Science: conflicting viewpoints and evidence that separates models

Original skill preparation; versioned source scope

ACT Science: Conflicting Viewpoints and Evidence That Separates Models

- State what each model or scientist predicts.
- Recognise each **model assumption** 模型假设.
- Identify **discriminating evidence** 区分性证据: an observation that fits one model but not the other.
- Design or recognise a **discriminating test** 鉴别性检验, and separate a design decision from a test of a **prediction** 预测.

Summarise each viewpoint

- For each model, write one line: what it assumes, and what it predicts.
- Note where they agree. Shared predictions cannot decide between them.
- Note where they differ. That is where a test can decide.

Evidence that separates models

- If both models predict a result, observing it supports neither over the other.
- If they predict different results, the observation can weaken one: "conflicts with P, consistent with Q".
- One result rarely proves a model; other explanations may still fit.

Figure: Evidence that separates models

Different predictions enable a discriminating test

Model	Same runtime; compare 15°C and 30°C
A: time only	Equal brightness
B: temperature rise	Lower brightness at 30°C

- A test can decide between two models only where they predict different results
- Match each part of the diagram to the text.

Designing a separating test

- Choose conditions where the predictions differ.
- Change only that factor; hold everything else, and repeat the trials.
- Check that the instrument is precise and calibrated enough to see the difference.

Explanations and decisions

- Whether a design meets a brief is a practical question. Why it works is a scientific one.
- A design can pass every requirement without telling you which model is right.

Practice research summary

- Original hypothetical research summary — A cooling sleeve
- A laboratory team tests sleeves intended to reduce a small sensor's temperature during operation.
- All sensors start at 22°C.
- Temperature is measured after ten minutes of use with the same power setting, room conditions and measuring instrument.

Worked example: predictions and Experiment 3

- Model P: temperature depends only on thickness. So equal-thickness A and B sleeves should give the same temperature.
- Model Q: material matters too; at equal thickness, B should be cooler than A.
- Experiment 2's falling trend fits both models, so it cannot separate them.
- Experiment 3 (both 2 mm): A 34 °C, B 31 °C. A 3 °C difference with a 0.1 °C instrument, calibrated, conflicts with P and is consistent with Q. More repeats are needed to measure variation and rule out manufacturing differences.

Worked example: a design decision is not a model test

- It meets the brief: cost ≤ 5 and temperature ≤ 35 °C.
- But with no matched A sleeve in the same test, it says nothing new about P against Q.
- So it supports a design decision, not a choice between models. Durability still needs checking.

Common errors

- Treating a result both models predict as support for one.
- Saying one experiment "proves" a model.
- Designing a test that changes two factors.

Common errors (2)

- Ignoring the instrument's resolution.
- Confusing "the design works" with "the model is right".

Key terms

- **model assumption**: A condition a model takes as true.
- **prediction**: What a model says will happen in a given situation.
- **discriminating evidence**: An observation that fits one model but conflicts with another.
- **discriminating test**: An experiment designed where two models predict different results.

Check yourself

- Both models predict that thicker sleeves are cooler. Can a thickness experiment separate them?
- What comparison would separate P from Q?
- An observation conflicts with P and fits Q. Is Q proved?