CER and PHET

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 Traverse City, Michigan

unmute!

Questions?
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Objective

Consider how to “squeeze more out of PhET” by incorporating CER (Claim, Evidence and Reasoning)

How? View 3 strategies to blend the use of Phet with CER and walk through implementation of 1 of the strategies
NGSS: Science and Engineering Practices

“Look and Feel of the task”  

Students should be:

- Obtaining, Evaluating, and Communicating Information
- Engaging in Argument from Evidence
- Asking Questions and Defining Problems
- Constructing Explanations and Designing Solutions
- Developing and Using Models
- Using Mathematics and Computational Thinking
- Analyzing and Interpreting Data
- Planning and Carrying Out Investigations
Engaging in Argument from Evidence

Constructing Explanations and Designing Solutions

Asking Questions and Defining Problems
Constructing Explanations and Designing Solutions

The products of science are explanations and the products of engineering are solutions.

Engaging in Argument from Evidence

Argumentation is the process by which explanations and solutions are reached.
CER: Claim   Evidence   Reasoning + PhET Simulations

“Look and Feel of the task”

Engaging in Argument from Evidence

Constructing Explanations and Designing Solutions

Asking Questions and Defining Problems

Planning and Carrying Out Investigations

Developing and Using Models

Analyzing and Interpreting Data
<table>
<thead>
<tr>
<th>Section</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asking Questions and Defining Problems</td>
<td>A practice of science is to ask and refine questions that lead to descriptions and explanations of how the natural and designed world works and which can be empirically tested.</td>
</tr>
<tr>
<td>Developing and Using Models</td>
<td>A practice of both science and engineering is to use and construct models as helpful tools for representing ideas and explanations. These tools include diagrams, drawings, physical replicas, mathematical representations, analogies, and computer simulations.</td>
</tr>
<tr>
<td>Planning and Carrying Out Investigations</td>
<td>Scientists and engineers plan and carry out investigations in the field or laboratory, working collaboratively as well as individually. Their investigations are systematic and require clarifying what counts as data and identifying variables or parameters.</td>
</tr>
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<td>Analyzing and Interpreting Data</td>
<td>Scientific investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists use a range of tools—including tabulation, graphical interpretation, visualization, and statistical analysis—to identify the significant features and patterns in the data. Scientists identify sources of error in the investigations and calculate the degree of certainty in the results. Modern technology makes the collection of large data sets much easier, providing secondary sources for analysis.</td>
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SQUEEZING THE MOST OUT OF THE PhET
Engaging in Argument from Evidence

Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments.
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Provide an already accepted statement (ex/ Boyle’s Law).

Students test it with PhET simulation. Students list evidence/data found from simulation.

Students share out Evidence. Students use evidence to reason: Therefor [claim] is (or is not) supported because [summarize evidence]
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students test it with PhET simulation. Students list evidence found from simulation.

Students use evidence to reason: Therefor [claim] is (or is not) supported because [summarize evidence]

GOOD for more complicated statements that would be hard for them to discover on own or that need a lot of modeling for students to understand.
<table>
<thead>
<tr>
<th>Accepted Statement</th>
<th>When temperature and number of moles of a gas are held constant, then the pressure and volume of the gas are inversely related.</th>
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<td><strong>What must be manipulated?</strong></td>
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<td>Provide a reason supporting the accepted statement.</td>
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Engaging in Argument from Evidence

Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge, and student-generated evidence.
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Round 1: Students are given time to “play around” with the PhET and learn how to work the simulation. Students share out in small group what they have learned about the tools and controls in the simulation.

Round 2: Each student then explores further (provide time frame). At the end they develop a claim. Share claim in small group.

Round 3: Test own claim or test claim of another group member. Write down the evidence and develop a reason to support or refute the claim.
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Good for claims that are more obvious for students to see on their own, considering what typical background knowledge/schema they already have.
<table>
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<th>Round One: what I learned about the simulation’s tools and controls (note 3).</th>
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Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence.
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Give students specific questions to investigate.

Students use simulation to arrive at data.

Provide a claim; students test it with PhET simulation. Students list evidence found from simulation. Students use evidence to reason: Therefore [claim] is (or is not) supported because [summarize evidence]
<table>
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<th>Teacher provided open ended questions</th>
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<tr>
<td>Evidence (list several pieces of evidence from working with simulation)</td>
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<td>Reasoning: Therefor [claim] is (or is not) supported because [summarize evidence]</td>
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Provide the accepted claim; students test it and find evidence to support it

*Good for complicated statements*

Have students make a claim

*Good for easy to discover claims*

Give students questions to investigate; they gather evidence and make claims.

*Good when wanting students to explore specific topics.*

Let’s take it for a spin...
Let’s give it a spin with “Molecule Polarity”

1) Assess the pre-teaching needed, plan and do: vocab and minimal concepts
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- Electronegativity - review
- Bond dipole - review
- Review small delta notation for partial charge
- Review types of bond names

Arrow showing bond dipole - let them discover

I might let them play around with the electrostatic potential, electron density and electron field without predefining and circle back.
Let’s give it a spin with “Molecule Polarity”

2) What is the learning standard/objective that you want students to learn from using this PhET?
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<td>What is the relationship between electronegativity (EN) of the atoms involved in the bond and the nature of the bond?</td>
<td>What is the relationship between EN of the atoms involved in the bond and the partial charges?</td>
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Considerations

**F2F:** Small Groups pre-set vs Students self grouping. Strict time limits with rounds. I would prefer paper copies.

**Remote:** I would premake my groups. I would premake the template (tables) in a google document view only that had one table copy / student (if group size is 3; 3 tables). In a google meet or in written directions, I would list the groups and highlight the name of the student who is to go make a copy of the template and share with others. I might prompt more about the simulation tools as conversation would be more difficult.
How I group students: “Work with 7 o’clock today”

<table>
<thead>
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<th>Triad A</th>
<th></th>
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</tr>
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Which PhETs?
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