

# The Calder Basin Treasure Mystery: Read the Clues, Place the Drills

**Investigation question: Using only surface clues and geologic history, where in the Calder Basin should a survey team drill for copper ore, petroleum, geothermal heat and groundwater, and why are those resources there and not elsewhere?**

Evidence-based mystery

Groups of 4

1 session

Setup 5 · Activity 40 · Cleanup 5 min

MS-ESS3-1 · assesses

MS-ESS2-1 · supports

Name \_\_\_\_\_

Group \_\_\_\_\_

Date \_\_\_\_\_

## Your role today

- ☐ **Chief geologist:** Reads each clue card aloud, leads the discussion of which process the clues point to, and makes sure every drill site has a written reason.
- ☐ **Cartographer:** Colors the prediction map, places the sticky-dot drill markers, and keeps the map consistent with the team's table.
- ☐ **Recorder:** Fills in the clue table row by row, writing the process and the predicted resource in the team's own words.
- ☐ **Auditor:** Checks each prediction against the full recipe (not just one clue), challenges weak reasoning, and scores the team after the reveal.

## Safety

- No hazards beyond paper, scissors (if cutting cards in class) and sticky dots; pass scissors handle first and keep them closed on the desk.
- If the activity is run as a floor map, keep walkways clear and have students step, not jump, between cells.

## Procedure

1. Lay the grid map flat and sort the sixteen clue cards by cell label. The chief geologist reads each card aloud while the recorder fills in the clue table: what the clues say, which process they point to, and which resource, if any, the team expects.
2. For every cell, check the full recipe before writing a prediction. Oil needs buried marine mud, deep burial, a porous layer and a sealed trap. Metal ore needs magma and hot fluids, or a stream that concentrated dense grains. Geothermal heat needs magma near the surface. Groundwater needs porous sediment or rock plus recharge, now or in a wetter past.
3. The cartographer colors each cell on the prediction map with the resource color the team expects, and leaves cells the team thinks are empty white. Mark cells where the team is unsure with a question mark.

- Decide on six drill sites. You must aim at least one marker at each of the four target resources (ore, petroleum, geothermal, groundwater). Place the sticky dots and record each site in the drill table with the evidence for it.
- The auditor reads every drill reason aloud and challenges any that rest on a single clue. Revise if needed. When the team agrees, sign the drill table; after this point no changes are allowed.
- Open the answer envelope (or watch the reveal). Score each drill site with the points in the drill table and total the team's score. Record which predictions were wrong and why.
- Answer the analysis questions individually. Then compare answers in the group and discuss which clue turned out to be the most reliable and which one fooled you.

## Record your observations

### Lab 1 recording sheet: The Calder Basin treasure mystery

The Calder Basin is a made-up region. Its west edge is a coast; a river runs down column B from the mountains in the north; the east side (column D) is desert. Use the clue cards to decide what each cell hides. Write the process first, then the resource. A clue is only evidence when the whole recipe is there.

#### Clue cards (cut apart, one per cell)

##### 1 A1: coast, north

A young volcano with steaming vents and hot springs. Lava flows only a few thousand years old. Small earthquakes most months. A plate boundary lies just offshore. Rain: 100 cm a year.

##### 2 A2: coast range

Old rounded mountains of granite. White quartz veins with green and blue stains cut through the rock. No volcano has erupted here for 40 million years, but the granite is the cooled root of ancient ones. Rain: 60 cm a year.

##### 3 A3: foothills

Streams leave the granite mountains and slow down over gravel bars. A prospector's pan from one bar shows a few tiny, dense yellow flakes. Rain: 50 cm a year.

##### 4 A4: coast, south

Steep mountains covered in thick forest. Thin rocky soil. The granite here has no veins and no stains. Rain: 150 cm a year.

##### 5 B1: lava plateau

A flat plateau of cracked gray lava two million years old. The springs are cold. Soil is thin and stony. Rain: 30 cm a year.

##### 6 B2: upper valley

A wide valley floor. A river fed by mountain snowmelt flows all year. Old well logs show 150 m of gravel and sand before bedrock. Rain: 70 cm a year.

##### 7 B3: lower valley

The same valley farther south, lined with orchards. Well logs show 120 m of sand and gravel. The river still flows most of the year. Rain: 55 cm a year.

##### 8 B4: old lake bed

The valley opens into a flat basin of gray clay laid down in a lake that dried up 10,000 years ago. Three wells drilled here produced only a trickle each. Rain: 40 cm a year.

**9 C1: folded hills**

Low hills of sandstone and shale with marine fossils. The layers arch upward like a bridge. Black, sticky tar oozes from a crack near the top of the arch. Rain: 25 cm a year.

