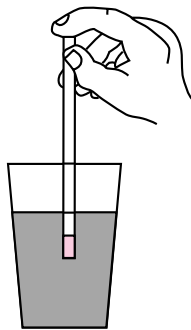


Team games: Liquid layers



60 mins

Students are introduced to the concept and skills of co-operative learning. They work in teams of three to investigate what happens when liquids of different densities are added to one another.



At a glance

Student book pages 1–4

- Introduce and explain team skills and team jobs.
- Demonstrate how to combine liquids.
- Introduce the team investigation.
- Form teams and allocate jobs.
- Students carry out the team investigation.
- Discuss questions in the student book.



Lesson outcomes

1 Students are aware of the skills that will help them to work in teams.

They show their awareness by:

- moving into their teams quickly and quietly;
- speaking softly;
- staying with their teams;
- taking turns; and
- doing their jobs.

2 Students understand that some liquids float on other liquids.

They show their understanding by describing the separate layers of liquids in their investigation and identifying the sequence of density of the liquids.



Equipment and preparation

For the class

team skills chart (BLM 6.1)

team jobs chart (BLM 6.2)

For class demonstration

4 clear containers (eg, plastic cups) labelled 1, 2, 3 and 4, holding salt solutions and water (see Preparation)

food colouring (green, red and blue)

1 clear or light-coloured plastic straw (or an eye-dropper)

1 container (eg, margarine), for waste liquids

Team investigation

For each team newspaper, to cover work area
 4 containers (eg, yogurt), each three-quarters full of one of the 4 liquids
 3 clear or light-coloured plastic straws (or eye-droppers)
 1 container (eg, margarine), for waste liquids
 3 coloured pencils (green, red and blue)
 3 A4 sheets of paper
 job badges for director, manager and speaker

Managers will find it easier to collect the equipment if you put the items for each team into a separate container.

Preparation To make the salt solution you will need:

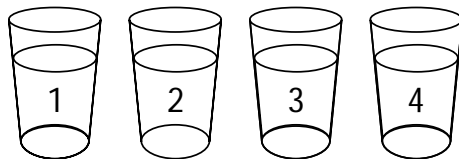
1 large container (eg, bucket)
 16 cups of boiling water
 4 cups (1 kilogram) of cooking salt
 1 large spoon, for stirring

- Add the salt to the water and stir until no more salt dissolves.

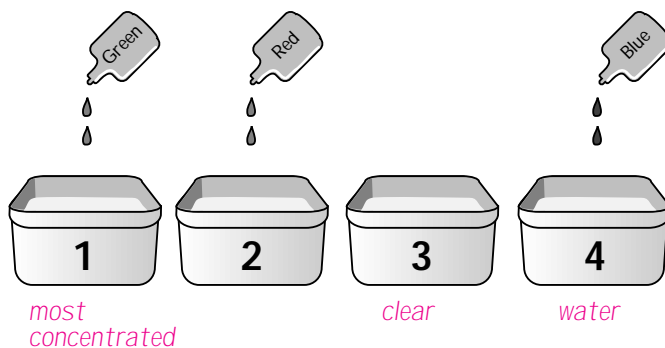
To prepare the liquids for the layers you will need:

4 containers (eg, 2-litre ice-cream) labelled 1, 2, 3 and 4
 16 cups of cold water
 food colouring (green, red and blue)

- Pour 8 cups of the salt solution into the container labelled '1'; 5 cups of the solution plus 3 cups of cold water into the container labelled '2'; 3 cups of the solution plus 5 cups of cold water into the container labelled '3'; and 8 cups of cold water into the container labelled '4'.
- For the class demonstration, set aside half a cup of each of these liquids (in numbered, clear containers). Do not add food colouring to them until the class demonstration.



- Add enough drops of the green, red and blue food colouring to the large containers to give the liquids a strong colour:



Three-quarters fill the containers for each team. Each team needs one container of each of the 4 liquids. (Teams' containers do not need to be numbered.)

This activity is likely to be messy so you may prefer to hold the lesson outside.

BLMs Make one copy of 6.1 and 6.2.



Teaching strategies

- 1 Introduce and explain the team skills chart and team jobs chart.
- 2 Show students the equipment table and discuss its use. Explain that this is where team managers will collect and return the equipment.

If students are using Primary Investigations for the first time, provide them with a full explanation of team skills and team jobs. Emphasise that each team member will contribute to the team investigations and that the team jobs will be rotated during the year.

Make sure students understand that only the manager of each team collects or returns equipment from the equipment table.

- 3 Display the small containers of colourless liquid and ask:

**Are these liquids all the same?
Why do you think so?**

Many students will suggest the liquids are the same because they look the same.

- 4 Explain that although the liquids look the same they are different, and that students are going to find out how they are different. Add drops of food colouring to the liquids:
- add green to container 1;
 - red to container 2;
 - blue to container 4.

