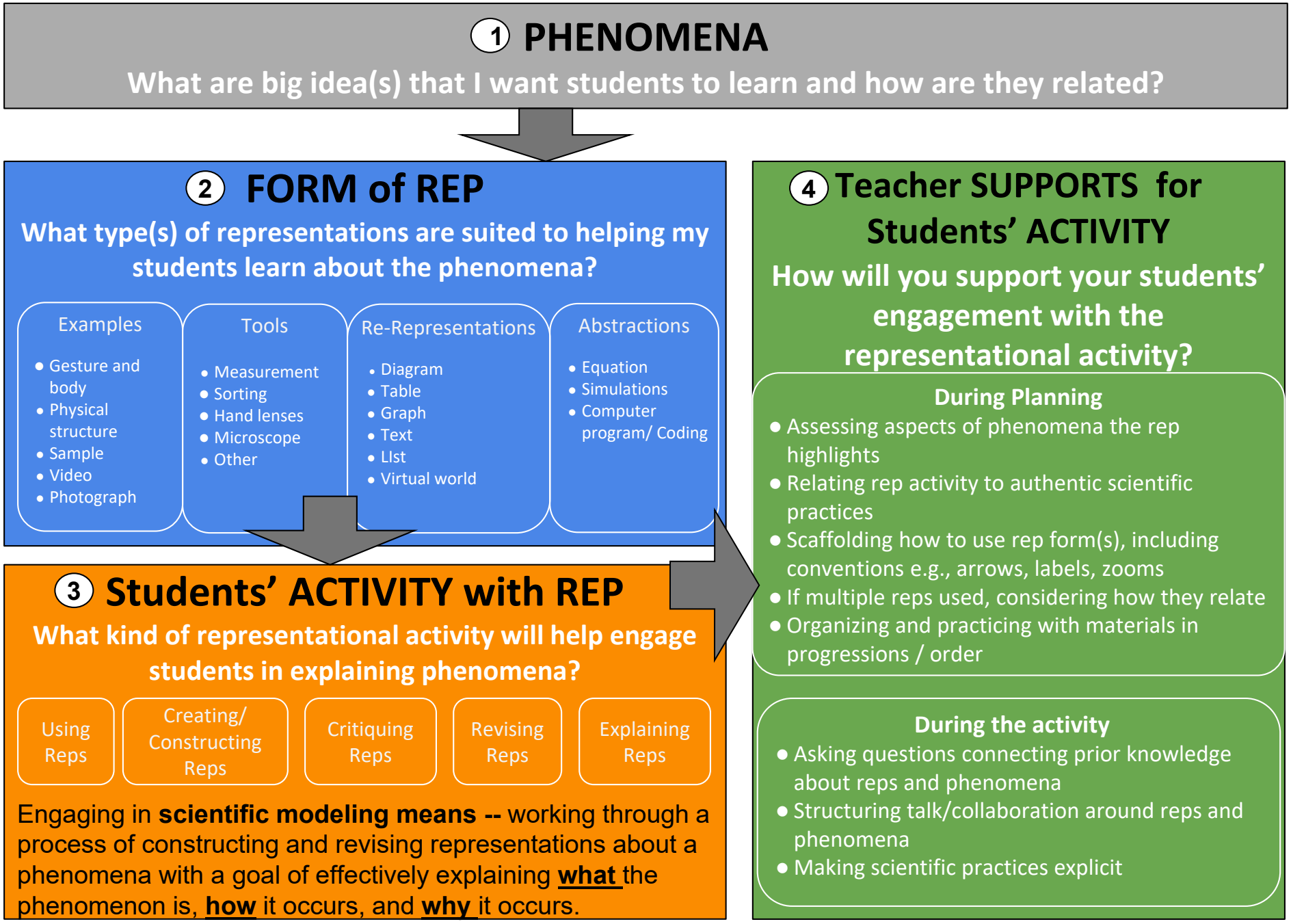

The RepTaL Project: www.reptalproject.org

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FORM of REPRESENTATION(s)

What type of representations are suited to helping my students learn in that way?

	Examples	Tools	Re-representations	Abstractions
Forms	- Gestures & body - Physical structure - Sample - Video - Photograph	- Rulers - Graduate Cylinders - Sieves - Hand lenses - Microscope	- Diagram - Table - Graph - Text - List - Virtual world	- Equations - Simulations - Computer programs/Coding
Value in supporting learning	Useful for observing and highlighting a phenomena, and getting students on the same page to begin their inquiry process.	Important for supporting detail observations or mathematical comparison of things in the world. Also, for separating items for closer examination. Tools are often used to create new re-representations (e.g., a table of measurement or schematic of layering).	Supports students to see information in new ways, often supporting them in seeing relationships between data (e.g., comparing sizes). Can be selected for students to organize data in a particular manner (e.g., a table) or student choice is given to allow their own connections to be made (e.g., a drawing).	The value of abstractions is in how they reveal general properties and principles, and can be used across concepts and ideas.
Planning considerations	• What features or ideas about the phenomena are being represented? • How does the representation change the way you see a phenomena and support student understanding?			

ACTIVITIES with REPRESENTATION(s)

What kind of representational activity will help engage students in learning in this way?

