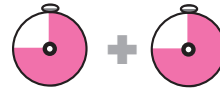
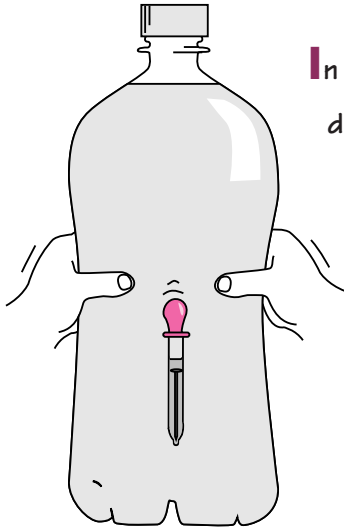


# Bottle divers



45 mins + 45 mins



In the first session, students make a bottle diver and decide what needs to be included in the system to explain how it works. In the second session, students apply the process of analysis to systems studied in earlier lessons.



## At a glance

Student book pages 9–14

### Session 1

- Demonstrate your bottle diver.
- Students carry out team investigation 1.
- Discuss the bottle-diver system.

### Session 2

- Discuss the 'analysis' process using the balloon rocket and 'dancing popcorn' systems.
- Students carry out team investigation 2.
- Teams explain their analyses.
- Discuss questions in the student book.

## Elaborate





## Lesson outcomes

- 1 **Students understand that systems are composed of parts that interact.**  
They show their understanding by explaining why the bottle diver is a system.
- 2 **Students are aware that analysis of systems helps them describe the interactions within a system more precisely.**  
They show their awareness by:
  - analysing the bottle-diver system; and
  - explaining how their analysis helped them answer questions about the system.



## Equipment and preparation

### Session 1 Team investigation 1

#### *For class demonstration*

a completed bottle-diver system (see Preparation)

#### *For each team*

- 1 eye-dropper
- 1 wide-mouthed jug (or bucket), three-quarters full of water *This could be shared by teams.*
- 1 small nail, to fit inside the eye-dropper
- 1 clear plastic 1-1.25-litre bottle with screw-top lid, full of water
- paper towels
- job badges for director, manager and speaker

**Preparation** Collect suitable bottles.

**M**ake a bottle diver by following steps 1 to 6 in the student book. It is crucial to get the eye-dropper to hang vertically in the water, with the rubber bulb just touching the surface. You will then only need to apply a moderate squeeze for the diver to sink. The nail is only added to the eye-dropper if you need to make it heavier. (It will rust if you leave it in the eye-dropper overnight.)

## Session 2

### For class demonstration

a 'dancing popcorn' system from Lesson 3 (optional)

### Team investigation 2

**For each team** each team's bottle-diver system  
writing paper

**Preparation** Teams will need a jug (or bucket) of water to reassemble their bottle-divers.



## Teaching strategies

### Session 1

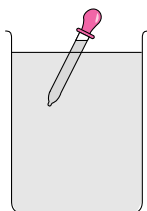
- 1 Demonstrate your bottle diver and explain that each team is going to make its own bottle diver.
- 2 Outline team investigation 1: *How can we make a bottle diver and find out if it is a system?*



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

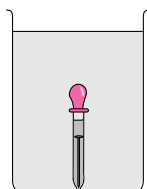
- 3 Ask students to carry out steps 1 to 7 in the student book. *When the teams begin to construct their bottle divers, make sure that their bottles are full of water.*

**Step 1** Use the water in the jug to fill the eye-dropper.

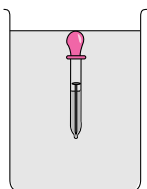


Squeeze the rubber bulb.

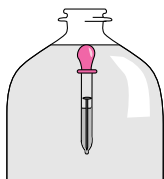
**Step 2** Put the eye-dropper in the jug. If it does not sink, remove the rubber bulb and put a nail inside the eye-dropper. Put the rubber bulb back on, refill the eye-dropper with water and put it back in the jug. It should now sink.



**Step 3** Take the eye-dropper out of the jug and squeeze out a few drops of water. Test to see if the eye-dropper will float upright, with the rubber bulb just touching the surface of the water. If it still sinks, squeeze out more water and test it again. Keep testing until the eye-dropper floats upright.



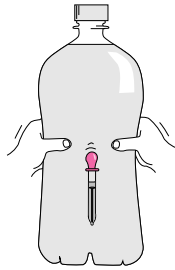
**Step 4** Put the eye-dropper in the bottle of water.



**Step 5** Screw the lid tightly on to the bottle.

You have now made a bottle-diver system.

**Step 6** Squeeze the sides of the bottle with both hands. Squeeze hard. Observe what happens to the eye-dropper.



Caution: **Do not squeeze the bottle unless the lid is screwed right down.**

Make sure each team mate has a turn at squeezing the bottle.

