Middle School Unit: What is a STEM career?

Lesson Level Performance Expectations:

Students work individually and in small groups to apply or create a use for technology to a problem they see in the world. Students are introduced to the design thinking process as part of this linkage. Design thinking is a multi-step process for creating and evaluating solutions. As introduced in the STEM class, this process will focus on technology-based solutions.

Previous Lesson:

Students explored how they are using technology in their environment. They discuss how technology is used in the world and what things technology can do that humans cannot do.

What We Figure Out: (Learning Objectives)

Students identify local and global problems that concern them and/or impact people close to them and understand the design thinking process. They come up with uses for technology to help solve the problems they identified. Students work in small groups to practice compassion for each other and the people they are attempting to help with their solution. They observe and learn from the solutions chosen by other groups.

BUILDING TOWARD

Connections to Engineering, Technology, and Applications of Science: Technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations.

TIMELINE

110 minutes (2 class periods)

INVESTIGATING

Local and global problems that concern them and/or impact people close to them.

SENSEMAKING

Using technology to help solve the problems they identified.

CRITIQUING

Gain experience working in a small group and practice compassion for each other and the people they are attempting to help with their solution.

GETTING READY: Materials

TEACHER

Teacher Materials

- Slides

STUDENTS

Student/Classroom Materials

- Student Activity Sheet (EN)
- Student Activity Sheet (SP)
- Student Activity Sheet - STEM Career Scavenger Hunt (EN)
- Student Activity Sheet - STEM Career Scavenger Hunt (SP)
- STEM Career Scavenger Hunt PPT Slide Template

ACTIVITY

Activity Supplies

- STEM Career Cards
- STEM Career Continuum Line

This material is based on work supported by the National Science Foundation (NSF) under award #DRL - UCAR: 1949322, CU: 1948709, USU: 1949299.

LEARNING PLAN: (for a more detailed description, click on the number to the left)

1. **(5 min)** Introduce students to the career card sort activity.
2. **(10 min)** In small groups, students sort the cards along a continuum from non-STEM careers to STEM careers.
3. **(10 min)** Have groups share their sorting and reasoning for where they placed careers along the continuum.
4. **(5 min)** Have groups discuss and decide where the "line" is that separates STEM careers from non-STEM careers.
5. **(15 min)** Have groups share their definition of a STEM career with the class and have a consensus-building discussion to construct a class definition of a STEM career.
6. **(5 min)** Introduce the STEM career scavenger hunt.
7. **(35 min)** Next class: Students share the STEM careers they found in their community using a gallery walk.
8. **(15 min)** Students discuss STEM careers and career pathway opportunities in their community.

LEARNING PLAN

1 (5 min) Introduce students to the career card sort activity

Begin by telling students that we will be exploring STEM Careers today. Together we will figure out what we think a STEM job is versus a job that may use STEM or STEM skills. Have students discuss with a partner or in small groups the following prompts:

Suggested Prompts:

- What is STEM?
- What do you think a STEM job is?
- What makes a job a STEM job?

Listen for student responses such as:
(Note: answers may vary, and at this point there is not a right or wrong answer; we are only trying to elicit students' ideas)

- STEM is Science, Technology, Engineering, and Math. So, it is something that uses some or all of these parts.
- A STEM job uses Science, Technology, Engineering, and Math
- A STEM job might be one that uses most of these parts and focuses on one more than the others.
- For a job to be a STEM job, it has to use at least…

Assessment Opportunities This is a good opportunity to learn what students think STEM is and how it relates to STEM careers.

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LEARNING PLAN

(10 min) In small groups, students sort the cards along a continuum from non-STEM careers to STEM careers.

Break the students into small groups of 2-4. Give each group a set of career cards and a STEM Career Continuum Line (see example below), You can draw the continuum line on a blank piece of paper or write "non-STEM careers" on one sticky note and "STEM careers" on another sticky note to create a continuum line on a table top. Instruct the students to read about each career listed on the cards and decide where on the career continuum line it should be placed. Give the groups time to discuss and place each career on the career continuum line.

