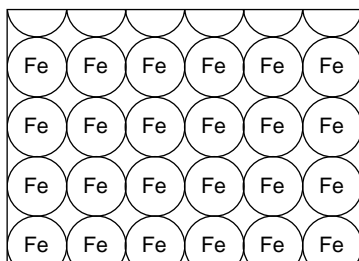
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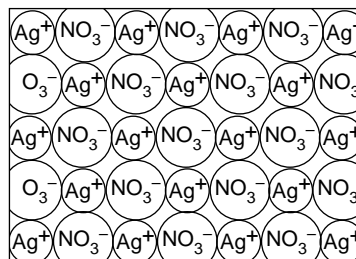
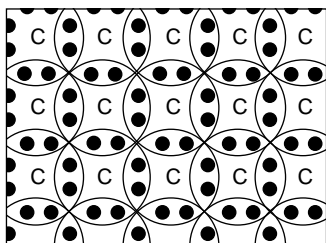
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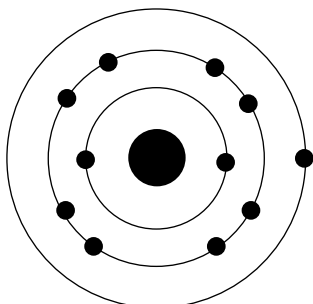
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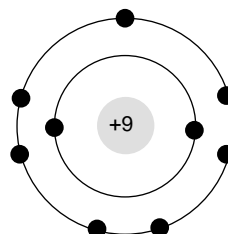
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Sodium atom



Fluorine atom

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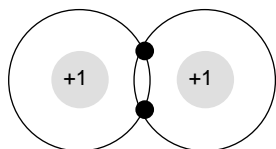
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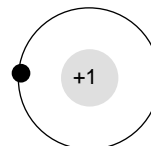
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Hydrogen molecule



Hydrogen atom

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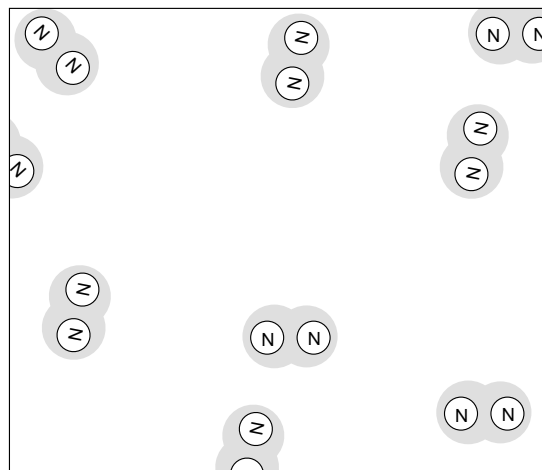
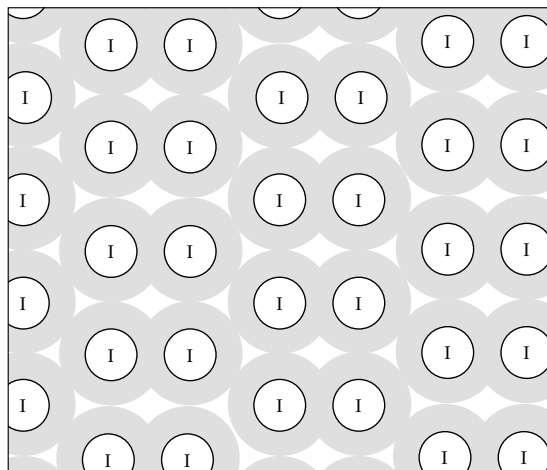
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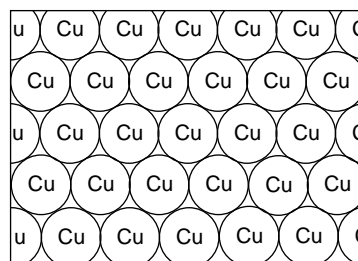
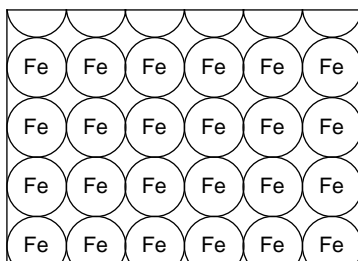
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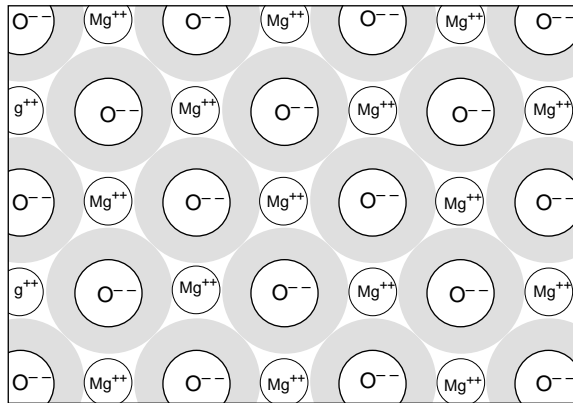
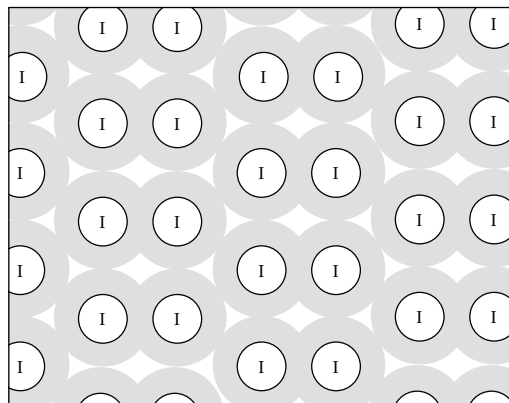
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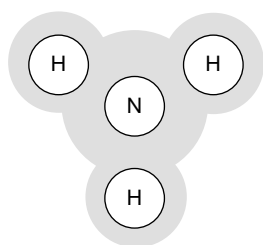
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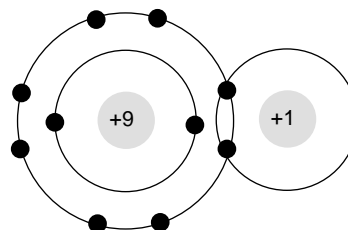
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Ammonia molecule



