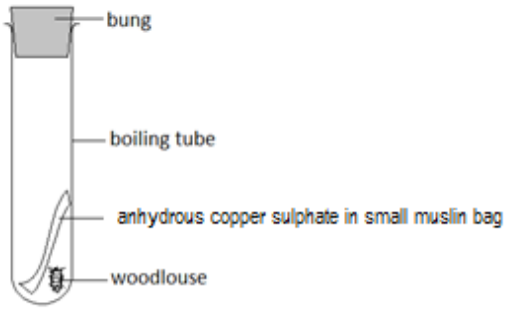
Claim A: Woodlice must spend time in damp, dark places in order to survive, because they lose moisture from their bodies.

Demonstration 1

Anhydrous copper sulphate turns blue in the presence of water. The copper sulphate was white when it was placed in the container with the woodlice.



To answer

1 If the claim is correct, what would you expect to see?

Now make your observations.

2 What are your observations?

3 What does this tell you about the woodlice?

4 How would this affect the survival of woodlice in damp or dry environments?

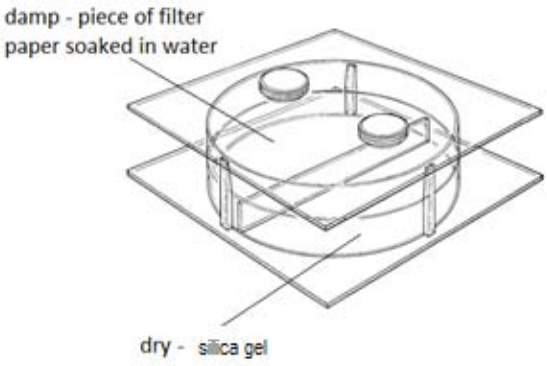
Claim A: Woodlice must spend time in damp, dark places in order to survive, because they lose moisture from their bodies.

Demonstration 2

A choice chamber allows you to change conditions in different parts of a container and see how organisms respond.

This choice chamber has been set up with water on one side and a desiccant (drying agent) on the other. This creates a condition gradient of damp to dry.

The cover of the choice chamber is obscured to create dark conditions.



The choice chamber has been left to equilibrate (to allow conditions to become stable) before introducing the woodlice. The woodlice were introduced through the hole in the centre of the lid or cover, in a way that did not favour either end of the condition gradient.

To answer

1 If the claim is correct, would you expect to see more woodlice in the damp-dark chamber, or more in the dry-dark chamber?

Now make your observations.

2 What are your observations?

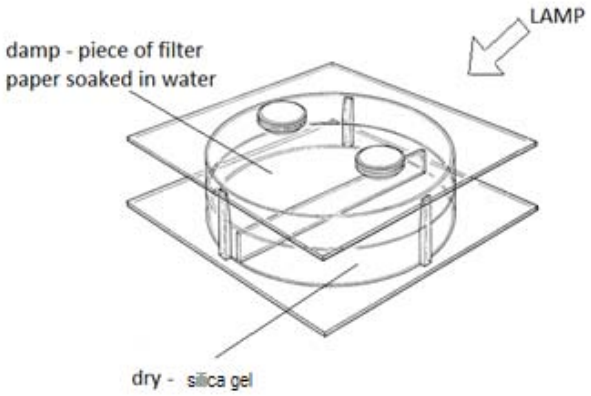
3 What does this tell you about the places where woodlice are usually found?

Claim B: Woodlice will settle in brightly-lit areas as long as the air around them is damp.

To do

1 A choice chamber has been set up for you with water on one side and a desiccant (drying agent) on the other. It has been left to equilibrate.