STEM Career Continuum Line Example:

Non-STEM Careers <----------> STEM Careers

As groups work to discuss and sort their cards, circulate among the groups to ask questions about their thinking while sorting the career cards.

Suggested Prompts:

- Why did you place this career there?
- What part(s) of STEM (Science, Technology, Engineering, Math) does this career use?
- What makes one career more STEM than another career?

Listen for student responses such as:

- Student responses might relate to how much time is spent using each of the STEM components or if a degree is needed for the career.

Discussion Strategies

INITIAL IDEAS DISCUSSION

Purposes

- To provide a supportive opportunity for students to make sense of their initial ideas (either their own or those of others).
- To support students in making tentative connections between questions being asked and the participants' experience and everyday ideas about observing a phenomenon

Some Unit Phases When Useful	Some Lesson Phases When Useful	Steps in A Possible Discussion Routine
• At the beginning of a unit • At the beginning of a new investigation within a storyline	"What are some ideas that could help us answer what we're wondering about?"	1. Provide a way for all students to surface their ideas (think-pair-share is one strategy). 2. Give people a chance to clarify one another's ideas and ask why people think their ideas are good ones. 3. Ask a student to summarize the initial ideas that the class has. 4. Ask students how they might test or further explore their ideas.

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POTENTIAL TALK MOVES FOR THIS DISCUSSION

When eliciting initial ideas:

- What are your ideas about how to explain this phenomenon?
- What's your "first draft" thinking about how to solve this design challenge?
- Let's see what we think about this phenomenon, using our past experiences and what we've learned in class this year as a guide.
- What experiences do you have that might help you with this phenomenon?

When clarifying ideas and pressing for reasoning:

- Can you say more about that? Where does that idea come from?
- Is that something you've heard, observed, or experienced before?
- What do you mean when you say the word "_____"?
- Can anyone add to this idea?
- Who has a different way of thinking about this topic?
- Can you think of an instance when this was not the case?

When asking a student to summarize initial ideas:

- Who can summarize some of the ideas we've heard today?
- Is this a complete summary? Can someone add what's missing?
- Does the summary capture our ideas accurately?

When asking students for how to investigate their initial ideas:

- What are some ways we could test our initial thinking?
- What ideas are we unsure about? Do we need to know more before we can be confident in them?

MAKING PARTICIPATION EQUITABLE

Think about what kinds of support your students might need to be able to ask each other these kinds of clarifying and summarizing questions without being critical or evaluative. You might try using the metaphor of a coach to introduce these think-pair-share routines. You could try telling students, "This is about helping your partner practice as a scientist and supporting them in their thinking, so you're going to ask questions, encourage them, and for now, your ideas will stay on the sideline. Then we'll switch, and you'll get a chance to share your ideas as your partner coaches you."

Tip: Have sentence starters ready for students so they know what to ask to push their partner further, but also have sentence starters to slow down the fast explainers, such as "Wait - you said that really fast. Can you say that again?"

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LEARNING PLAN

(10 min) Have groups share their sorting and reasoning for where they placed careers along the continuum.

Once groups have completed discussing and sorting the career cards, bring the class back together to have students share their thinking. This can be done as a gallery walk, leading to a whole group Building Understanding Discussion. The purpose of this discussion is for groups to share their thinking about where they placed STEM careers on the line and to have the opportunity to compare their thinking with other groups. There are different ways that you can choose to facilitate this sharing. You can have each group take turns explaining their sorting with the class. An alternate option for facilitating this discussion would be to focus on one specific career card at a time, having each group share where they placed that specific card. Repeat this until most or all of the cards have been discussed. Then, have students compare what is similar about cards that were sorted as STEM careers. This can help the students refine their own thinking about what a STEM career entails.

Suggested Prompts:

- Why did you place this career there?
- What parts of STEM does this career use?
- What makes one career more STEM than another career?

Listen for student responses such as:

- We put X job here because…
- In this job, they do… or use Science, Technology, Engineering, or Math.

Discussion Strategies

BUILDING UNDERSTANDINGS DISCUSSION

Purposes

- Students share their reasoning and evidence publicly so that other students can connect with, critique, and build upon ideas.
- Teachers and students clarify which understandings emphasized in the storyline have been developed and which need further development.

