

Evidence essay · Observation and data

A research question before a sensor

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Fictional author and institute · Editorial demonstration, not peer reviewed

ABSTRACT

Choosing a sensor before defining the research question can produce precise data that do not answer the original concern. This essay works backwards from a hypothetical river-colour problem to distinguish community concern, a researchable comparison, and the decision a limited study might inform. It examines competing explanations, representative locations, event timing, existing records, and plans for unsafe access or missing samples. The National Inuit Strategy on Research supplies governance context, and NOAA's network assessment illustrates why more observations at an unsuitable location do not repair every gap. Equipment selection follows the required quantity, discrimination, and coverage, with maintenance and stewardship included. Rehearsing a possible result using explicitly invented values tests whether the proposed observations could distinguish explanations without predetermining the finding.

Keywords: research design · sampling strategy · competing explanations · measurement selection · river water

Adapted from the Still North field journal. Original article. A source-based editorial text, not a report of original Still North research. Examples and imagery are illustrative.

A sensor catalogue offers answers in the form of specifications: range, resolution, memory, and battery life. A research plan has to begin elsewhere. What question matters, who needs the answer, and what would count as evidence? Without those decisions, a team can collect a large, precise dataset that never addresses the concern that justified the work.

Consider a hypothetical concern about a river changing colour after periods of high flow. A continuous temperature logger could be useful, but it would not directly measure the substances responsible for the colour. A camera could document appearance while leaving chemistry unresolved. Buying either first would let available equipment narrow the question before the question had been properly discussed.

Separate concern, research question, and decision

The concern might be water quality. A researchable question could ask whether selected chemical indicators differ between upstream and downstream locations under specified flow conditions. A decision might concern additional investigation, treatment, or an authority's assessment. These are connected, but a limited research design must not promise to settle every question of safety or management.

Ask who has authority to define the decision and whose knowledge is needed to shape the question. The National Inuit Strategy on Research calls for research governance and funding aligned with Inuit priorities. In Inuit Nunangat, an outside team's preferred equipment is not a substitute for engaging the relevant Inuit organisations and research processes. Elsewhere, the applicable authorities and agreements will differ.

Our orange-river explainer shows why an appearance is a starting point rather than a diagnosis. A proposed design should state what it can establish, what it can only

suggest, and what would require different expertise or a separate study. Those boundaries help avoid both over-promising and collecting information without a credible use.

Write down competing explanations

In the hypothetical river example, changes in suspended material, dissolved substances, flow, and illumination might affect the recorded appearance. The study should identify the explanations it intends to distinguish and the observations each would require. Sampling only on clear, low-flow days could miss the event of interest, however accurately the samples are analysed.

Paired locations, repeated observations, and records of flow and recent conditions may help answer a defined question. They are not a universal recipe. A site that looks like a convenient comparison may differ in geology, drainage, or other inputs. The design needs a reason for its comparison, along with a plan for what happens when access is unsafe or a sample cannot be collected.

Existing records should be examined before expanding collection. They may reveal suitable timing, an earlier method to preserve, or a gap that cannot be filled by another sensor of the same type. The NOAA observing-network assessment links gaps in coverage and validation with limits on useful knowledge. Its examples include sparse precipitation observations in complex terrain. More frequent readings at an unrepresentative location do not automatically repair a spatial gap.

Now choose the measurement system

Only after defining the quantity, place, timing, and required discrimination should the equipment comparison begin. An automatic sensor can capture events between visits, but it also needs maintenance, power, quality checks, and interpretation. A smaller set of carefully timed samples may answer a chemical question better than continuous measurement of an indirect proxy. Some-

times the useful first step is analysis of existing evidence rather than new field activity.

- What change must the method distinguish, and with what uncertainty?
- Which conditions and locations must be represented?
- Who can maintain the system and assess unusual readings?
- What permissions, access arrangements, and return of results are required?
- What would cause the team to revise or stop collection?

Include analysis and stewardship in the same design. A measurement that cannot be linked to its method or accessed by the agreed users has not completed its intended journey. The [Open observations](#) page describes the record that allows useful reuse, while [Permafrost and freshwater](#) sets out the wider catchment context.

Rehearse the result before collecting it

Sketch the table or figure that would answer the question using explicitly invented values. If the proposed observations cannot populate it, or the same pattern fits every competing explanation, revise the design. Do this on paper, before freight and field commitments make revision expensive. The purpose is not to predetermine the finding. It is to discover whether the planned measurements could answer the question at all.

References

1. National Inuit Strategy on Research (itk.ca)
2. NOAA observing-network assessment (arctic.noaa.gov)