2 Position a lamp so that it illuminates the choice chamber and both sides are brightly lit.



3 Place 10–20 woodlice in the choice chamber.

4 Observe their final positions. The woodlice are likely to slow down after about 5–10 minutes.

4 Analyse the results. What do your observations tell you about the conditions in which woodlice will settle?

To record

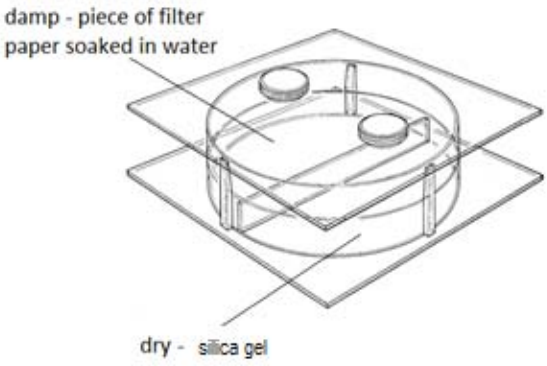
Record what you did and the evidence you collected. Use this evidence to argue for or against the claim.

Remember to think about what makes a good scientific argument.

Claim C: If conditions change, woodlice tend to move to a new, more suitable place because they move around more in dry conditions and slow down when they reach a damper area.

To do

1 A choice chamber has been set up for you with water on one side and a desiccant (drying agent) on the other. It has been left to equilibrate.



2 Place one or two woodlice in the choice chamber. Each woodlouse needs a different observer. If two woodlice are used it helps if they look different and you can tell them apart, even if they move close to one another.

3 Monitor the movement of each woodlouse, for about 5 minutes, using method 1 or method 2.

Method 1: Place a piece of acetate on top of the choice chamber and trace the path the woodlouse takes, marking its position every 30 seconds.

Method 2: Place graph paper beside the choice chamber and estimate the woodlouse's position every 30 seconds, joining the dots to show the woodlouse's track in the choice chamber.

4 Analyse the results.

- Where do the woodlice move quickly?
- Where do the woodlice move slowly?
- Where do the woodlice end up?

To record

Record what you did and the evidence you collected. Use this evidence to argue for or against the claim.

Remember to think about what makes a good scientific argument.

Arguing for or against a claim

A good scientific argument will use evidence to justify a claim or conclusion.

Things to think about when developing a scientific argument are:

- Have you clearly stated the claim?
- Have you linked the claim to the available evidence?
- Have you explained whether the evidence supports the claim?
- Have you suggested what other claims could be made based on the same evidence?
- Have you explained why your argument is stronger?

Based on the evidence available, write down an argument for or against the claim you are evaluating.

Learning structure of the lesson

The big picture

This lesson is designed to exemplify an argumentation approach to practical work, using a 'predict, observe, explain' framework.

Students make observations about the places where woodlice are usually found and use this evidence to evaluate various claims about woodlouse behaviour. They discuss how a claim (or idea) is supported by evidence (or data) and develop arguments based around these claims.

The students' focus during the practical work should be on using the evidence collected to evaluate these claims, rather than on the practical methodology.

Age range: 16–18
(could be used with high-ability 14–16)

Timing: 50 minutes
(with more time the lesson could begin with viewing woodlice in their natural habitat)

Learning episode 1 (teacher-led) 5 mins

Use the video to show students the kinds of places where woodlice are typically found. Discuss students' thoughts about the questions posed at the end of the video.

Share the learning outcomes for the lesson.

Learning episode 2 (student-led) 15 mins

Students consider a claim about woodlice behaviour and discuss how they might evaluate it. They work in groups to collect data and summarise their findings.

Students discuss whether they agree or disagree with the claim and why. Some feedback to the class. Encourage others to ask questions and challenge students to justify their arguments. Explain what makes a good scientific argument.

Learning episode 3 (teacher-led) 15 mins

Students consider a second claim about woodlice behaviour and discuss how they might evaluate it. They work in groups to collect data and summarise their findings.

Students discuss whether they agree or disagree with the claim and why. They then work individually to write down their argument, including a comment on the value of the evidence.

Learning episode 4 (student-led) 15 mins

Students reflect on what makes a good scientific argument.

