4.3 Case study 3 (CS3 Ireland)

Concept focus	Investigating the living conditions of woodlice
Inquiry skills	Planning investigations Developing hypotheses
Scientific reasoning and literacy	Not assessed
Assessment methods	Classroom dialogue Teacher observation Self-assessment Worksheets Presentations
Student group	**Grade:** transition year (an optional year offered to students at senior cycle with the purpose of providing broad educational experiences in order to increase maturity, personal development, learner responsibility, transferrable skills and decision making before proceeding to further study.) **Age:** 15-16 years **Group composition:** co-ed **Prior experience with inquiry:** Students had some prior experience in IBSE

In this *bounded inquiry*, an open discussion on what living conditions woodlice like or prefer took place initially, after which students were given three possible variables to investigate in the next lesson – light, moisture and food. Students' skill in *developing hypotheses* was assessed, in particular their ability to generate a question, make a prediction and form a testable hypothesis. Formative assessment took place on the fly, while student worksheets were assessed using a four-level rubric after the lesson.

(i) How was the learning sequence adapted?

A detailed activity, including a worksheet, was planned based on the outline of the **Woodlice** activity. The activity was carried out with 23 students aged 15-16 years. In a 40-minute lesson an open discussion took place on what living conditions woodlice like or prefer. Based on these discussions, students were given three possible variables to investigate: light, moisture (at three levels: dry/damp/wet wood), and food, in a subsequent 80-minute class. Students were asked to select one of these three to investigate, predict what would happen and explain why they thought it would happen. Each group were allowed use up to a maximum of 20 woodlice.

The process for developing a hypothesis involved:

- Discussion on what students know already (in previous class)
- Further research of the problem
- Generate a prediction and justification
- Formulate a testable hypothesis

In the worksheet, the students were given three sub-questions to help them with their investigation and formulate a hypothesis:

1. Question to be answered:
2. What do you think will happen?
3. Why do you think this will happen?

(ii) Which skills were to be assessed?

Developing hypotheses (generating questions)

(iii) Criteria for judging assessment data

Each of the three sub-questions can be assessed separately and together. This assessment can take place both on the fly (as students are discussing the questions or examining what they have written in-class) or afterwards. Things to look out for:

1. Is the question clear, qualified (e.g. do students mention levels), is the question testable and sufficiently specific?
2. Is the prediction linked to the question? Does it suggest an outcome to the investigation?
3. Is the hypothesis justified, for example based on personal experience, students' own observations, or trials?

(iv) Evidence collected

The students' worksheets were collected and assessed using a four-level rubric (Table 1).

Table 1: Rubric using in CS3 to assess skill developing hypotheses

Assessed skill	Emerging	Developing	Consolidating	Extending
1. Generating questions	A question was formulated e.g. "Do woodlice swim?"	A clear investigable question was formulated, such as distinguishing between moisture, humidity, liquid water	A clear investigable question was formulated mentioning specific levels of food/light/moisture	A clear investigable question was formulated mentioning specific levels of food/light/moisture and how it affects the woodlice
2. Making predictions	A prediction is made	A testable prediction is made linked to the question	A testable prediction to the question is made that suggests a clear outcome	A testable prediction to the question is made that suggests a clear outcome based on scientific reasoning
3. Formulating hypotheses	Hypothesis not justified	Hypothesis based on personal experience or inference	Hypothesis based on scientific knowledge or scientific observation	Hypothesis based on scientific knowledge or scientific observation with clear explanation

