

# Science

Name: ..... ( )

Class: .....

Date: ..... / ..... / .....

## The Nature of Science – The Scrambled Sentence

### Background Information

In this activity, students try to construct a meaningful sentence by successively turning over a set of word cards. Parallels are drawn to particular aspects of the nature of science.

### Learning Objectives

By the end of this activity, students should be able to:

1. Describe aspects of the nature of science such as the self-correcting nature of science, the tentative nature of scientific knowledge and science as an ongoing human endeavour.
2. Give one authentic example of science as an ongoing human endeavour.
3. Give one authentic example of the tentative nature of scientific knowledge.

### Introduction to the Activity

The activity is designed to explicitly teach ideas about the nature of science. It contains no specific scientific content knowledge. This means that students can learn about the nature of science without having to understand new science content at the same time.

In this activity, students gather information and work towards a closer approximation of the actual sentence. There is built-in ambiguity in the sentence, and several reasonable “correct” answers are possible.

Despite the artificial context of this activity, some aspects of the experience closely resemble real-life science. It can be used to teach students about the self-correcting nature of science, the tentative nature of scientific knowledge and science as an on-going human endeavour. For example, as the students turn over more cards, they will change their ideas of what the story might be about.

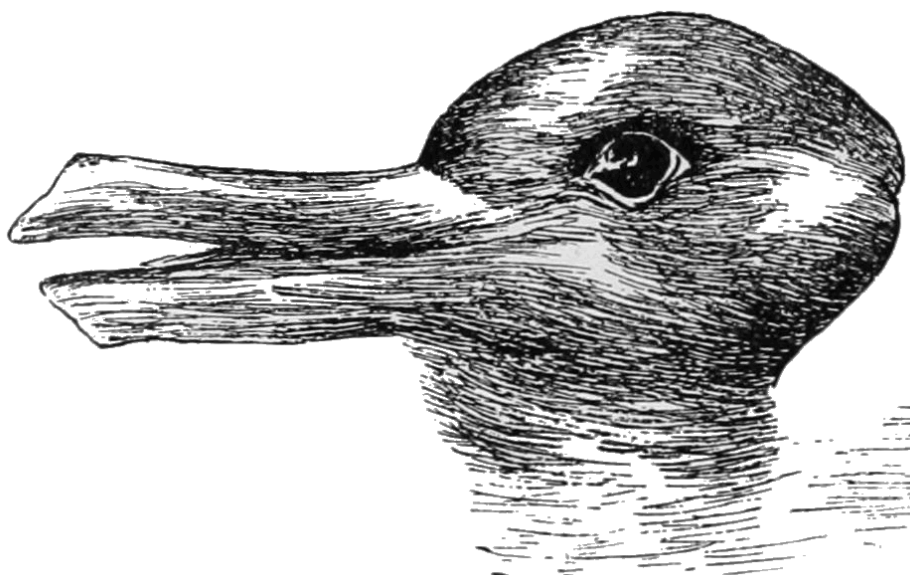
The parallel here to the way science works is that scientists will change their ideas, explanations, hypotheses or theories as they gather more information.

## Materials

- One set of word cards for each group. For variety, the words can be printed on different coloured paper. Printing the words on card, and then laminating them, makes the words more durable.
- Copies of “What do you think the story is about?” for groups to record successive hypotheses.

