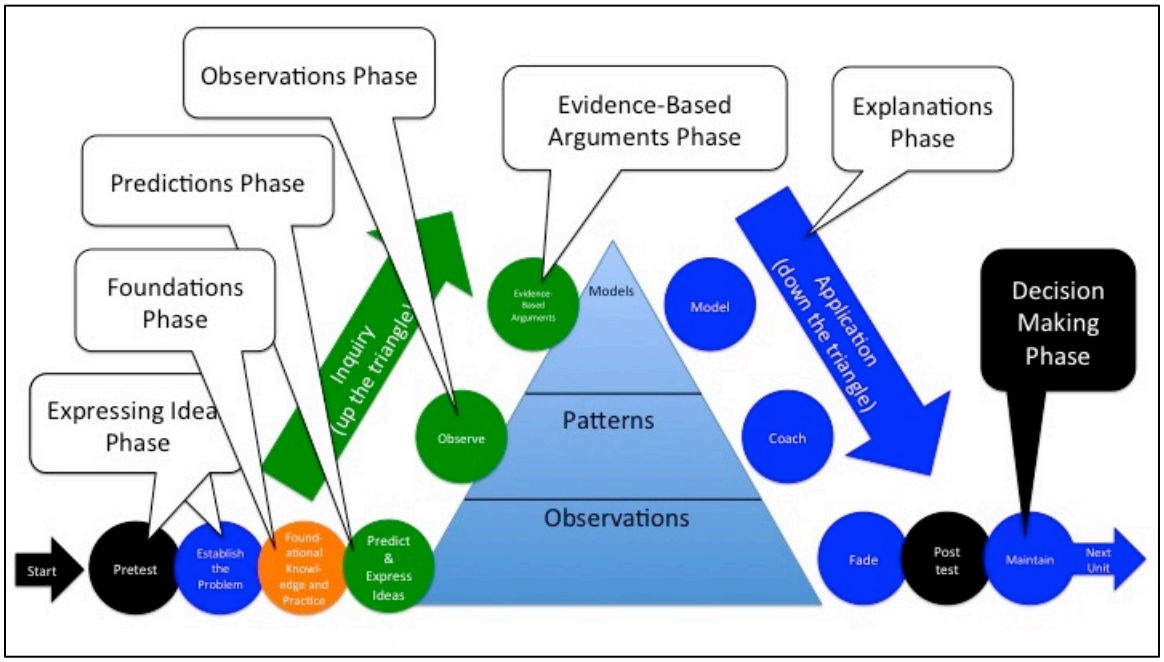
Carbon TIME Talk and Writing Goals

Research Findings
Carbon TIME is a project about teaching and learning. It is also a project about research on how we teach and learn. One of our research interests is on how teachers and students create a classroom environment that is supportive of rigorous and responsive teaching and learning. We have watched a lot of videos of teaching, and we have discovered that some teachers do an outstanding job of creating environments in their classroom that support student **talk** and **writing**. Specifically, some teachers give their students lots of opportunities to share and examine their own ideas in a whole class, in small groups, in pairs, and as individuals. So one of our goals for *Carbon TIME* professional development is to share with you what we've seen happening, so you can work to create environments that are supportive of talk and writing in your classroom as well.

Why focus on talk and writing?
But who cares about talk and writing? Why do we think this is such an important part of learning? For your students, talking and writing are ways of learning. Through trying to explain their ideas, and comparing and contrasting their own ideas with the ideas of others, students develop and practice a second language for describing scientific phenomena. By writing their ideas down, students can analyze and revise their own writing, and also revisit their ideas at a later point in time to see how their ideas change. For you as a teacher, hearing your students express their ideas out loud and in writing is a way of assessing the state of their thinking, and it helps you understand what their needs are as individuals and as a class. It also helps you identify patterns in their thinking that you would not have access to if they didn't try to say and write their ideas.

