Year 13 Science: Planning and running an independent ESS investigation

Name: _____ Date: _____

Try these without your notes first, then check the answer key.

Practice

1. Four repeats gave rises of 6.4, 6.6, 9.8 and 6.5 °C, and the notes say the lamp was bumped closer in the third run. Find the mean.

2. Using Aroha's line, rise = 8.4 sin θ °C, predict the rise at 50°.

3. What is the Sun's noon elevation at Invercargill (46.4° S) at an equinox?

4. Auckland is at 36.8° S. Find the noon elevations at the two solstices and how many times more energy per m² the summer Sun delivers.

5. A student increases the repeats at each angle from 3 to 5. Does this mainly improve reliability or validity?

Fix the mistake

6. Correct this statement: "Doing more repeats makes my data more valid."

7. Correct this statement: "I left out the 9.0 °C reading because it did not fit my hypothesis."

8. Correct this statement: "My conclusion is that the angle of light causes the seasons."

9. Correct this statement: "My evaluation: I could have done it more carefully."

Answer key (for parents and tutors)

1. Four repeats gave rises of 6.4, 6.6, 9.8 and 6.5 °C, and the notes say the lamp was bumped closer in the third run. Find the mean.
   The 9.8 °C run has a known cause (the lamp moved closer), so exclude it: (6.4 + 6.6 + 6.5) ÷ 3 = 19.5 ÷ 3 = 6.5 °C.
2. Using Aroha's line, rise = 8.4 sin θ °C, predict the rise at 50°.
   8.4 × sin 50° = 8.4 × 0.766 = 6.4 °C.
3. What is the Sun's noon elevation at Invercargill (46.4° S) at an equinox?
   90° − 46.4° = 43.6°.
4. Auckland is at 36.8° S. Find the noon elevations at the two solstices and how many times more energy per m² the summer Sun delivers.
   Summer: 90° − 36.8° + 23.4° = 76.6°; winter: 90° − 36.8° − 23.4° = 29.8°; sin 76.6° ÷ sin 29.8° = 0.973 ÷ 0.497 = 1.96 times.
5. A student increases the repeats at each angle from 3 to 5. Does this mainly improve reliability or validity?
   Reliability: more repeats give a better mean and show whether results agree, but do not change what is being measured.
6. Correct this statement: "Doing more repeats makes my data more valid."
   Repeats improve reliability; validity comes from measuring the right thing and controlling the other variables.
7. Correct this statement: "I left out the 9.0 °C reading because it did not fit my hypothesis."
   Exclude a reading only with a reason from the method (the card was still warm), and report that you did it.
8. Correct this statement: "My conclusion is that the angle of light causes the seasons."
   Conclude about what you measured (rise ∝ sin θ), then link it to the seasons as a model, with its limits.
9. Correct this statement: "My evaluation: I could have done it more carefully."
   Name the specific source of error, its effect on the data, and how you would reduce it.