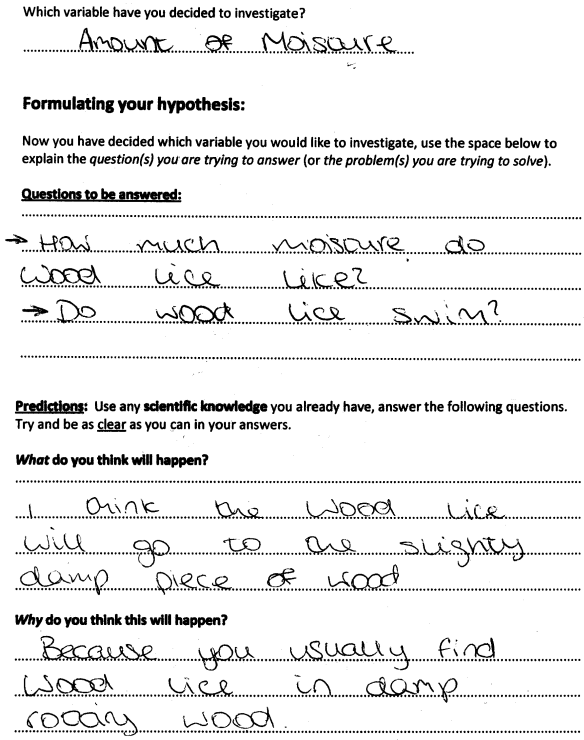
Sample student artefacts

The question that was formulated by Student A raises some doubts as to whether this student distinguishes between humidity, moisture, and amounts of liquid water (Figure 1). A discussion could draw out to what extent the question whether woodlice can swim is relevant to the investigation. The connection between the student's question and their prediction is not very clear (moving from "moisture" to "damp piece of wood".) The student's justification is only linked to prior experience and appears to bring in another variable. Discussion could elicit to what extent the student associates rotting with dampness.

The answers provided by Student H (Figure 2) could be considered as more advanced than those of Student A (Figure 1). The student mentions moisture in the environment, and appears to distinguish it from humidity and amounts of liquid water; nevertheless, this could be probed. This student has also discovered in their research that woodlice are crustaceans. However, the argument could be clarified further, e.g. explain why they think the woodlice would drown if they were crustaceans? (Woodlice are one of the few crustaceans that are non-aquatic.)

Student G made a detailed prediction (Figure 3) and explained why they believed this would happen using their scientific content knowledge (indicating differences in different types of wood, and that woodlice are decomposers.)

Student R does not mention any qualitative or quantitative level of light intensity and only provides a rewording of the question (Figure 4). The student may have a basic or complex investigation in mind, but this cannot be extracted from the written work. The prediction does link back to the question, and the justification relates the question to some knowledge of woodlice. Again further elaboration would be required to ascertain the depth of thought underpinning the answer.


Which variable have you decided to investigate?
Amount of Moisture

Formulating your hypothesis:

Now you have decided which variable you would like to investigate, use the space below to explain the *question(s) you are trying to answer* (or *the problem(s) you are trying to solve*).

Questions to be answered:

→ How much moisture do wood lice like?
→ Do wood lice swim?

Predictions: Use any **scientific knowledge** you already have, answer the following questions. Try and be as clear as you can in your answers.

***What* do you think will happen?**

I think the wood lice will go to the slightly damp piece of wood

***Why* do you think this will happen?**

Because you usually find wood lice in damp rotting wood

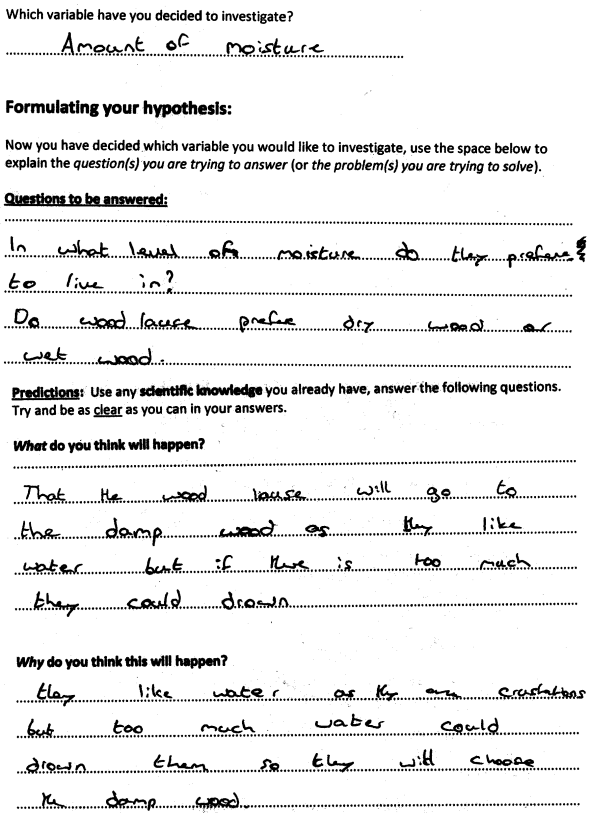
Which variable have you decided to investigate?
Amount of moisture

Formulating your hypothesis:
Now you have decided which variable you would like to investigate, use the space below to explain the questions(s) you are trying to answer (or the problem(s) you are trying to solve).
Question to be answered:
How much moisture do woodlice like?
Do woodlice swim?