Hydrogen fluoride molecule

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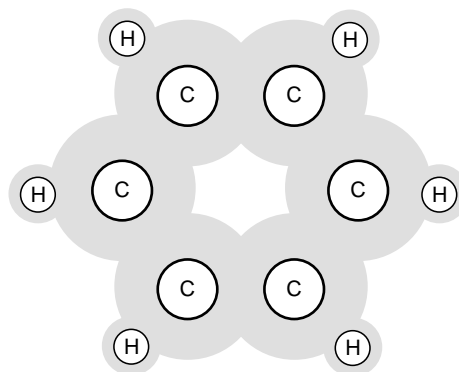
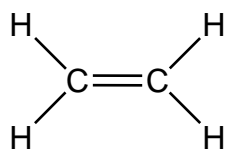
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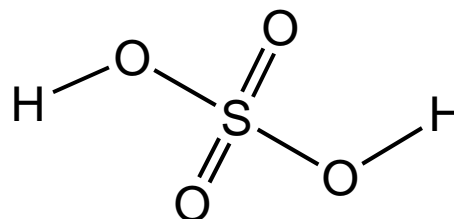
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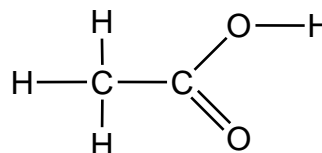
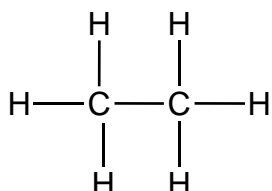
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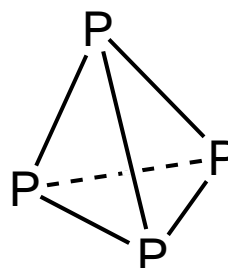
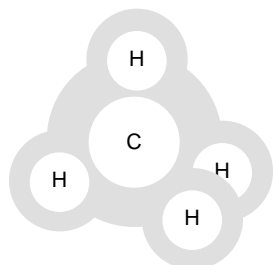
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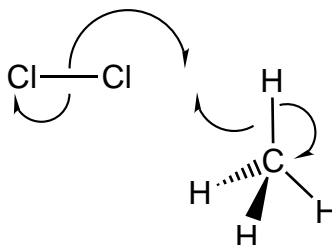
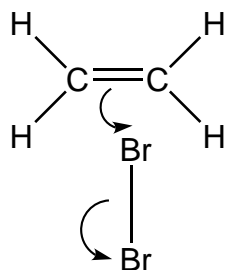
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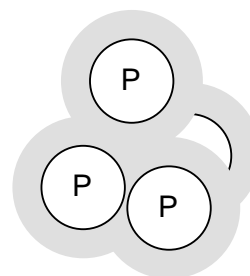
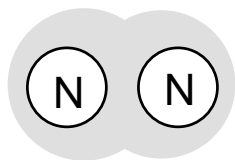
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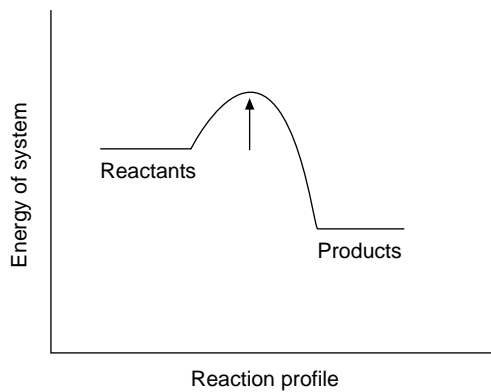
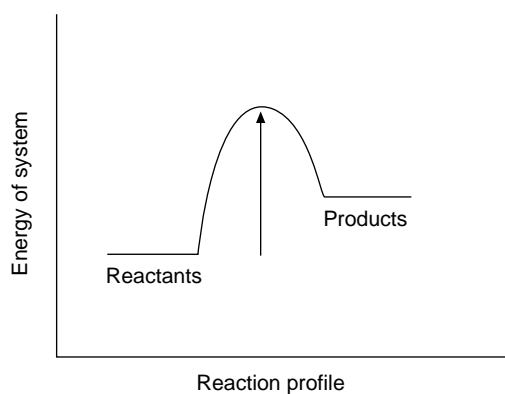
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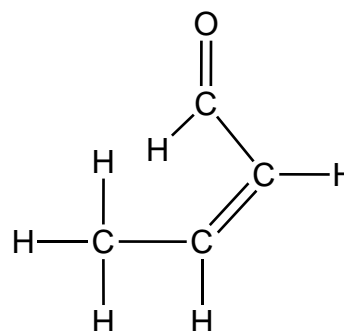
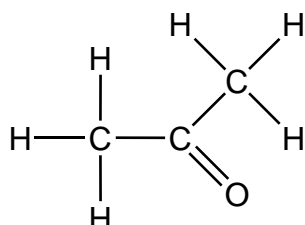
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Which of these similarities and differences do you think are important to chemists? Put a star symbol (*) in front of the important similarities, and the important differences.

