RockEDU
SCIENCE OUTREACH

WORKSHEET

Narrowing Down Your Research Question

Generating a robust and creative research question requires a consideration that there are many ways of knowing, and that knowledge can take a variety of forms that can be drawn from diverse resources. Yet, how do we know what we don't know? The universe is vast, and sometimes knowing how to start feels daunting. Firstly, let's acknowledge the fact that research is hard and that is ok! Secondly, we can also acknowledge that there is always something we can learn. How will you define your scientific journey?

Learning the Styles of Scientific Reasoning Can Set You Free

A "cultural rationale for science education"

What do you hope to learn from your research system? To answer this question, we suggest moving beyond the traditionally taught "scientific method" to better appreciate the three forms of knowledge that is embodied by authentic scientific reasoning:

- Content Knowledge (*What exists?*)
- Procedural Knowledge (*Why does it happen?*)
- Epistemic Knowledge (*How do we know it to be true?*)

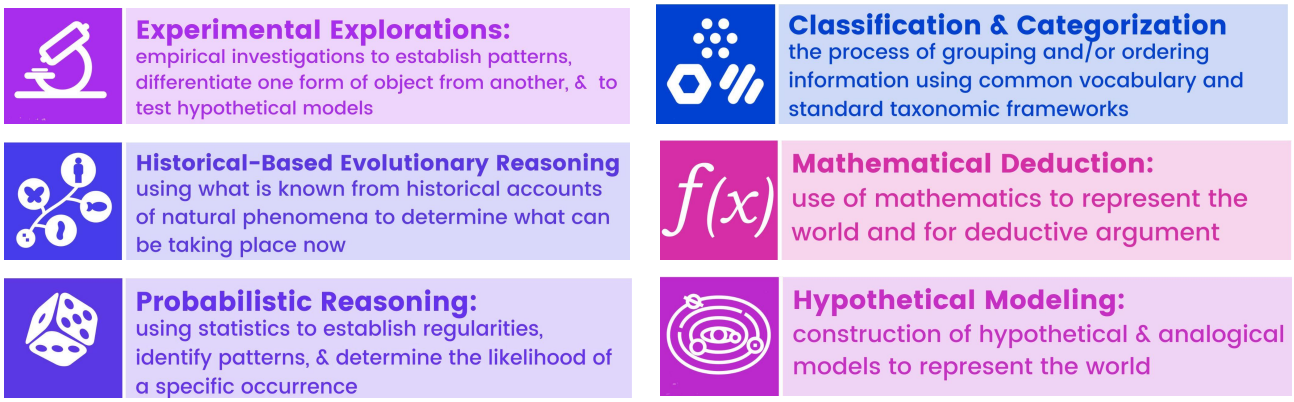
From here we can then move on to contextualize these forms of knowledge and ask: *What can we do with this collection of knowledge*?
https://doi.org/10.1002/sce.21251

In following the styles of scientific reasoning when thinking about our research design, we are able to incorporate the role of culture in shaping how we view and interpret knowledge. This is to say that the styles of scientific reasoning allow us to acknowledge our positionality -- or how our values, views, and location in time and space -- drives how we understand the world around us.

Defining the styles of scientific reasoning

In articulating six distinct styles of scientific reasoning we can better assess how to approach conducting research in

a particular system in a way that can align with research goals. Descriptions of these distinct styles of reasoning are elaborated upon in the graphics below. Note how this system helps to think beyond a controlled experiment.



Let's work through your experimental design!

Science is an incremental process

When scientists head to the lab, it is unlikely that any single day or experiment will provide a full answer. Instead, scientists will continue building on previous knowledge until a new scientific story emerges. This process, which takes place in seemingly small increments, often takes months or even years. Science, as an enterprise, may encompass all sorts of research questions that can be applied to an infinite number of research systems. However, all are unified by the idea of learning from failure. The process of designing, failing, reflecting, and iterating is what the scientific process is all about!

Begin by articulating what is known about your system

What is the system you will use to study a research question? What do you know about this system? Jot down your thoughts below.

Consider: What are your available resources?

What kind of time will you have to work on your research project? Is this something you can tend on a daily basis? Weekly? How much time per session can you dedicate? How many sessions are possible, and how will they be spread out?

What are the materials you have at your disposal? Are there materials that you don't have but can acquire with little effort?

What is the space you can use to conduct your experiment?

What kinds of human support do you have? Are you relying on just the internet?

Consider: What are your scientific interests?

Consider the styles of scientific reasoning -- is there an approach that resonates with you more than others? Note that you can use more than one style when designing your research!

Ask yourself what you like about this project -- what piques your curiosity?

Know thyself -- it's not just about your interests, it is also about knowing what you DON'T want to be doing! What are YOU hoping to learn from this experience?

Consider: What types of feedback can you get from others?

Speak your ideas out loud. Sometimes just hearing yourself reveals a lot! If you are going to pitch your idea to a friend or colleague, how would you describe it?

Get feedback from people who want to see you experience success, whatever that means for you :-) What does success mean to you in this context?

Consider: What can you measure?

Think about your research system, your resources, and your time. What kinds of research designs make the most sense? Do you have to collect data within an hour, or can your experimental approach take place over several days?

What are the metrics you will use for data collection? What kinds of resources does this involve?

Can you find a way to iterate on your work? How can you show rigor and reproducibility?