Learning outcomes

Students will be able to:

- recall the habitats in which woodlice are found
- collect evidence to investigate claims about woodlouse behaviour
- describe woodlouse behaviour that results in their being found in damp dark places
- collect evidence to investigate claims about woodlouse behaviour
- evaluate the degree of confidence in the claim by assessing the reliability of the data and relevance of the data to the claim

Equipment and materials

Teacher guidance

Practical guidance

Slide presentation

Video

Student sheets

Collection of around 200 woodlice from local habitat

Dry boiling tubes with bungs

A muslin bag containing anhydrous copper sulphate (turns blue as it absorbs water)

Boiling tube racks

Choice chambers

Filter papers

Silica gel (a safe, solid desiccant)

Opaque cover – to make areas of the choice chamber dark

Lamps

Stopwatch

Piece of OHP acetate, large enough to cover the choice chamber, or graph paper

OHP or other pens

Refer to the health and safety advice and practical guidance

Key words

Habitat, argument, conclusions, claim, evidence/data

Prior knowledge

It is assumed that students know the following.

- Simple reflex behaviours ensure survival of simple animals.

Background information

Terrestrial animals lose water from their bodies readily in warm (especially warm and dry) conditions. Animals can only survive where they can maintain a steady level of water in their bodies (dehydration is fatal to most animals). All terrestrial animals have adaptations (anatomical, biochemical or behavioural) that allow them to maintain a suitable level of water in the body.

Woodlice are terrestrial crustaceans, a body-form otherwise only found in aquatic organisms. In their natural environment, woodlice are found in damp, dark places (e.g. under stones and amongst rotting wood/leaf litter). They dry out quickly in dry air (e.g. in the open and/or in bright sunlight).

A choice chamber can be used to demonstrate that damp is more important to woodlice than dark – they will accumulate in damp, bright places in preference to dry, dark places.

Simple organisms have simple reflex actions. These reflex actions increase the organisms' chances of survival. For example, woodlice are more active in dry conditions and less active in damp conditions. Simple reflex responses of an organism could be a taxis (movements towards or away from stimuli) or kinesis (overall movement caused by increased activity in certain situations). Woodlice show positive photokinetic and negative hygrokinetic responses.

Using a choice chamber, you can observe how quickly woodlice move in different conditions and gather evidence which shows that they move around more in dry conditions than in damp. The increase in frequency of movement and change in direction (kinesis) is a simple reflex behaviour that ensures woodlouse survival.

Note that students can sometimes associate dark, cold and damp, and similarly light, warm and dry and fail to see them as three distinct factors.

Note also that woodlice can demonstrate a clumping/aggregation behaviour, which may affect results, when more than one woodlouse is placed in a choice chamber at the same time. This may need to be discussed with students if it affects results.

Terminology

The terms which students need to understand and use in this lesson are:

habitat – the place where an organism lives

argument – the process that students use to articulate, support and justify claims or conclusions

claim – a conclusion, idea, proposition or assertion

evidence/data – the observations and accepted scientific theories used to support the claim

Differentiation

With more time the lesson could include collecting more evidence and arguing more claims. Students could discuss how to test the claims and design a practical, or carry one out. Further claims which could be explored by practical work are suggested here.

Claim: Moisture is more important to woodlouse survival than darkness.

Suggested method: Set up four choice chambers, with the conditions indicated in the table below. Introduce woodlice into the central hole, or equal numbers into each half/quadrant. Leave for 20 minutes then count the woodlice in each area.

What pattern of woodlouse distribution would you expect if darkness is more important? What about if moisture is more important?

	Choice chamber 1		**Choice chamber 2**		**Choice chamber 3**		**Choice chamber 4**	
Conditions	all light		all dark		light	dark	light	dark
	dry	damp	dry	damp	all dry		all damp	
Number of woodlice in each area								

Claim: If conditions change, woodlice can move to a new, more suitable place by moving towards moisture or away from strong sunlight.