**10 C2: dry plain**

A flat plain. A survey well found sandstone arched beneath a thick shale layer, with marine fossils. This was a sea 20 million years ago; the layers were later buried 3 km deep, then folded. Rain: 20 cm a year.

**11 C3: reef limestone**

Flat layers of limestone full of coral and shell fossils. The layers lie flat and were never buried deeper than 1 km. No shale or salt layer on top. Rain: 25 cm a year.

**12 C4: stripped layers**

Tilted sandstone layers exposed by erosion. The sand is stained brown and smells faintly of oil but is dry. The shale that once covered it has eroded away. Rain: 25 cm a year.

**13 D1: dune desert**

Sand dunes over thick sandstone. Ancient rock paintings show lakes, fish and hippos. The few wells give sweet water, and tests show that water fell as rain more than 10,000 years ago. Rain: 8 cm a year.

**14 D2: granite desert**

Bare granite bedrock at the surface with almost no sediment. No veins, no stains. Rain: 8 cm a year.

**15 D3: salt flats**

White crusted flats. Beneath them lie thick beds of salt and gypsum left when an arm of the sea dried up. Rain: 10 cm a year.

**16 D4: flat shale**

Flat-lying dark shale with marine fossils, buried 2 km at most and never folded or faulted. A survey well found no sandstone layer and no oil. Rain: 10 cm a year.

**Clue table: process first, resource second**

| Cell | Key clues (your words) | Process the clues point to | Predicted resource (or none) | Confidence (low / medium / high) |
|------|------------------------|----------------------------|------------------------------|----------------------------------|
| A1   |                        |                            |                              |                                  |
| A2   |                        |                            |                              |                                  |
| A3   |                        |                            |                              |                                  |
| A4   |                        |                            |                              |                                  |
| B1   |                        |                            |                              |                                  |
| B2   |                        |                            |                              |                                  |
| B3   |                        |                            |                              |                                  |
| B4   |                        |                            |                              |                                  |
| C1   |                        |                            |                              |                                  |
| C2   |                        |                            |                              |                                  |
| C3   |                        |                            |                              |                                  |
| C4   |                        |                            |                              |                                  |

| Cell | Key clues (your words) | Process the clues point to | Predicted resource (or none) | Confidence (low / medium / high) |
|------|------------------------|----------------------------|------------------------------|----------------------------------|
| D1   |                        |                            |                              |                                  |
| D2   |                        |                            |                              |                                  |
| D3   |                        |                            |                              |                                  |
| D4   |                        |                            |                              |                                  |

-  Draw the 4 x 4 grid (A-D across, 1-4 down). Color each cell with your predicted resource using a key: one color each for metal ore, petroleum, geothermal heat and groundwater; leave empty cells white. Mark your six drill sites with an X.



#### Drill table (sign before the reveal)

| Drill site (cell) | Resource you expect | Evidence: the process chain in one sentence | Result after the reveal | Points |
|-------------------|---------------------|---------------------------------------------|-------------------------|--------|
| 1                 |                     |                                             |                         |        |
| 2                 |                     |                                             |                         |        |
| 3                 |                     |                                             |                         |        |
| 4                 |                     |                                             |                         |        |
| 5                 |                     |                                             |                         |        |
| 6                 |                     |                                             |                         |        |
| Total             |                     |                                             |                         |        |

**Scoring after the reveal** — Rich target resource found: 3 points. Modest resource found (a placer, a slow-refilling desert aquifer, or the salt beds): 2 points. Nothing worth drilling: 0 points. Add 1 bonus point for each drill site whose written evidence names the correct process, even if the drill came up dry. Maximum: 24.

1. Which cell fooled your team the most, and which single clue led you astray?

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2. Which drill site were you most confident about before the reveal? Write the full chain of evidence you used.

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## Analysis questions

3. Cells C1, C2, C3 and C4 all had marine fossils, yet only two hold oil. Explain, using the full oil recipe, why C3 and C4 came up dry.

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4. Cell A4 has the most rain in the basin but no useful groundwater, while D1 is a desert with a large aquifer. Explain both facts, and then say which aquifer could be pumped sustainably and why.

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5. Copper ore is in A2 but not in D2, even though both cells are granite. What is different about the history of A2, and what process concentrated the metal there?

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6. The gold flakes in A3 did not form in A3. Describe the two-step history that put them there, naming the process at each step.

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7. Suppose B2 is pumped for forty years at twice its recharge rate and C1 is drilled until its reservoir is empty. Redraw the resource map in words: what changes, what does not, and which change could reverse?

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8. Write the one-sentence rule your team would give a new survey crew about when a single clue is enough and when it is not.

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