Chemistry investigation: trends and decay

Suggested grades 10-12 or learners ready for quantitative chemistry | 45-60 minutes.

1. Test an increase

Prediction: does first ionization energy always rise across period 3?

Reported first ionization energies (kJ/mol): Na 495.8, Mg 737.7, Al 577.5, Si 786.5, P 1011.8, S 999.6, Cl 1251.2, Ar 1520.6.

Plot atomic number against first ionization energy. Identify each adjacent decrease and write a claim that includes the exceptions.

_____

_____

Use electron configurations to propose an explanation. State what a shell-ring model cannot show.

_____

2. Critique an association

Choose two properties in Trend lab. Record the selection, number of complete pairs and Pearson r. Explain why this statistic is not evidence of causation and why missing values matter.

_____

_____

3. Repeat a decay trial

Carbon-14 has a reported half-life of 5700 years in the IAEA snapshot. For 256 parent nuclei, calculate the expected count after 1, 2 and 3 half-lives and the corresponding elapsed years.

Half-lives Expected count Elapsed years
1 _____ _____
2 _____ _____
3 _____ _____

At 3 half-lives, use New sample and Record this sample five times. Record counts; calculate mean and range.
Counts: _____
Mean: _____ Range: _____

Why might the sample mean differ from the expectation? Does every nucleus have a fixed lifetime of one half-life?

_____

4. Evaluate the model

Write two limitations: consider source uncertainty, missing values, daughter decays, reference conditions or graph interpolation.

_____

_____

Source: adapted Periodic-Table-JSON and IAEA LiveChart snapshot. See sources.html for provenance; values and model simplifications are not laboratory measurements.

Suggested levels are starting points, not formal curriculum alignment. Use the site or printed data; no physical element samples are needed. Source data and limitations: elementexplore.com/sources.html. These original Element Explore materials may be copied and adapted for classroom use.