Optional extension activities

Explore the survival value of other simple reflexes (e.g. earthworm twitch, human pupil reflex, human newborn reflexes, other instinctive/ reflex animal responses). See the Practical Biology experiment 'Changes in earthworm responsiveness'.

Related practical activities on Practical Biology

Using a choice chamber to investigate animal responses to stimuli:

www.nuffieldfoundation.org/practical-biology/using-choice-chamber-investigate-animal-responses-stimuli

Changes in earthworm responsiveness:

www.nuffieldfoundation.org/practical-biology/changes-earthworm-responsiveness

Lesson details

Video

Task: If possible, students should observe woodlice in a natural habitat in the school grounds and collect some for investigation.

This could be plenary to a previous lesson, or a short lunchtime activity. This could be a task for a selected group of students (one representative from each working group for this lesson) who can then describe their observations in detail to the rest of the group.

Task: Show the **video** (which shows the kinds of places woodlice are found in a garden) and ask students to think about the questions posed at the end.

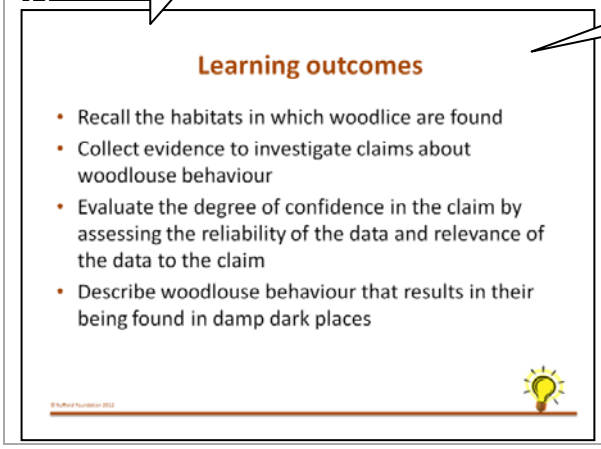
Task: Discuss as a class the answers to these questions.

If observation of woodlice in their natural habitat has taken place these observations can be included in this discussion.

Students may talk about the availability of food in these damp, dark places. Explain that woodlice eat rotting vegetation, particularly wood and dead leaves, and the organic matter in soil and compost.

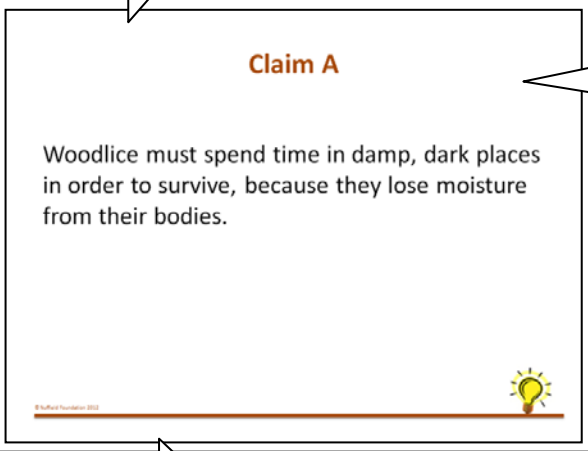
Explain: Explain that woodlice are crustaceans. They breathe through air-holes in their external skeleton and this system stops working if woodlice dry out.

Slide 2



Task: Share the learning outcomes for the lesson using **slide 2**.

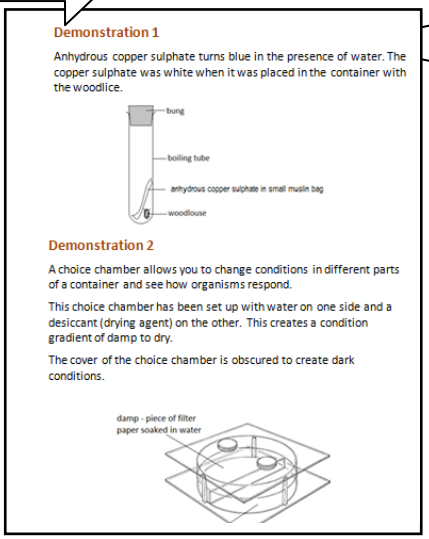
Slide 3



Task: Students consider Claim A (**slide 3**). Ask students how they might decide whether or not the claim is correct. Discuss the importance of evidence (data/observations) in supporting or refuting a claim.