Emphasise that the food colouring is not making the liquids different in any significant way, but is being used as a marker so that students can tell the liquids apart.

- 5 Hold up container 3 and ask students to predict:

What will happen if I add a drop of the red liquid to the clear liquid?

Demonstrate this procedure.

What will happen if I now add a drop of the blue liquid to the clear liquid?

Demonstrate this and ask:

What did you observe?

Encourage students to observe whether the coloured liquid sinks in the clear liquid. You may need to hold a piece of white paper behind the container so that students can see better.

The drop of red liquid should sink while the drop of blue liquid shouldn't.

- 6 Demonstrate how to use a straw to collect liquids. Dip the bottom end of the straw in the liquid, place a moist finger over the top end of the straw and lift it out of the liquid. Demonstrate this procedure several times. Then show students how to collect a second liquid in the same straw by following step 2 in the student book.
- 7 Outline the team investigation: *How can we find out which liquids make layers?*



- Form teams and allocate jobs.
- Ask managers to collect team equipment.

Remind students to wear their job badges. This makes it easier for you to identify which job each student should be doing—and easier for the students to remember what they and their team members should be

- 8 Ask students to carry out steps 1 to 5 in the student book.

If a team is having difficulty, ask questions such as:

What combinations have you tried?

Where have you recorded these?

What do you notice about the layers you've recorded?

What do you think would happen if you tried this sequence?

Can you see a pattern?

Encourage students to predict the effect of particular sequences. Prediction will challenge them to identify a pattern, and will indicate to you whether students have grasped the concept.

Step 1 Practise using your straw to collect one of the liquids. Remember that while your finger is firmly on the top opening of the straw, any liquid that is in it will stay there. Once you release your finger, the liquid falls out. The amount of liquid taken into the straw depends on how far you put the straw into the liquid.

Step 2 Collect two different liquids in your straw at once.

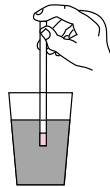
Do this by dipping your straw about 1 centimetre into the blue liquid.



Then place your finger firmly over the top of the straw and remove the straw from the liquid. One centimetre of blue liquid will remain in the straw.



Keep your finger on top of the straw and dip it about 2 centimetres into the red liquid.



Release your finger. One centimetre of red solution will move into the straw, pushing the blue layer up.



Again, put your finger over the top of the straw and remove it from the red solution. You will have a blue layer on a red layer.

When you want to discard the liquid, hold the straw over the empty container and take your finger off the top of the straw. The liquid will drop into the container.

Step 3 Repeat this procedure with different liquids.



Sometimes the two liquids will form layers, like this:

Sometimes they will simply mix together.

When you collect two liquids that form layers, draw the coloured layers on a sheet of paper.

When you collect two liquids that mix, write down the names of the colours and the word 'mixed'.

Step 4 Discuss the following with your team mates:

- ◆ The order in which you collect the liquids is important if you want them to make layers. Which sequence of liquids made layers, and which didn't?
- ◆ Do you agree with your team mates? If not, check it together.
- ◆ Do you think you can make three layers?
- ◆ Which colours do you think would make three layers? Draw them. (Remember to record them in the order you think they will form.)

Step 5 Now try it. Collect three liquids in the straw. (Remember to place your finger over the top of the straw as you lift it from one solution to the next.)

Do the three liquids mix together, make two layers, or make three layers?

If you make three layers, draw the coloured layers.

Make sure you record them in the right order.

9 When all teams have completed the investigation, discuss the questions in the student book:

- 1 Which liquid was always at the top of the colour stacks?

- 2 Which liquid was always at the bottom of the colour stacks?
- 3 Can you order the four liquids from bottom to top?
- 4 At the beginning of the lesson, the liquids all looked the same, but they are not. Apart from their colour, how are they different?
- 5 Which skills did your team perform well?
- 6 Which skills does your team need to practise?

10 Explain how you made up the four liquids and why they are different.



Background information

The four liquids have different densities. If equal volumes of them were weighed, their weights would be different. The liquid with the most salt in it is the densest (or heaviest); the unsalted water is the least dense. If the unsalted water is collected first, it stays at the top of the liquid stack.

If the liquids are collected into the straw in the wrong sequence, so that a denser liquid is collected before a less dense liquid, their relative 'weights' cause them to mix together.

If a layered stack of liquids is left for a time, the layers disappear. The motion of the molecules causes the layers to mix together by diffusion. The higher the temperature the faster this will happen, because the molecules will be moving more quickly.



Extensions

Students repeat the investigation with a set of different liquids, such as water, glycerine, cooking oil, motor oil and syrup. When the relative densities have been determined, the liquids can be poured gently down the side of a glass, starting with the densest liquid, until they form a layered stack in the glass.

Students collect three or four layers of liquid in a straw. They push the bottom of the straw into some plasticine to seal it and stand it in a cup. They investigate what happens to the layers if they leave them for a day or two. ☹