Some Unit Phases When Useful	Some Lesson Phases When Useful	Steps in A Possible Discussion Routine
After a series of lessons when a piece of understanding should have been built, toward the end of an investigation within the storyline	• "What did we figure out last time? What did we wonder about?" • "What have we figured out today? What questions do we still have?"	1. Invite a student or group to share their current explanatory model or design solution with the class. 2. Invite others to ask questions about the model/solution, suggest additions, and critique the model/solution. 3. Invite a second student or group to share their model/solution and then invite responses and critiques. 4. Ask students how the models/solutions compare in terms of similarities and differences. 5. Invite the class to consider what might need to be revised in models/solutions based on the models seen and the evidence so far.

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POTENTIAL TALK MOVES FOR THIS DISCUSSION

When inviting a group to share:

- What are some of the key components of your model/solution?
- How does this model explain the evidence we have so far about this phenomenon?
- How does this solution fit the criteria we identified for a possible solution?
- Is there any evidence you know your model/solution doesn't account for?
- Did you consider other models/solutions? If so, what were they?
- For a second group: How is your model/solution different from or similar to the ones presented earlier?

When inviting others to critique a model/solution:

- What questions do you have for this group about their model/solution?
- Can you clarify _____ aspect of your model/solution?
- Let me see if I understand this aspect of your model/solution here. Are you saying...?
- What do the rest of you think of that idea?
- Is there anything you can add to this model/solution?
- How well does this model fit the evidence we've gathered so far?
- How well does this solution meet the criteria we identified for the solution?
- What could the group do to improve the model/solution?

When inviting students to compare models/solutions and consider revisions:

- How does group A's solution connect to group B's?
- How do these models/solutions help us make sense of and contribute to our question at hand?
- What might a model/solution look like that we think best reflects all the evidence we have so far?
- Is there any evidence we have that none of our models/solutions can account for?

MAKING PARTICIPATION EQUITABLE

Consider lower-stakes ways for students to have these discussions, such as in a gallery walk where one person stays by the model to invite critique with the questions above, and the other students ask pressing questions. During critique-based interactions, it is important to emphasize "making our ideas stronger," not "showing that we have the best ideas."You can also encourage students to take a "coaching" stance here; their role is to ask questions that support others' ideas and encourage students to speak up when something needs to be repeated.

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LEARNING PLAN

(5 min) Have groups discuss and decide where the "line" is that separates STEM careers from non-STEM careers.

After the students have had a chance to discuss and compare their career card sorts, have them get back into their groups and tell the students, "Now that we have been able to compare our card sorts and come to some agreement about what makes a career a STEM career, we are going to need to get more specific with what we mean when we say a career is a STEM career or not." Instruct the students to discuss as a small group which point on the line might indicate that the careers to the right of that point are STEM careers and the careers to the left of this point are just careers that use STEM to some degree (See example below).

STEM Career Continuum Line Example:

Non-STEM Careers <----------X----------> STEM Careers

Careers the use STEM STEM Careers

As groups discuss, circulate among the small groups to ask guiding questions as needed.

Suggested Prompts:

- What makes a career a STEM career?
- How does this career use STEM?
- How much STEM is enough to make a career a STEM career?
- Why did you place the point there on the line?
- Why are these STEM careers and those are not? Why do you think it would matter to call a career a STEM career?

Listen for student responses such as:

- These jobs are STEM jobs because…
- These jobs are not STEM jobs because…

Discussion Strategies

INITIAL IDEAS DISCUSSION

Purposes

- To provide a supportive opportunity for students to make some sense of what may be not yet fully formed ideas (either their own or those of others).
- To support students in making tentative connections between the questions asked and the participants' experience and everyday ideas about observing a phenomenon

Some Unit Phases When Useful	Some Lesson Phases When Useful	Steps in A Possible Discussion Routine
• At the beginning of a unit • At the beginning of a new investigation within a storyline	"What are some ideas that could help us answer what we're wondering about?"	1. Provide a way for all students to surface their ideas (think-pair-share is one strategy). 2. Give people a chance to clarify one another's ideas and ask why people think their ideas are good ones. 3. Ask a student to summarize the initial ideas that the class has. 4. Ask students how they might test or further explore their ideas.