Predictions: Use any **scientific knowledge** you already have, answer the flowing questions. Try and be as clear as you can in your answers.
What do you think will happen?
I think the woodlice will go to the slightly damp piece of wood

Why do you think this will happen?
Because you usually find woodlice in damp rotting wood

Figure 1: Worksheet from Student A



Which variable have you decided to investigate?

Amount of moisture

Formulating your hypothesis:

Now you have decided which variable you would like to investigate, use the space below to explain the *question(s) you are trying to answer* (or *the problem(s) you are trying to solve*).

Questions to be answered:

In what level of moisture do they prefare to live in?

Do wood lauce prefer dry wood or wet wood.

Predictions: Use any **scientific knowledge** you already have, answer the following questions. Try and be as clear as you can in your answers.

***What* do you think will happen?**

That the wood louse will go to the damp wood as they like water but if there is too much they could drown

***Why* do you think this will happen?**

They like water as they are crustaceans but too much water could drown them so they will choose the damp wood.

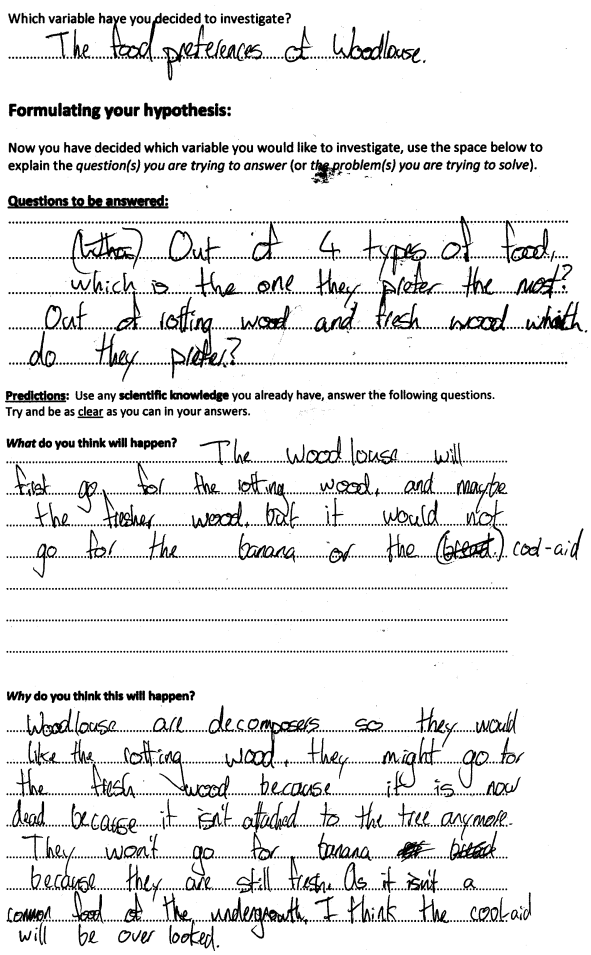
Which variable have you decided to investigate?
Amount of moisture

Formulating your hypothesis:
Now you have decided which variable you would like to investigate, use the space below to explain the questions(s) you are trying to answer (or the problem(s) you are trying to solve).
Question to be answered:
In what level of moisture do they prefer to live in? Do woodlouse prefer dry wood or wet wood?

Predictions: Use any **scientific knowledge** you already have, answer the flowing questions. Try and be as clear as you can in your answers.
What do you think will happen?
That the woodlouse will go to the damp wood as they like water but if there is too much they could drown

Why do you think this will happen?
They like water as they are crustaceans but too much water could drown them so they will choose the damp wood.

Figure 2: Worksheet from Student H



Which variable have you decided to investigate?
The food preferences of Woodlouse.