Explain: Explain that students will now collect some data in order to evaluate this claim.

Practical



Task: Put students in groups of four (two pairs) to make observations on the demonstration experiments (see **Practical guidance** and **Student sheet**).

One pair from each group goes to observe the woodlice with anhydrous copper sulphate (demonstration 1). The other pair goes to observe the dark-damp/dark-dry choice chamber (demonstration 2).

Students should observe in demonstration 1 that the anhydrous copper sulphate is blue, and deduce that the woodlice are losing moisture from their bodies.

Students should observe in demonstration 2 that most woodlice are found in the damp area.

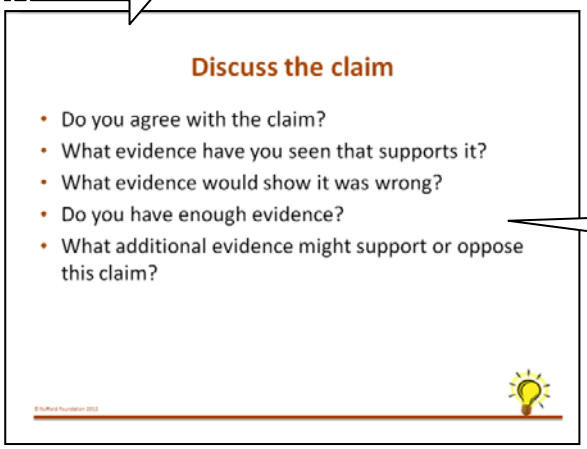
Task: Students return to groups of four to share their observations, and write a 'tweet' on a post-it note to summarise their findings. Post-it notes to be stuck at the front of the class.

Task: Restate Claim A and ask students to discuss in their groups for 1 minute whether they agree with the claim or not and why.

Task: Get a few groups to present their argument and other groups explain whether they agree or disagree and why.

Encourage students to hold differing views, but they must explain their reasons. They should focus on the evidence and whether or not it is adequate to support the claim.

Slide 4



The evidence **does** show that woodlice spend time in damp places. It also shows that they lose moisture, suggesting that in dry places they will dry out (dehydrate). However, the evidence **does not** show that they will not survive elsewhere.

Misconceptions, or statements which appear to contain misconceptions, (e.g. woodlice *prefer/want to go to* damp places) should be challenged. 'How do you know what a woodlouse wants?'

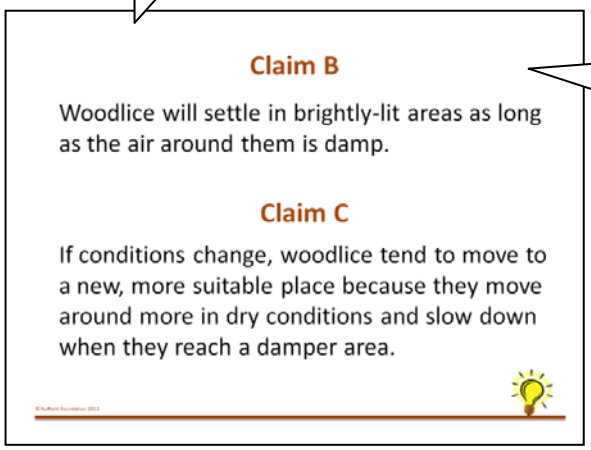
Task: Teacher supports the discussion by keeping focus on these questions on **slide 4.**

The teacher could get involved as devil's advocate by offering a personal opposing view such as:

- 'I think they would survive perfectly well in the dry – but their food is in dark damp places.'
- 'Losing a little bit of moisture isn't a problem – so long as they can find some water to drink later.'
- 'I'm not convinced by your explanation because...'