**Step 7** Discuss whether or not you think the bottle diver is a system.

Does it have parts? If so, what are the parts? Do the parts interact?

**4** When students have finished the investigation ask them to remove the nails from the eye-droppers. Show students where to store their equipment for the next session.

**5** Discuss: **Is the bottle diver a system?**

*Students should say it is a system. It has parts such as the eye-dropper, water and bottle. The parts interact to make the eye-dropper dive. Each part separately would not make this happen.*

*Do not expect students to be able to explain why the eye-dropper rises and falls. After they have analysed the system during the second session, they should have a better understanding of this system.*

## Session 2

### 6 Read 'Introducing analysis' in the student book.

When you separate a system into its parts to understand it, you are analysing the system. People do not always take a system apart physically to analyse it. They take the system apart in their minds—they think about it. When you named the parts of the bottle-diver system, you took it apart in your mind. You started to analyse the system.

One way to analyse a system is to:

- observe the system (see what is happening)
- ask questions about what you see happening
- describe how you can tell that things are interacting (the evidence of an interaction)
- identify the parts of the system
- answer the questions you asked about the system earlier.

Do you remember the balloon rocket system in Lessons 1 and 2? If you wrote down your analysis of that system, it might look something like this:

Balloon rocket system

I observed that I had to blow up the balloon to make the rocket go.

I observed that the balloon got smaller as the rocket went along.

I observed that the rocket followed along the fishing line.

What made the rocket go?

The evidence for an interaction between the air in the balloon and the rocket is the first two observations above, the evidence for an interaction between the rocket and the string is the third observation.

The necessary parts of the system are the balloon, the air inside it, the straw and the fishing line.

The answer to the question is that the air coming out of the neck of the balloon makes the rocket go, and the string guides it.

You may see that this analysis follows the same set of steps suggested earlier:

- observe
- ask questions
- describe the interactions
- identify parts of the system
- answer your questions.

**7** Analyse the balloon rocket system from Lessons 1 and 2.

Ask:

**What did you observe happening in the balloon rocket system?**

**How did you know that some parts of the system interacted?**

**What are the parts of the system?**

**8** Repeat this analysis with the 'dancing popcorn' system from Lesson 3.

*It may be an idea to demonstrate this activity again.*

**What did you observe about the popcorn when you added the vinegar?**

*Students should describe, as accurately as possible, what they observed. You could summarise their comments on the board, for example: 'popcorn rose and fell', 'bubbles on glass', 'bubbles on popcorn', 'bubbles popped at the top'.*

**What questions can you ask about this system? Can you answer them by observing the 'dancing popcorn' system closely?**

*If students included questions in their observations, write those questions on the board as well.*

**What evidence can you give to show that interactions occurred?**

*Evidence of interactions should focus on what changed or moved.*

**What are the parts of the system?**

*The parts of the system include the water, the popcorn and the bubbles. They could also include the cup, the bicarbonate of soda and the vinegar.*

As you do the analysis with the class, write the stages up on the board and summarise the students' answers.

- 9 Outline team investigation 2: *How can we analyse the bottle-diver system?*



Ask managers to collect team equipment.

- 10 Ask students to carry out steps 1 to 6 in the student book.

**Step 1** Observe what happens in the bottle-diver system.

Squeeze the bottle, make the eye-dropper dive, and continue to observe the system.

**Step 2** Write down some of the questions your team has about the bottle-diver system.

**Step 3** Describe the evidence that parts of the system interacted. How do you know that some parts of the system interacted with others? What happened?

**Step 4** List the parts of the system.

**Step 5** Use your observations to answer the questions you asked in step 2.

In your answers, use the parts of the system and the interactions that you identified.

**Step 6** Discuss these questions with your team mates.

How did analysing help you answer a question about the bottle-diver system?

Did identifying the interactions between the parts help you?

Did you find any new parts you did not observe at first?

11 Ask teams to explain their analyses.

*Expect students to identify anything they mentioned in their observations as parts of the system. For example, if students observed that the amount of air in the eye-dropper changed, they should include the air in the eye-dropper as part of the system.*

*Students should be able to state that analysis of systems can help them answer questions, make more accurate predictions and solve problems.*

12 Discuss the questions in the student book:

- 1 In what ways is analysing a system useful?
- 2 Is your team a system? What are the parts of your 'team system'?
- 3 How could you improve the interactions between the parts of your 'team system'?



## Background information

When the bottle is squeezed the volume of the bottle decreases so more water is forced into the eye-dropper. As a result, the eye-dropper becomes heavier and sinks. Comparison can be made with the operation of a submarine, which increases or decreases its weight by taking water into its ballast tanks or forcing it out.



## Extensión

Students use library resources to read about submarines and divers. 🌀