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POTENTIAL TALK MOVES FOR THIS DISCUSSION

When eliciting initial ideas:

- What are your ideas about how to explain this phenomenon?
- What's your "first draft" thinking about how to solve this design challenge?
- Let's see what we think about this phenomenon, using our past experiences and what we've learned in class this year as a guide.
- What experiences do you have that might help you with this phenomenon?

When clarifying ideas and pressing for reasoning:

- Can you say more about that? Where does that idea come from?
- Is that something you've heard, observed, or experienced before?
- What do you mean when you say the word "_____"?
- Can anyone add to this idea?
- Who has a different way of thinking about this topic?
- Can you think of an instance when this was not the case?

When asking a student to summarize initial ideas:

- Who can summarize some of the ideas we've heard today?
- Is this a complete summary? Can someone add what's missing?
- Does the summary capture our ideas accurately?

When asking students for how to investigate their initial ideas:

- What are some ways we could test our initial thinking?
- What ideas are we unsure about? Do we need to know more before we can be confident in them?

MAKING PARTICIPATION EQUITABLE

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LEARNING PLAN

5 (15 min) Have groups share their definition of a STEM career with the class and have a consensus-building discussion to construct a class definition of a STEM career.

Bring the students back together for a consensus-building discussion. The purpose of this discussion is to help the class come to a common definition of what a STEM career is. Begin by having each group show and share where they decided to place the point on their line. Ask each group to share their thinking and to provide their reasoning for placing the point where they did.

After each group has shared, ask the class, "What makes a career a STEM career versus a career that only uses STEM?" Let students from each group share their thinking. As they share, record ideas on the board or chart paper. Guide students to form a class definition of a STEM career. Use this class definition to guide future STEM career activities. You can leave this definition and the STEM continuum displayed in the classroom for this purpose.

Suggested Prompts:

- What makes a career a STEM career?
- How does this career use STEM?
- How much STEM is enough to make a career a STEM career?
- Why did you place the point there on the line?
- Why are these STEM careers and those are not?

Discussion Strategies

CONSENSUS BUILDING DISCUSSION

Purposes

- To press toward a common (class-level) explanation or model, resolving (if possible) disagreements, different perspectives, or partial understandings.
- To support public revision of earlier ideas, as new ideas are shared and as they learn information that makes visible the limitations of previous understandings held by individuals or even the class as a whole.

Some Unit Phases When Useful	Some Lesson Phases When Useful	Steps in A Possible Discussion Routine
• After a series of lessons when multiple pieces of understanding should have been built • At the end of an investigation within the storyline	"What have we figured out today? What questions do we still have?"	1. Ask students to take stock of where the class has been and what they've figured out, offering conjectures or pieces of a model, explanation, or solution. 2. Ask students to propose a synthetic model, explanation, or solution. 3. Ask students to support or challenge proposals and say what evidence is the basis for their support or critique. 4. Ask students to propose a modification to the model based on input from the class.

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POTENTIAL TALK MOVES FOR THIS DISCUSSION

During stock-taking:

- What are some things we can say at this point about our anchoring phenomenon that are supported by evidence?
- Could you clarify the link between your explanation and the evidence?
- Could someone restate our question (or our charge)? What are we building consensus about?

When inviting proposals for a synthetic model/explanation/solution:

- How are these explanations similar? How are they different?
- Both groups seem to be using the same term but in a different way. Could someone explain the difference?
- Could someone restate our question (or our charge)? What are we building consensus about?

When inviting support or critique:

- Who feels like their idea is not quite represented here?
- Would anyone have put this point a different way?
- What ideas are we in agreement about?
- Both groups seem to be using different wording to explain the same idea. Is that what you are hearing?
- Are there still areas of confusion or discontent?
- Are there still places where we disagree? Can we clarify these?