Explain: Explain that we can successfully argue for a claim when we have evidence to support it. We would argue against someone else's claim if we didn't accept their evidence, or didn't agree that the evidence really does support the claim, or have evidence to support a counter-claim.

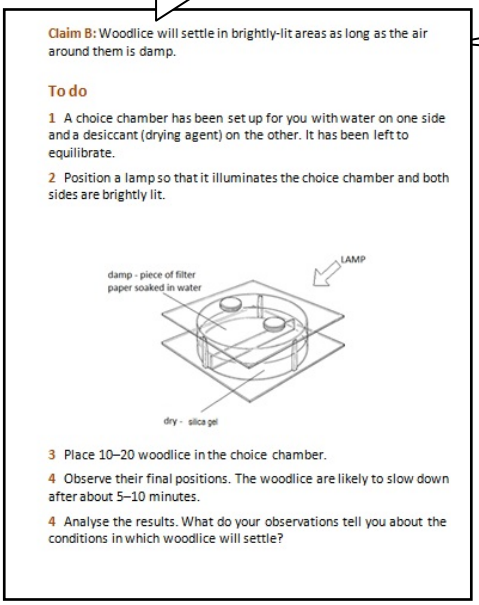
Slide 5



Task: Present each group with either Claim B or Claim C. These are shown on **slide 5**. Ask students how they would go about evaluating these claims, and ensure they understand the importance of evidence.

Differentiation: Claim C is more challenging and may be best presented only to selected groups.

Student sheet



Claim B: Woodlice will settle in brightly-lit areas as long as the air around them is damp.

To do

1 A choice chamber has been set up for you with water on one side and a desiccant (drying agent) on the other. It has been left to equilibrate.

2 Position a lamp so that it illuminates the choice chamber and both sides are brightly lit.

3 Place 10–20 woodlice in the choice chamber.

4 Observe their final positions. The woodlice are likely to slow down after about 5–10 minutes.

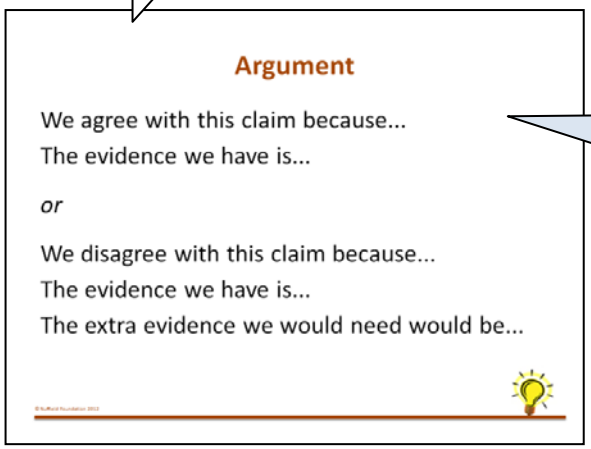
4 Analyse the results. What do your observations tell you about the conditions in which woodlice will settle?

Task: Students follow the practical procedures on the **Student sheet** to collect evidence to decide whether they agree or disagree with the claims.

Claim B can be tested by putting several woodlice in damp-bright/dry-bright choice chamber and observing final positions. (See **Practical guidance** for practical 1). The woodlice are likely to congregate in damp rather than dry when brightly lit and may congregate on top of one another.

Claim C can be tested using a dry/damp choice chamber, and by monitoring movement of individual woodlice introduced one at a time into the central hole. (See **Practical guidance** for practical 2). Woodlice do move more quickly in dry conditions, and more slowly in damp. This is the reflex response that results in their accumulation in damp areas.