Formulating your hypothesis:

Now you have decided which variable you would like to investigate, use the space below to explain the *question(s) you are trying to answer* (or *the problem(s) you are trying to solve*).

Questions to be answered:

(Within) Out of 4 types of food, which is the one they prefer the most? Out of rotting wood and fresh wood which do they prefer?

Predictions: Use any **scientific knowledge** you already have, answer the following questions. Try and be as clear as you can in your answers.

***What* do you think will happen?** The wood louse will first go for the rotting wood, and maybe the fresher wood, but it would not go for the banana or the (bread) cool-aid

***Why* do you think this will happen?**

Woodlouse are decomposers so they would like the rotting wood. They might go for the fresh wood because it is now dead because it isn't attached to the tree anymore. They won't go for banana ~~or~~ bread because they are still fresh. As it isn't a common food of the undergrowth. I think the cool aid will be over looked.

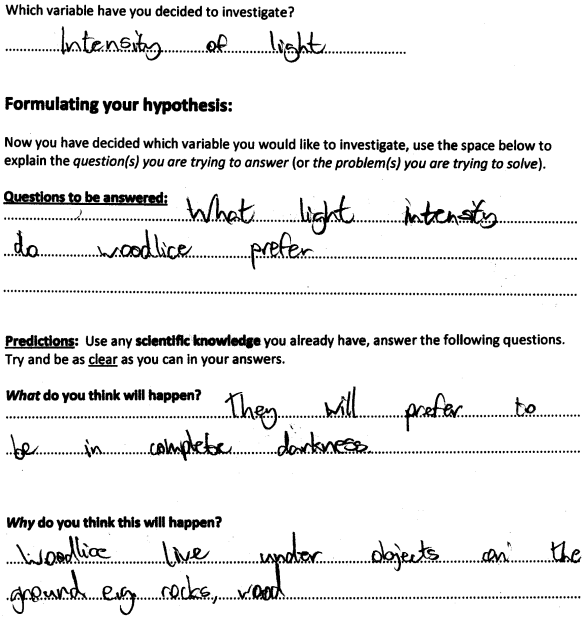
Which variable have you decided to investigate?
The food preferences of woodlouse

Formulating your hypothesis:
Now you have decided which variable you would like to investigate, use the space below to explain the questions(s) you are trying to answer (or the problem(s) you are trying to solve).
Question to be answered:
Out of 4 types of food which is the one they prefer the most? Out of rotting wood and fresh wood which do they prefer?

Predictions: Use any **scientific knowledge** you already have, answer the flowing questions. Try and be as clear as you can in your answers.
What do you think will happen?
The woodlouse will first go for the rotting wood and maybe the fresher wood but it would not go for the banana or cool aid

Why do you think this will happen?
Woodlouse are decomposers so they would like the rotting wood. They might go for the fresh wood because it is now dead because it isn't attached to the tree anymore. They won't go for the banana because they are still fresh. As it isn't a food of the undergrowth. I think the cool aid will be overlooked

Figure 3: Worksheet from Student G



Which variable have you decided to investigate?
Intensity of light

Formulating your hypothesis:

Now you have decided which variable you would like to investigate, use the space below to explain the *question(s) you are trying to answer* (or *the problem(s) you are trying to solve*).

Questions to be answered: What light intensity do woodlice prefer

Predictions: Use any **scientific knowledge** you already have, answer the following questions. Try and be as clear as you can in your answers.

***What* do you think will happen?** They will prefer to be in complete darkness

***Why* do you think this will happen?**

Woodlice live under objects on the ground eg rocks, wood

Which variable have you decided to investigate?
Intensity of light

Formulating your hypothesis:
Now you have decided which variable you would like to investigate, use the space below to explain the questions(s) you are trying to answer (or the problem(s) you are trying to solve).
Question to be answered:
What light intensity do woodlice prefer?

Predictions: Use any **scientific knowledge** you already have, answer the flowing questions. Try and be as clear as you can in your answers.
What do you think will happen?
They will prefer to be in complete darkness

Why do you think this will happen?
Woodlice live under objects on the ground, e.g. rocks, wood

Figure 4: Worksheet from Student R