This is a lot to ask!
NGSS supporting documents make it clear that "Learning to explain phenomena and solve problems is the central reason students engage in the three dimensions of the NGSS" (Achieve, 2016). They do this through talk and writing as they articulate their ideas and revise them based on evidence and scientific models throughout a unit. This is very different (and much more challenging!) than simply memorizing facts. Creating a classroom community where students feel comfortable sharing their ideas and where everyone's goal is to figure out phenomena rather than just learning information is no easy task. Decades of research in science classrooms have demonstrated that typical classroom talk promotes procedural display rather than developing and using scientific knowledge in authentic ways. Procedural display refers to playing the "classroom game" in which the students are just learning the teacher's answers and repeating them back to earn a good grade. Creating a classroom driven by curiosity about phenomena where talk and writing is used to work on ideas rather than practice correct answers takes a lot of intentional support from teachers.

Talk and Writing Goals within *Carbon TIME* Units
Each Carbon TIME unit has six talk and writing **phases**. Each of these phases has specific talk and writing goals. This document overviews the first five of these phases, and how the curriculum supports these different goals.

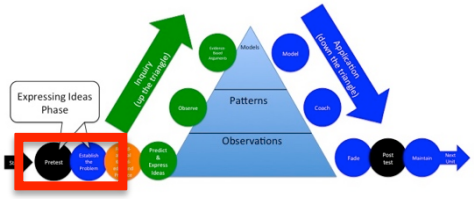


What we see in the videos that DOES support talk and writing goals for all phases:

- Students have opportunities to share and examine their ideas with the whole class, in small groups, with partners, and as individuals (through talk and writing).
- Students ask (as well as answer) conceptual questions about phenomena.
- Teachers use a variety of talk strategies to facilitate classroom talk and discussion.
- Follow up questions to student ideas inquire about their thinking with respect to content-knowledge as well as **matter** and **energy** at different **scales**.
- The teacher references the phenomenon and driving question many times during each lesson and helps students understand how each activity will help them figure out something.

What we see in the videos that does NOT support talk and writing goals for all phases:

- The teacher is the primary speaker during class.
- Students rarely share their ideas (or if they do, it is the same 3-5 students).
- Student ideas are rarely discussed as a whole class, in a small group, or with a partner.
- Teachers tend to ask a lot of factual questions and focus on whether students are answering "right" or "wrong."
- Follow up questions focus on *procedure* or *content-knowledge*, but lack a focus on what is happening to matter and energy at different scales.



Expressing Ideas Phase

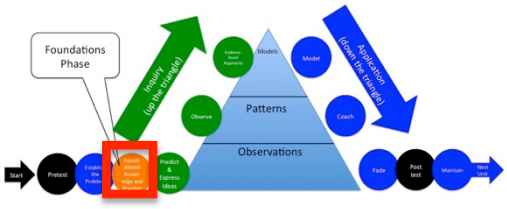
Talk and Writing Goals for Expressing Ideas Phase	Teacher Talk Strategies That Support This Goal	Curriculum Components That Support This Goal
Treat this as brainstorming and elicitation of student ideas.	*Remember, there are no "right" answers at this point. We want to hear all ideas.*	Unit Pretest My Students' Answers
Listen for student ideas about **matter** and **energy** at different **scales**, but do not correct wrong ideas.	*Where did the energy come from?* *Where does the matter go next?* *Are you talking about matter or energy?* *What about the atomic-molecular scale?*	Unit Pretest **Expressing Ideas Tool**
Elicit a range of ideas. Press for details. Encourage students to examine, compare, and contrast ideas with the ideas of other students.	*Who can add to that?* *What do you mean by _____? Say more.* *So I think you said _____. Is that right?* *Who has a different idea?* *How are those ideas similar/different?* *Who can rephrase _____'s idea?*	Unit Pretest **Expressing Ideas Tool**
Encourage students to provide evidence.	*How do you know that?* *What have you seen in the world that makes you think that?*	**Expressing Ideas Tool**
Document student ideas so they can be revisited later.	*Let's record our ideas so we can come back to them and see how our ideas change.*	Sticky notes on class poster or Activity 1.2 Presentation **Expressing Ideas Tool**

What we see in the videos that DOES support talk and writing goals for this phase:

- Students understand that they will be expected to share their ideas, even if they might be "wrong."
- Students have a chance to think individually, share with a partner or small group, and as a whole class.
- The teacher comes back to students' initial ideas and questions often and points out where they have revised an idea or answered a question.