When inviting modifications to models/explanations/solutions:

- How could we modify what we have to ensure we account for the evidence we agree is important to consider?
- What modifications might you make to clarify any confusion or address the discontent the group feels?
- Is there more evidence or clarification needed before we can come to an agreement? What is that?

MAKING PARTICIPATION EQUITABLE

Many students are uncomfortable being the “only one” who voices a disagreement, discontent, or potentially incorrect idea, so ask students to think-pair-share and carefully listen to their partners’ ideas. Then, ask students to think about what they heard their partners saying and ask the room if their partners’ ideas are represented in the class discussion. This supports all students to share, listen, be heard, and be represented.

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LEARNING PLAN

(5 min) Introduce the STEM career scavenger hunt activity

Tell the students that they will be doing a STEM career scavenger hunt over the next week, and they will need to be ready to present their findings during a future class period. For the STEM scavenger hunt, students will investigate careers in their community and use the class definition of a STEM career to decide if that career is a STEM career or not. Students will need to identify at least one STEM career and one STEM-related career found in the community. Students will need to investigate and be prepared to share the following information about the careers they identify:

- What is the title of the career?
- What would a person in this career do?
- How does this career use STEM (Science, Technology, Engineering, Math)?
- Based on our class definition, would you consider this a STEM career? Why or why not?
- How does this career serve your local community?
- What types of training or education would you need to have this career?

To investigate local STEM careers, students can:

- Do an online search for local businesses.
- Talk with family, relatives, neighbors, etc., about STEM careers they may be aware of.
- Talk to a local post-secondary or vocational education provider.

Differentiation Strategies and Alternate Activities

The STEM Career Scavenger Hunt can be completed using a few different options:

- Students can create a Google slide document with a slide for each career.
- Students can use Flipgrid to share what they found about each career.
- Students can create a poster showing what they discovered about each career.

Additional Supports

You may need to provide a list specific to your local community with resources to help students identify where they can find STEM in their local community. A good place to start is the local Chamber of Commerce, local business listings, and the local STEM alliance if present.

LEARNING PLAN

(35 min) Next class: Students share the STEM careers they found using a gallery walk.

Begin the class by reorienting students to the STEM card sort lesson, e.g., "What did we do last time we talked about STEM careers with the card sort?" Allow students to share. Tell the students that they will be sharing about the careers they investigated. This can be done using a gallery walk strategy or another format depending on how students completed the assignment (e.g., Google slides, Flipgrid, posters, etc.) Give students time to explore the careers their classmates discovered. You may want to have students record which careers they want to know more about. Encourage discussion about STEM-related careers in their community.

Suggested Prompts:

- What is the title of the career?
- What would a person in this career do?
- How does this career use STEM?
- Would you consider this a STEM career? Why or why not?
- How does this career serve your local community?
- What types of training or education would you need to have this career?
- Are there any careers you would like to know more about?

Discussion Strategies

BUILDING UNDERSTANDINGS DISCUSSION

Purposes

- Students share their reasoning and evidence publicly so that other students can connect with, critique, and build upon ideas.
- Teachers and students clarify which understandings emphasized in the storyline have been developed and which need further development.

Some Unit Phases When Useful	Some Lesson Phases When Useful	Steps in A Possible Discussion Routine
After a series of lessons when a piece of understanding should have been built, toward the end of an investigation within the storyline	• "What did we figure out last time? What did we wonder about?" • "What have we figured out today? What questions do we still have?"	1. Invite a student or group to share their current explanatory model or design solution with the class. 2. Invite others to ask questions about the model/solution, suggest additions, and critique the model/solution. 3. Invite a second student or group to share their model/solution, then invite responses and critiques. 4. Ask students how the models/solutions compare in terms of similarities and differences. 5. Invite the class to consider what might need to be revised in models/solutions based on the models seen and the evidence so far.

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POTENTIAL TALK MOVES FOR THIS DISCUSSION

When inviting a group to share:

- What are some of the key components of your model/solution?
- How does this model explain the evidence we have so far about this phenomenon?
- How does this solution fit the criteria we identified for a possible solution?
- Is there any evidence you know that your model/solution doesn't account for?
- Did you consider other models/solutions? If so, what were they?
- For a second group: How is your model/solution different from or similar to the ones presented earlier?