	Using	Creating	Critique/Giving Feedback	Revising Representations	Explaining
Description and how this supports learning	Students use representations they are given to investigate phenomena and document their findings. This is useful for scaffolding students' work in ways that highlight specific ideas.	Students create NEW representation(s) of their thinking about a phenomena. This is a great way to begin constructing explanations and thus knowledge. Explanations and feedback can then support revision of students' representations.	Students give and receive feedback about representations in terms of their scientific validity, clarity, and other criteria that are important in your classroom. Giving feedback helps students engage more deeply with their peers' ideas, and receiving feedback helps students revise their own.	Students revise representations based on feedback and/or new evidence obtained. It is important to make time for this as refining representations often gives students an opportunity to revise and explore the underlying ideas. This is also more like the practice of professional scientists.	Students explain representations that are already made (theirs or someone else's including one from the teacher). This helps make students' thinking and understanding of the representation visible for them and their peers.
Planning considerations	What aspects of phenomena are important to investigate? How will students document their investigation? How will students analyzed any data collected?	What aspects of the phenomena are important for students to represent? What representational conventions (e.g., arrows, "zooms") might help them represent? Will students create individually or collaboratively?	How could students share their science ideas beyond the teacher? What classroom norms need to be in place for feedback to be constructive? What is important for students to share about the phenomena? About the representation?	How can I provide opportunities for revision? What is important for students to revise? What should revisions be based on? (Feedback? Criteria? Etc.)	What aspects of a phenomena are important to notice and explain? How will you support students in providing evidence to back up explanations? What level should explanations occur on?

ENGAGING in LEARNING

How will I support student engagement with the phenomena?

	Constructing Knowledge	Explaining with Evidence	Sharing Knowledge	Revising Explanations	Highlighting
How reps can support learning	Reps can be used to help students explore new ideas, developing new understandings as they work. This is in contrast with simply telling them, which is less effective. Creating new representations is often a powerful way to support this.	Reps can be used to record (e.g., table), illustrate (e.g., diagram), or generate (e.g., model) evidence to *explain* natural phenomenon. Evidence can be used to generate explanations and representations of explanations. **Levels of Explaining:** **1) What?** **2) How?** **3) Why?**	Reps can support students in *communicating* and getting feedback on their developing science ideas – as scientists do. This helps them think about how to communicate ideas, and is also a great way to help them refine their ideas as they think about an audience.	Scientists develop ideas through cycles of proposing explanations, collecting evidence, and revising explanations. This can often be done with and through representations. Revising reps in response to feedback also supports the construction of knowledge and explanations.	Reps can *highlight* aspects of science phenomena that are not obvious by just observing. This is best used in service of other approaches that support the construction of knowledge and explanations based on noticing those features.
Planning considerations	How can the rep be used to have students engage actively with constructing new knowledge rather than as passive recipients of knowledge? Could students make a rep to explore their own ideas?	Does the rep allow students to show "what", "how" or maybe even "why" something is happening? Does the rep help students use evidence in their explanations, or generate evidence towards a fuller explanation?	How does sharing help students reflect on what they are learning? How could students share their science ideas beyond the teacher (peers, parents)? What is important for students to share?	How can I help students see the value in iterating on ideas? How can representations support this process? Should the rep be revised, or new ones created?	Does the rep highlight something I want students to learn? How can I help my students notice differences between the rep and what it's representing?

Other considerations: **Background knowledge:** What knowledge of science phenomena and representations do students bring from experiences in school AND home? **Understandability of rep:** Are there features of the representation that will make it unclear to students? Ex. too much text, unclear use of arrows, missing important aspects of phenomena

Alignment of Life Square phenomenon, representational forms, and learning activities with SEPs and CCCs dimensions.

Phenomenon – What and how do our squares change?	Representational Forms[a] Included	Representation Learning Activity	Dimension – SEPs	Dimension – CCCs
Day 1 - Teachers represented the contents in their one-meter square plot using at least two ways of showing what is found in the square.	• Samples/ Materials • Photos • Diagrams • Tables • Text/List	• Creating Representations • Using Representations	• Develop & Use Models • Use Mathematics • Obtain, Evaluate & Communicate Information	• Patterns • Systems and System Models[b] *(specifying boundaries)*
Day 2 – Teachers were to add to their prior representations identifying differences from Day 1 to Day 2 of items in their square.	• Samples/ Materials • Photos • Diagrams • Tables • Text/List	• Creating Representations • Using/Gather Representations • Revising Representations (Day 1&Day 2)	• Develop & Use Models • Analyze & Interpret Data • Use Mathematics • Obtain, Evaluate & Communicate Information	• Patterns • Systems & System Models[b] • Scale, Proportion, Quantity
Day 3 *[1 month later]* – Teachers return to their original squares and similar to Day1 record content of items in their square. They also compared Day 1 and 2.	• Samples/ Materials • Photos • Diagrams • Tables • Text/List • Grid drawings	• Creating Representations • Using/Gather Representations • Feedback on Representations • Revising Representations	• Develop & Use Models • Analyze & Interpret Data • Use Mathematics • Obtain, Evaluate & Communicate Information	• Patterns • Scale, Proportion, Quantity • Systems & System Models[b]
Days 4 and 5 – Teachers compile representations and using conventions (e.g., arrows) indicate movement, growth, and new positions of materials. Discussion as a whole group occurs about similarities and differences in the content of the squares and processes of change.	• Samples/ Materials • Photos • Diagrams • Tables • Text/List • Graphs	• Creating Representations • Feedback on Representations • Revising Representations • Explaining Representations	• Develop & Use Models • Analyze & Interpret Data • Use Mathematics • Construct Explanations • Engage in Argument from Evidence • Obtain, Evaluate & Communicate Information	• Patterns • Cause & Effect: Mechanism & Explanation • Scale, Proportion, Quantity • Systems & System Models[b] • Stability and Change

[a] Compilation of representational forms included across the teachers' recordings.

[b] Making explicit model of system