Slide 6



Argument

We agree with this claim because...
The evidence we have is...

or

We disagree with this claim because...
The evidence we have is...
The extra evidence we would need would be...

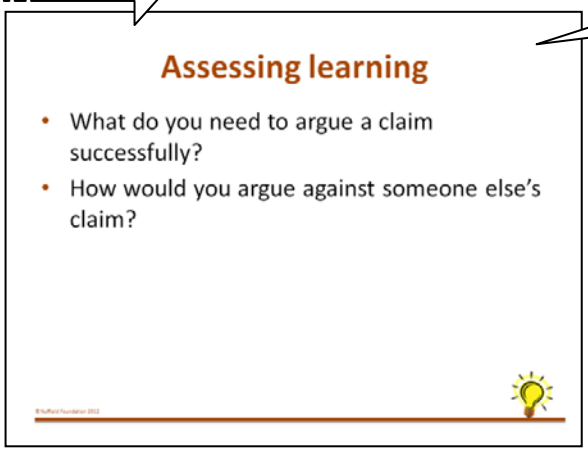
Task: Having collected their evidence, students discuss in their groups whether they agree or disagree with the claims and why.

Differentiation: Provide the prompt questions (**slide 6**) for those students who feel they need further support in developing their arguments.

Task: One group presents their argument and other groups explain whether they agree or disagree and why.

Students then work individually to write down their argument explaining their decision to support or deny the claim, including a comment on the value of the evidence. Use **Student sheet** page 5 which provides guidance on developing a good scientific argument.

Slide 7



Task: Ask students the questions on **slide 7** and discuss the answers as a class.

We can successfully argue for a claim when we have evidence to support it.

We would argue against someone else's claim if we didn't accept their evidence or didn't agree that the evidence really does support the claim or have evidence to support a counter claim.

Equipment and materials

Per class

Collection of woodlice from local habitat – around 200 woodlice needed

Demonstration 1

Per station

Dry boiling tube with bung
A muslin bag containing anhydrous copper sulphate (turns blue as it absorbs water)
Boiling tube rack

Demonstration 2

Per station

Choice chamber
Filter paper – as moisture reservoir
Silica gel (a safe, solid desiccant)
Opaque cover – to make areas of the choice chamber dark

Class practical 1

Choice chamber
Filter paper – as moisture reservoir
Silica gel (a safe, solid desiccant)
Lamp

Class practical 2

Choice chamber
Filter paper – as moisture reservoir
Silica gel (a safe, solid desiccant)
Piece of OHP acetate, large enough to cover the choice chamber, or graph paper
OHP or other pens
Stopwatch

Health and safety and technical notes

Before carrying out these practical activities, users are reminded that it is their responsibility to carry out a risk assessment in accordance with their employer's requirements, making use of up-to-date information.

Read our standard health & safety guidance.

1 The choice chambers and boiling tube need to be set up in advance of the lesson.

2 Choice chambers are expensive and not readily available. Many schools will substitute Petri dishes. If a standard 9cm Petri dish is used, this is too small for 20 woodlice. In this case it would be sensible for students to investigate with a much smaller number of woodlice. This would also mean less of a problem with obtaining the animals. Choice chambers are available from TIMSTAR at a price of 7 for £35+ VAT and £12 + VAT per square metre for mesh to make the woodlouse platform (prices correct at end 2012): www.timstar.co.uk

3 Detailed instructions for handling woodlice, collecting and keeping woodlice are at

www.nuffieldfoundation.org/practical-biology/using-choice-chamber-investigate-animal-responses-stimuli

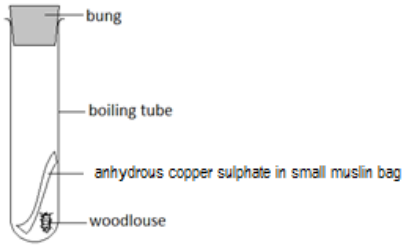
Detailed instructions for setting up choice chambers are at www.nuffieldfoundation.org/practical-biology/using-choice-chamber-investigate-animal-responses-stimuli.