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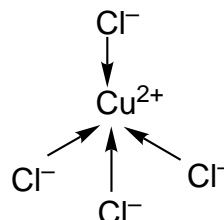
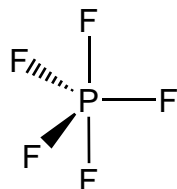
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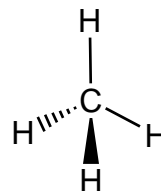
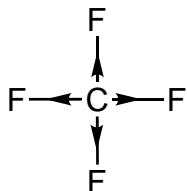
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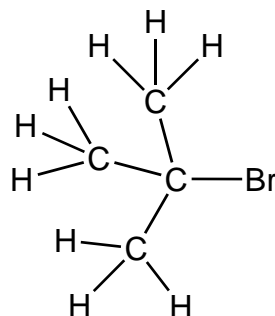
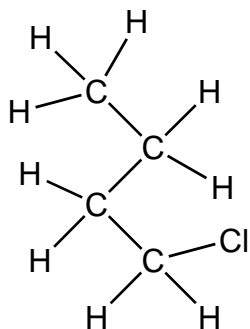
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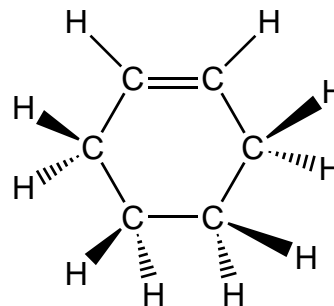
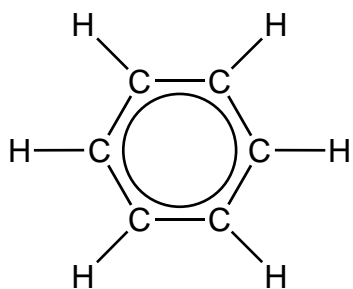
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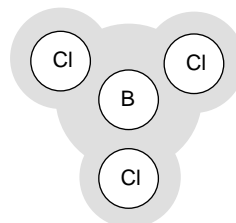
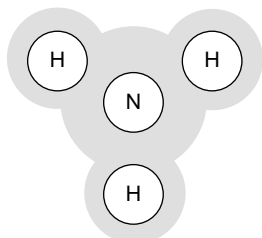
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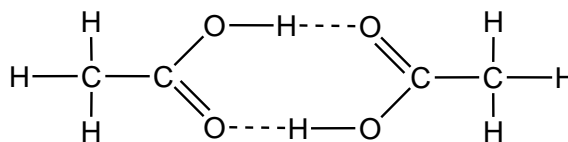
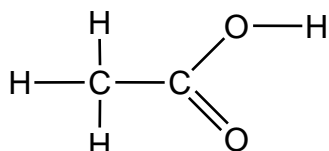
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