Socratic Seminar Toolkit

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Scholarly Engagement & Seminar Norms

What is "Scholarly Engagement" (10%)?

In this course, your engagement grade measures something *real*: whether you are practicing the skills scientists use to build understanding together.

You earn Scholarly Engagement credit through: - **iClicker participation** during in-class questions (often think–pair–share). - **In-class group inquiry activities.** - **Socratic Seminars** (a structured discussion where we interpret a shared "text," often a figure, spectrum, short excerpt, or dataset).

This is not "points for talking." It's credit for *doing the intellectual work* of astronomy in community.

What "good engagement" looks like (examples)

During discussion, lab-style activities, or seminar, strong engagement sounds like:

- "My claim is ***, because the plot shows*** ."
- "I'm not fully sure, but I think _____ **under the assumption that** _____."
- "Can we check the axis / units / trend again? If that's true, then _____."
- "An alternative explanation could be _____. What observation would separate them?"

You do *not* need to be loud to be engaged. You do need to be *evidence-based* and *constructive*.

Socratic Seminar norms (how we talk like scientists)

In seminar, our goal is **shared inquiry**, not performance.

1) Anchor claims in evidence.
If you make a claim, point to something specific: a line in the text, a feature in the figure, an axis label, a trend, a number.

2) Name assumptions out loud.
Astronomy is inference under constraints. Assumptions are part of the job, not something to hide.

3) Disagree with ideas, not people.
Use: "I interpret it differently because…" not "That's wrong."

4) Share the airtime.
If you've spoken a lot, practice listening. If you've been quiet, try one contribution: a question, a clarification, or one evidence-based claim.

5) Let uncertainty be normal (but not vague).
Uncertainty is fine. Vague claims are not. Try: "I'm ~70% confident because…"

Practical seminar roles (so everyone can contribute)

Depending on the day, you may be in an **inner circle** (speaking) or **outer circle** (observing + supporting).

Outer circle contributions that count as full engagement: - Track where the group used **evidence** well (and where we didn't). - Notice **assumptions** that were stated (or missing). - Identify a moment when someone **revised** their thinking. - Offer one "what would we measure next?" question during the debrief.

What hurts your Scholarly Engagement grade

- Side conversations during class or seminar
- Phone use that distracts you or others
- Dismissing classmates instead of engaging their reasoning
- Speaking without evidence (repeatedly) after redirection

Academic integrity and AI tools

Your thinking matters here. **Generative AI tools (e.g., ChatGPT, Copilot, Gemini, Claude) are prohibited for course-related assessments.**
That includes any for-credit written seminar prep/reflections, if assigned. If you're unsure whether something counts, ask before submitting.

Discourse Kit

Evidence & Reasoning Sentence Starters

Use these in Socratic Seminar, think–pair–share, and group inquiry activities. The goal is not fancy wording—it's clear scientific thinking.

Claim (what you think is true)

- "A conservative interpretation is that…"
- "The figure suggests that…"
- "My current best claim is…"

Evidence (what you're pointing to)

- "I'm basing that on _____ (axis/line/value/quote)…"
- "In the region where _____, the trend shows…"
- "The key detail is _____, which indicates…"

Reasoning (why the evidence supports the claim)

- "That supports the claim because…"
- "If _____ increases, then _____ should change because…"
- "The physical story is: _____ → _____ → _____."

Assumptions (what must be true)

- "This depends on the assumption that…"
- "We're implicitly assuming _____ (calibration / geometry / equilibrium / negligible dust)…"
- "If that assumption fails, the conclusion could change by…"

Alternative explanations (how to avoid tunnel vision)

- "Another explanation consistent with the data is…"
- "A competing model would predict…"
- "These interpretations differ mainly in the assumption that…"

Uncertainty (allowed; vagueness is not)

- "I'm about ___% confident because…"
- "The biggest uncertainty is…"
- "I'm unsure whether _____ or _____, because the data don't constrain…"

Discriminating tests (what would we measure next?)

- "A measurement that would distinguish these is…"
- "If we observe ***, it would support model A; if we observe*** , it would support model B."
- "The next-best observation would be _____ because it reduces the degeneracy between…"

Building on others (collaboration moves)

- "I want to build on what _____ said by adding…"
- "I agree with _____ under the condition that…"
- "I interpret that differently because the evidence suggests…"

Common Astronomy Inference Pitfalls

Astronomy is inference under constraints. These pitfalls are *normal*—the goal is to notice them early and build guardrails.

