Black box activity 1: Tricky tracks

Teachers’ notes

Objectives
- To help the students distinguish between observation and inference.
- To introduce the concept that all ideas are valid unless there is further evidence to suggest otherwise.

Teaching topics

This activity is appropriate for 11–13 years olds and fits into a scheme of work anywhere where observations are made. It can also be successfully used with lower ability 14–15 year olds. A possible follow up activity would be to carry out a series of class ‘test tube’ experiments, which required careful observation, followed by interpretation.

Background information

This activity assumes the following definitions:
- An observation is what is actually seen.
- An inference is interpreting what you see.

Teaching tips

This activity could be carried out as a whole class exercise, with individual students recording their own answers or in groups of 3–4 students.

The lesson could be introduced as follows:

Scientists are always putting forward ideas or theories to try and explain the things they see happening in the world.

Scientists often test their ideas and theories by carrying out some experiments. Sometimes new ideas come along which do not fit the old ideas. So more experiments have to be carried out to see if the new idea is correct.

Resources

- OHP – if the activity is carried out as a whole class exercise. Photocopiable worksheets Tricky tracks 1–3 will need to be transferred onto OHT slides.
- Class sets of student worksheets if the activity is to be carried out in groups
  - Tricky tracks 1
  - Tricky tracks 2
  - Tricky tracks 3
  - Questions

Timing

60–70 minutes. Approximately half the time should be used to carry out the worksheet tasks and the rest of the time discussing the answers.
Possible lesson plan

1. Give out the student worksheet Tricky tracks 1 and the Making a model or theory worksheet. The class starts the worksheets either individually or in groups and collects Tricky tracks 2 and 3 as required.

Or if using an OHP, put up Tricky tracks 1 and give the class 10 minutes to do question 1, before putting up Tricky tracks 2 and Tricky tracks 3.

2. Feedback to the whole class some answers to question 1, by asking different students to read out their accounts. Try and get as many different explanations as you can. It is important to accept all explanations equally.

3. Go through the rest of the questions, pointing out the difference between observation and inference.

4. Finally, link this exercise to scientists, saying that scientists often make similar inferences as they try to interpret their observations. There may be several equally valid theories until new evidence comes along to change it.

Next lesson
Carry out a class practical which involves recording observations and deductions in a table. For example, the reaction of metals and acids, or calcium and water, or iron and sulfur.

Adapting resources

The student worksheet can be easily adapted to meet the needs of less able students by omitting some of the more demanding questions, such as 3 and 7, and renumbering the other questions.

Some students may find question 3 confusing and may become frustrated by the exercise (see answers), but it should present no problems to the more able student.

Answers

1. All answers to question 1 should be accepted.

Possible answers to question 1 could include:

a) Two animals or birds were out hunting in the forest. On meeting each other at the clearing, they had a fight.

b) Two animals or birds had a fight in the forest and then went off home to different places.

c) The tracks lead down to the place where birds meet before going for a swim. During the day many different birds will come and go, that is why you can see so many tracks. The big birds and little birds live in different places and that is why the big tracks go off in a different direction to the small tracks. Most of the birds arrive and leave by air, so you cannot see their tracks on the ground. Usually the small birds and the large birds go to the ponds at different times because the little birds try to avoid the big birds, which often chase them.

d) One day a large male dinosaur was out looking for food. As he was searching a small area he noticed a beautiful female dinosaur coming towards him. It was love at first sight. Being a little shy, he hid behind a rock and when she got closer he jumped out and introduced himself. At first she was afraid, she thought that he was going to attack her and she tried to escape. But when he spoke and told her not to be afraid, they sat down on the rock and had a good chat.
2. In **Tricky tracks 2** we see two sets of marks. The marks on the left side of the page are bigger than on the right side of the page. Each big mark has three points coming out of a small black blob. The marks form a diagonal line. Each mark is pointing in the same direction.

The marks on the right hand side of the page have three points coming out of an elongated blob. There are two rows of marks going along the side of the page.

There are 14 big marks and 34 small marks.

Only accept answers that describe what is actually seen on the page.

**Do not accept any answers that try to interpret what the marks are.**

A typical student answer might be:
‘I can see two sets of bird tracks on the page. One bird is bigger than the other bird.’

**Challenge the student:** How do you know they are bird tracks? Could the tracks belong to anything else?

**Explanation:** You should now explain that an observation is what you see on the page, not what you think you see on the page.

The typical student answer given above, had been interpreted by using some other knowledge.

The student reasoning could be as follows:

‘From previous knowledge, I know that these marks resemble birds tracks. I know that big birds have bigger feet than small birds, therefore I have used bird tracks in my answer.’

Remind the class of the question, ‘What do you observe in **Tricky tracks 2**?’

3. This is really a trick question. We do not know that the tracks have been made by animal and we do not know that they are going in the same direction. It should be pointed out that this question has been built on two assumptions. Often in science, we have to be careful about the questions we ask.

4 & 5 These should be treated in the same manner as question 2. You may wish to give the class time to change the answer to their questions, in the light of the answer to question 2.

6. Based on the current evidence, we can never know what has really happened. We can only imagine what has happened. Therefore, at each stage all the theories put forward in question 1 are equally valid.

7. To find out more about the situation we could look try and identify the tracks using a key. Once the tracks were identified, more could be found out about the behaviour of the animals, which may offer support to some theories and not to others.
Tricky tracks 1
Tricky tracks 2
Tricky tracks 3
Questions

1. Carefully study **Tricky tracks 1** and write a short account of what you think has happened.

   **Now collect Tricky tracks 2 from your teacher**

   2. What do you observe in **Tricky tracks 2**?
   3. Why are the two animals heading towards the same point?

   **Now collect Tricky tracks 3 from your teacher**

   4. What do you observe in **Tricky tracks 3**?
   5. What do you observe in **Tricky tracks 1**?
   6. Based on what you have found out so far, do you think we can ever know what has really happened?
   7. What could you do to find out more about the situation?