## Instructions

1. Divide the class into group of three-to-four students and give each group a set of the word cards and a copy of the worksheet “What do you think the story is about?” Instruct each group to spread-out their cards face-down on the table. Tell the class that the cards form one long sentence that also tells a story. The objective is for the students to figure-out the story from the words that they discover when they turn the cards over. Encourage students to keep their ideas within their group until the class discussion at the end.
2. Ask the groups to turn-over five cards at random and then write down a sentence that uses all five of the words (Hypothesis One). Ask the students if it would help to have more information.
3. Have each group turn-over five more cards. What do they think the story is about now? Have each group record their ten word sentence (Hypothesis Two) and their ideas. Ask the students if their idea of the sentence changed with the addition of more information. Discuss briefly with the class, but do not ask them to share their sentences just yet.
4. Have the groups turn over five more cards and record their fifteen word sentence (Hypothesis Three) and ideas. Allow groups to share with the class what they think the sentence says. Discuss the possible reasons why groups have different answers. Ask the students how this is similar to a palaeontologist digging-up fossils (the scientist uncovers information slowly, over a period of time). Ask the students why scientists may not agree on their explanations of things (scientists have different information or different ways of interpreting the same information).
5. Allow all of the groups to turn over all of the cards and revise their hypothesis (Hypothesis Four). Encourage the groups to share their “final” hypothesis. It is most likely that the groups will not have exactly the same sentences – even though they now all have the same information (words). Ask the groups why they have different sentences. Ask the students why scientists may not have exactly the same explanation for things even though they may have exactly the same information (the scientists may have different background knowledge, make different assumptions, have different points of view and so on). To illustrate this further, ask students to look at the drawing by Joseph Jastrow (**Figure 1**). Even though all students look as the same drawing, some will say they see a duck while others say they see a rabbit.



**Figure 1.** Drawing by Joseph Jastrow (1863 – 1944). What do you see?

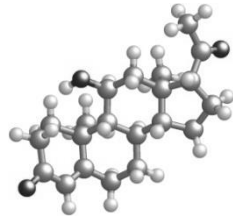
6. Encourage the groups to brainstorm and discuss parallels between this activity and how scientists work. Some examples are given below:

| Possible Student Response  | Parallels to the Work of Scientists   |
|--|---|
| “We tried to make sense of the cads. We had data and tried to make sense of it.”                             | Scientists try to make sense of the natural world. Scientific ideas are developed through reasoning. Scientists develop explanations using observations and what they already know about the natural world.   |
| “As we were given more information (words) we came-up with new ideas. We changed our hypothesis (sentence).” | Science is on-going, tentative, subject to change with more evidence or with the re-interpretation of existing evidence. Science corrects itself.   |
| “More information (words) made it easier to develop a hypothesis (sentence).”                                | The more data scientists have, the easier it is to develop a reliable hypothesis.   |
| “We all had different ideas in our group.”   | Based upon the same data, two scientists can have different hypotheses or explanations.   |
| “There was more than one possible sentence that fitted the data.”  | Science does not prove or conclude – science is always a work in progress.  |
| “We used our existing knowledge to help construct the sentence.”   | Science is socially and culturally embedded and theory laden. For example, a person who did not know that flamingos are pink could not assemble the sentence that way. Scientists bring existing theories and background knowledge to any investigation – and this will affect how they interpret the data. |

- Adapted from an activity by Al Janulaw and Judy Scotchmoor, University of California Museum of Palaeontology.
- Additional information taken from Science Learning, New Zealand, <http://sciencelearn.org.nz>.

Word Cards

|                 |                 |              |               |
|-----------------|-----------------|--------------|---------------|
| <b>THE</b>      | <b>TALL</b>     | <b>SOFT</b>  | <b>PINK</b>   |
| <b>FLAMINGO</b> | <b>CARRYING</b> | <b>A</b>     | <b>GOLD</b>   |
| <b>RING</b>     | <b>JUMPED</b>   | <b>ONTO</b>  | <b>THE</b>    |
| <b>LITTLE</b>   | <b>WOODEN</b>   | <b>TABLE</b> | <b>UNDER</b>  |
| <b>THE</b>      | <b>TREE</b>     | <b>AND</b>   | <b>ATE</b>    |
| <b>THE</b>      | <b>BOWL</b>     | <b>OF</b>    | <b>CRISPS</b> |



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### Student's Worksheet – “What Do You Think the Story is About?”

#### Hypothesis One

- What is your first sentence (hypothesis)? Five words.

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- Elaborate on your ideas about the sentence – what do you think the story is about?

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#### Hypothesis Two

- What is your second sentence (hypothesis)? Ten words.

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- Elaborate on your ideas about the sentence – what do you think the story is about?

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#### Hypothesis Three

- What is your third sentence (hypothesis)? Fifteen words.

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- Elaborate on your ideas about the sentence – what do you think the story is about?

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#### Hypothesis Four

- What is your fourth sentence (hypothesis)? Twenty-four words.

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- Elaborate on your ideas about the sentence – what do you think the story is about?

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