4 Woodlice are very difficult to obtain for much of the school year. In the late autumn through to early summer, woodlice availability in the natural environment is very low. Woodlice can be purchased from suppliers, but this removes the possibility of students finding woodlice themselves. Blow fly larvae can be used in place of the woodlice, but they have very different responses. So, it is best to carry out this activity in the summer and early autumn. Alternatively, schools could farm woodlice, which is not very difficult and ensures a constant supply.

Procedure

Demonstration 1 – Woodlice with anhydrous copper sulphate

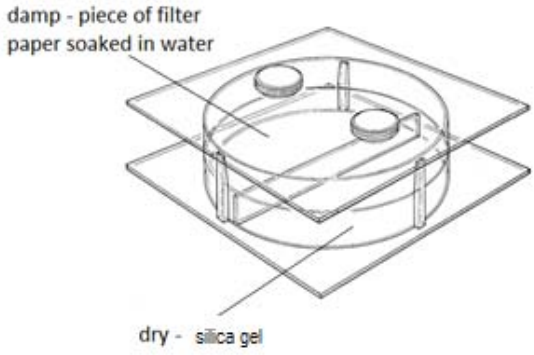
1 Advance preparation: About 10 minutes before observations are to take place, place a small muslin bag with anhydrous copper sulphate and a woodlouse into a boiling tube, and close with a bung. Place the boiling tube in a rack.



Demonstration 2 – Choice chambers

1 Advance preparation: Set up a choice chamber about 30 minutes to 1 hour before observations are to take place. The choice chamber should offer woodlice two environments (damp or dry) and has been covered so that all are dark.

2 Place 10–20 woodlice in the choice chamber.



Class practical 1

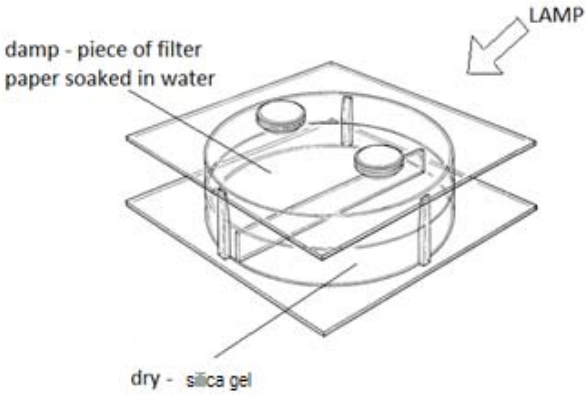
Woodlice will settle in brightly lit areas as long as the air around them is damp

1 Advance preparation: Set up a choice chamber about 30 minutes to 1 hour before observations are to take place. The choice chamber should offer woodlice two environments: damp or dry.

2 Position a lamp so that it illuminates the choice chamber and both sides are brightly lit.

3 Place 10–20 woodlice in the choice chamber.

4 Observe their final positions. The woodlice are likely to slow down after about 5–10 minutes.



Class practical 2

If conditions change, woodlice tend to move to a new, more suitable place because they move around more in bright, dry conditions and slow down when they reach a darker, damper area

1 Advance preparation: set up a choice chamber (the same as for practical 1) about 30 minutes to 1 hour before observations are to take place. The choice chamber should offer woodlice two environments; damp or dry. This choice chamber will not be brightly lit.

2 Place one or two woodlice in the choice chamber. Each woodlouse needs a different observer. If two woodlice are used it helps if they look different and can be easily distinguished from one another.

3 Monitor the movement of each woodlouse. Either use a piece of acetate on top of the choice chamber and trace the path the woodlouse takes, marking its position every 30 seconds, or use graph paper placed beside the choice chamber and estimate its position every 30 seconds, joining the dots to show the woodlouse's track in the choice chamber. Continue monitoring for about 5 minutes.