When inviting others to critique a model/solution:

- What questions do you have for this group about their model/solution?
- Can you clarify _____ aspect of your model/solution?
- Let me see if I understand this aspect of your model/solution here. Are you saying...?
- What do the rest of you think of that idea?
- Is there anything you can add to this model/solution?
- How well does this model fit the evidence we've gathered so far?
- How well does this solution meet the criteria we identified for the solution?
- What could the group do to improve the model/solution?

When inviting students to compare models/solutions and consider revisions:

- How does group A's solution connect to group B's?
- How do these models/solutions help us make sense of and contribute to our question at hand?
- What might a model/solution look like that we think best reflects all the evidence we have so far?
- Is there any evidence we have that none of our models/solutions can account for?

MAKING PARTICIPATION EQUITABLE

Consider lower-stakes ways for students to have these discussions, such as in a gallery walk where one person stays by the model to invite critique with the questions above, and the other students ask pressing questions. During critique-based interactions, it is important to emphasize "making our ideas stronger," not "showing that we have the best ideas."You can also encourage students to take a "coaching" stance here. Their role is to ask questions that support others' ideas and encourage students to speak up when something needs to be repeated.

Additional Guidance

Depending on the class size, you may choose to have each student only share about one or two of the careers they investigated.

Differentiation Strategies and Alternate Activities

The STEM Career Scavenger Hunt can be completed using a few different options:

- Students can create a Google slide document with a slide for each career.
- Students can use Flipgrid to share what they found about each career.
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LEARNING PLAN

(15 min) Students discuss STEM careers and career pathway opportunities in their community.

Bring the class back together for a whole group discussion. This discussion aims to help the students become more aware of where STEM is in their community, what STEM careers are present in their community, and what opportunities to engage in STEM careers and career pathways are present in their local community. Use the following prompts in your class discussion:

Suggested Prompts:

- Did you discover anything unexpected or surprising?
- What types of STEM careers did we find here in our community?
- How does STEM help our community?
- How would a person get a STEM career?
- What education or training do you need for STEM careers?
- What opportunities for STEM careers or education are here in our community?
- Are any of you interested in learning more about a STEM career?

Discussion Strategies

BUILDING UNDERSTANDINGS DISCUSSION

Purposes

- To press toward a common (class-level) explanation or model, resolving (if possible) disagreements, different perspectives, or partial understandings.
- To support public revision of earlier ideas, as new ideas are shared and as they learn information that makes visible the limitations of previous understandings held by individuals or even the class as a whole.

Some Unit Phases When Useful	Some Lesson Phases When Useful	Steps in A Possible Discussion Routine
After a series of lessons when multiple pieces of understanding should have been built at the end of an investigation within the storyline	"What have we figured out today? What questions do we still have?"	1. Ask students to take stock of where the class has been and what they've figured out, offering conjectures or pieces of a model, explanation, or solution. 2. Ask students to propose a synthetic model, explanation, or solution. 3. Ask students to support or challenge proposals and say what evidence is the basis for their support or critique. 4. Ask students to propose a modification to the model based on input from the class.

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POTENTIAL TALK MOVES FOR THIS DISCUSSION

During stock-taking:

- What are some things we can say at this point about our anchoring phenomenon that are supported by evidence?
- Could you clarify the link between your explanation and the evidence?
- Could someone restate our question (or our charge)? What are we building consensus about?

When inviting proposals for a synthetic model/explanation/solution:

- How are these explanations similar? How are they different?
- Both groups seem to be using the same term but in a different way. Could someone explain the difference?
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When inviting support or critique:

- Who feels like their idea is not quite represented here?
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- Both groups seem to be using different wording to explain the same idea. Is that what you are hearing?
- Are there still areas of confusion or discontent?
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When inviting modifications to models/explanations/solutions:

- How could we modify what we have to account for the evidence we agree is important to consider?
- What modifications might you make to clarify any confusion or address the discontent the group feels?
- Is there more evidence or clarification needed before we can come to an agreement? What is that?

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