Use this sheet during problem-solving and seminar.

1) Mixing up what's measured vs what's inferred

Guardrail: Write "Observable:" and "Inference:" separately.
Example: flux is measured; distance is inferred using a model.

2) Confusing brightness with luminosity

- **Brightness (flux)** depends on distance.
- **Luminosity** is intrinsic power output.
  Guardrail: Ask: "Is this property distance-dependent?"

3) Treating a model assumption as a fact

Examples: circular orbits, equilibrium, "standard candle," negligible dust.
Guardrail: Say: "This conclusion holds *if* _____."

4) Over-claiming (data show X → therefore theory Y is true)

Data usually constrain a *family* of models.
Guardrail: Ask: "What else could explain this pattern?"

5) Ignoring selection effects ("what got into the dataset?")

What you observe is shaped by detection limits and survey design.
Guardrail: Ask: "What might be missing, and why?"

6) Forgetting units or axis scaling (especially log axes)

A straight line on a log plot means something different than on a linear plot.
Guardrail: Always write the units and identify linear vs log.

7) Confusing correlation with causation

Two quantities can vary together due to a third variable or measurement bias.
Guardrail: Ask: "What mechanism connects them? What would break the trend?"

8) Treating uncertainty as a footnote

Uncertainty is part of the claim.
Guardrail: Try: "I'm ~___% confident because…" and name your biggest uncertainty.

9) Single-figure tunnel vision

A great plot can still be misleading without context (calibration, sample, method).
Guardrail: Ask: "What information is missing that could change interpretation?"

The most scientific question you can ask:
"What observation would discriminate between these explanations?"

Figure Kit

How to Read a Scientific Figure (Micro-Guide)

Name: _____ **Date:** _____

Astronomy is a science of *inference*. A figure is not "the truth"—it's a compact argument made out of data, axes, and assumptions.

Step 0: Identify the figure's job (one sentence)

This figure is trying to show:

_____

Step 1: Read the axes like a scientist

- **What are the axes?** (write the full variable names, not just symbols)
  x-axis: _____ **units:** _____
  y-axis: _____ **units:** _____
- **What is *measured* vs *inferred*?**
  Measured (observables): _____
  Inferred (model-dependent): _____
- **What is the scale?** (linear/log; important!)
  linear log mixed/other: _____

Step 2: Describe the pattern (before you interpret it)

Use literal description first.

- **Trend:** _____
- **Scatter / uncertainty:** _____
- **Outliers:** _____
- **Range / limits:** _____

If error bars exist: what do they represent? measurement error intrinsic scatter not sure

Step 3: What claim does the figure support (conservatively)?

Conservative claim (supported by what's shown):

_____

Evidence in the figure (point to a specific feature/value/region):

_____

Step 4: Name at least one assumption

Interpretation requires assumptions. Name one.

Assumption: _____
If this assumption fails, the interpretation might change because:

_____

Step 5: Ask the "discriminating test" question

What new measurement would best reduce ambiguity?

Next measurement: _____

If we saw _____, it would strengthen the claim. If we saw _____, it would weaken it.

Quick checklist (for seminar)

I can say what each axis means and its units.
I separated *description* from *interpretation*.
I named at least one assumption.
I can propose a next measurement.

Socratic Seminar Prep — Half-Sheet

Name: _____ **Date:** _____
Seminar topic / "text" (figure, excerpt, dataset): _____

1) My Claim (one sentence)

Write a *specific* claim that you think the "text" supports.

Claim:

2) Evidence (two concrete pieces)

Point to *specific* evidence: a quoted phrase, a trend, an axis label + value, a feature in a spectrum, etc.

Evidence #1 (what I'm pointing to):

Why it supports my claim (one sentence):

Evidence #2 (what I'm pointing to):

Why it supports my claim (one sentence):

3) Assumption (what must be true for my claim to hold)

Name at least one assumption your inference relies on. (Examples: equilibrium, calibration, geometry, negligible dust, "standard candle" validity, selection effects.)

Assumption:

If this assumption fails, my claim would change like this:

4) Uncertainty (optional but strongly encouraged)

Try a confidence estimate *with a reason.*

I am about _____% **confident because**

5) Next Measurement (the discriminating test)

If you had one new observation/measurement you could make, what would best test your claim or distinguish between competing explanations?

Next measurement:

What outcome would strengthen my claim?

What outcome would weaken my claim?

6) One Question I want to ask the group

Ask something that pushes thinking forward (not a yes/no question).

Question: