Student Sheet

In this practical I will be:

- Carrying out the practical, making careful observations.
- Accurately using key terms such as **mixture, emulsion, emulsifier, hydrophilic** and **hydrophobic.**
- Using my observations of the experiments to draw conclusions about the properties of the liquids used in the practical.
- Suggesting ways of creating an **emulsion** from two non-mixing, based on my observations of the experiment.

Introduction:

You are an ancient Egyptian science-artist, and you have heard of an up-and-coming artist whose new paints are causing quite a stir. Apparently he has been using lots of different minerals and other materials to create paints of amazing colours. However, when you tried to use these minerals in the past, you were unable to make a useable paint by just adding water. Apparently he adds a secret ingredient to his paint, and according to rumours it has something to do with chicken eggs. Like all good science-artists, you decide to investigate further…

Equipment:

- 6 small screw top bottles (100 cm^3) or test tubes and bungs
- 5 disposable (teat) pipettes – 1 for the water, 1 for the oil, 1 for the detergent 1 for the egg white and 1 for the egg yolk (it may be easier to use a spoon for the egg yolk)
- 3 teaspoons (or plastic disposable spoons)
- 2 cm^3 any cooking oil
- 2 cm^3 good quality detergent
- 10 g sugar
- 10 g flour
- 10 g mustard powder
- 1 egg
- 2 bowls (or 100 cm^3 glass beakers)
- Egg yolk separator (or separate using the egg shell)
- Plastic disposable gloves

Method:

Part 1

1. Using a (teat) pipette put about 2 cm^3 of oil into a screw top bottle (or test tube).

2. Using another (teat) pipette add about 2 cm^3 of water.
3. Put the top on tight or bung in.
4. Shake the mixture in the bottle/test tube for about a minute.
5. Record what you see by taking a photograph, draw a picture or write a sentence.
6. Remove the screw top/(bung and leave the mixture to stand for around 5 to 10 minutes.
7. Record what you see by taking a photograph, draw a picture or write a sentence.

8. Repeat steps 1 and 2 with a fresh bottle or test tube.
9. Add 2 cm^3 of detergent to the mixture of oil and water.
10. Put the screw top on/bung in tight.
11. Shake the mixture in the bottle/test tube for about a minute.
12. Record what you see by taking a photograph, draw a picture or write a sentence.
13. Remove the screw top/bung and leave the mixture to stand for
14. Record what you see by taking a photograph, draw a picture or write a sentence.

15. Repeat steps 1 and 2 with a fresh bottle/test tube.
16. Add half a teaspoon of sugar to the mixture of oil and water.
17. Put the screw top on/bung in tight.
18. Shake the mixture in the bottle/test tube for about a minute.
19. Record what you see by taking a photograph, draw a picture or write a sentence.
20. Remove the screw top (bung) and leave the mixture to stand for around 5 to 10 minutes.
21. Record what you see by taking a photograph, draw a picture or write a sentence.

22. Repeat steps 1 and 2 with a fresh bottle (test tube).
23. Add half a teaspoon of flour to the mixture of oil and water.
24. Put the screw top (bung) on tight.
25. Shake the mixture in the bottle (test tube) for about a minute.
26. Record what you see by taking a photograph, draw a picture or write a sentence.
27. Remove the screw top (bung) and leave the mixture to stand for around 5 to 10 minutes.
28. Record what you see by taking a photograph, draw a picture or write a sentence.

Part 2

29. Repeat steps 1 and 2 with a fresh bottle (test tube).
30. Add half a teaspoon of mustard to the mixture of oil and water.
31. Put the screw top (bung) on tight.
32. Shake the mixture in the bottle (test tube) for about a minute.
33. Record what you see by taking a photograph, draw a picture or write a sentence.
34. Remove the screw top (bung) and leave the mixture to stand for around 5 to 10 minutes.
35. Record what you see by taking a photograph, draw a picture or write a sentence.

36. Take the egg and break it into the egg yolk separator above a bowl. (Or separate the yolk from the white by passing the egg between the egg shells. The yolk will drain into the bowl or beaker while the egg yolk will stay in the shell you are holding. When separated place the egg yolk into a different bowl or beaker from the egg white.
37. Let the egg white drain through into the bowl
38. Put the egg yolk into another bowl

39. Repeat steps 1 and 2 with a fresh bottle (test tube).
40. Add about 2 cm^3 of egg white to the mixture of oil and water.
41. Put the screw top (bung) on tight.
42. Shake the mixture in the bottle (test tube) for about a minute.
43. Record what you see by taking a photograph, draw a picture or write a sentence.
44. Remove the screw top (bung) and leave the mixture to stand for around 5 to 10 minutes.
45. Record what you see by taking a photograph, draw a picture or write a sentence.

46. Repeat steps 1 and 2 with a fresh bottle (test tube).
47. Add about 2 cm^3 of egg yolk to the mixture of oil and water. (You may find it easier to use a spoon rather than a pipette for this).
48. Put the screw top (bung) on tight.
49. Shake the mixture in the bottle (test tube) for about a minute.
50. Record what you see by taking a photograph, draw a picture or write a sentence.
51. Remove the screw top (bung) and leave the mixture to stand for around 5 to 10 minutes.
52. Record what you see by taking a photograph, draw a picture or write a sentence.
53. Discuss the results and work out which out of detergent, sugar, flour, mustard, egg white and egg yolk, worked as an **emulsifier**.

Theory:

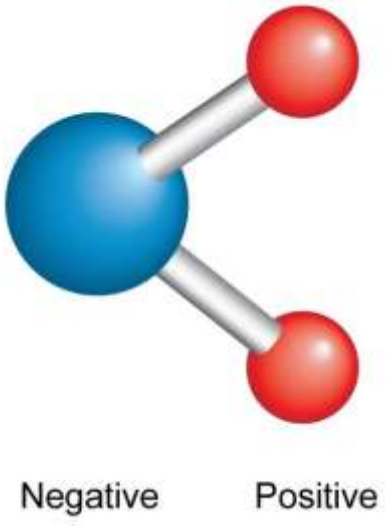
A range of substances commonly found in the kitchen can stabilise an oil and water **emulsion** (a mixture of one liquid dispersed in another liquid). Stabilise means the two liquids do not separate but remain mixed as a mixture called **colloid**. Colloids such as these are often found in foods. In paints some substances are added to allow the oil, pigment and other liquids to blend into an emulsion, hence the name emulsion paint.

An emulsifier is a substance that stabilises an emulsion. Detergent, egg yolk and mustard are emulsifiers, the others are not. Students may observe colloidal mixtures in the other bottles, but they are not oil and water emulsions and two separate layers should be clearly seen.

The oil and water mixed much better when the egg yolk was added. The protein lecithin, which is in the egg yolk, acts as an **emulsifying agent**. Emulsifying agents have regions on the molecule that act as a bridge between the oil and the water. The lecithin molecules in the egg yolk form a layer around the oil droplets and prevent the tiny oil droplets from coming together to make a separate layer. Because the oil is still separate from the water even with the egg yolk present, it cannot be a solution. The emulsion created is a dispersion of oil inside the water, with the egg yolk acting as an emulsifier.

Deeper level chemistry for secondary pupils

Water (H_2O) is a **polar molecule** meaning it has positively and negatively charged ends. This **polarity** is created because the **electrons** are attracted to the oxygen (O) **atom** (blue in diagram) of the molecule more than the hydrogen (H) atom (red in diagram). The density of electrons makes the oxygen slightly negative while the hydrogen will be slightly positive (see below).



The polarity means that water molecules can attract each other. When salt (sodium chloride) is put into water, it breaks down to form charged **ions**: a positively charged sodium ion (Na^+) and a negatively charge chloride ion (Cl^-). The water is attracted to the ions and surrounds them so the ions are mixed evenly throughout the water. We call this **dissolving**. So ions or molecules with a slight or strong charge can dissolve in water.

Oil does not have a polarity so it is not attracted to the water. Oil molecules will clump together. They are known as **hydrophobic** molecules from the Greek *hydro,* meaning *water*; *phobos*, meaning *fear*. Sugar does dissolve in water because it has a slight negative charge that is attracted to the water. Sugar is known as a **hydrophilic** molecule from the Greek *hydro* meaning *water*; *philia*, meaning *love*.