What we see in the videos that DOES NOT support talk and writing goals for this phase:

- The introduction to the unit is about what they will *do* (e.g., an investigation, complete a worksheet) not what they will learn or know when it is over.
- Teachers give students the opportunity to record their ideas on the poster or ppt, but to not hold student ideas up to discussion in a class or group.



Foundations Phase

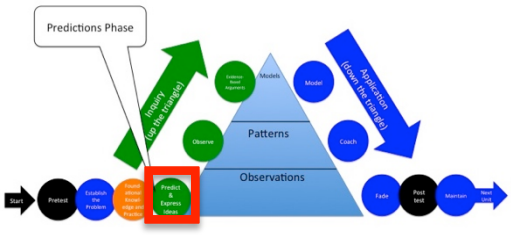
Talk and Writing Goals for the Foundations Phase	Teacher Talk Strategies That Support This Goal	Curriculum Components That Support This Goal
Treat this as background information.	*The teacher explains specifically how the background information is connected to their initial ideas and questions about the phenomenon.*	
Listen for student ideas about **matter** and **energy** at different **scales**, and attend to wrong ideas.	*What is happening to matter and energy at _____ scale? Who can explain?* *Are you in the macroscopic scale or the atomic-molecular scale?* *Who can explain that at a different scale?*	The **PPT** that "Zooms into" the macroscopic subjects of the unit: a leaf, a potato, air, fossil fuels, etc.
Examine student ideas and correct them when there are problems. It's ok to give the answers away during this phase! Help students practice using **precise language** to describe **matter and energy** at different **scales**.	*Let's think about what you just said: air molecules. What are air molecules?* *Are you talking about matter or energy?* *Remember: atoms can't be created. So that matter must have come from somewhere. Where did it come from?* *Let's look at the molecule poster again… is carbon an atom or a molecule?* *Let's revisit our scale poster… what is happening to matter at a macroscopic scale?*	Powers of Ten Video Powers of Ten Poster Molecule Poster Three Questions Poster
Grade student ideas.		There is often a **quiz** during this phase of the unit to help you decide if your students are ready to move on.

What we see in the videos that DOES support talk and writing goals for this phase:

- Students understand that they will be expected to share their ideas, but that they will be corrected if they are using imprecise language or breaking the "rules" of matter and energy.

What we see in the videos that DOES NOT support talk and writing goals for this phase:

- Teacher lectures during the entire activity because it is a "background info" lesson.
- Posters, videos, and handouts are not discussed as a class. They are used more as tools to move the activity along.
- Class ideas appear to understand scale, principles, and use precise language because only a few students share their ideas out loud.



Predictions Phase

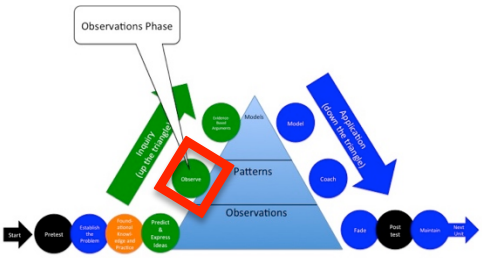
Talk and Writing Goals for the Predictions Phase	Teacher Talk Strategies That Support This Goal	Curriculum Components That Support This Goal
Treat this as elicitation and brainstorming (like the Expressing Ideas Phase), but with more directed questioning.	*Now that we have set up the investigation, we want to predict what we think will happen to matter and energy.*	Three Questions Handout **Predictions Tool**
Elicit a range of student ideas. Press for details. Encourage students to examine, compare, and contrast their ideas with the ideas of other students.	*Who can add to that?* *What do you mean by _____? Say more.* *So I think you said _____. Is that right?* *Who has a different idea?* *How are those ideas similar/different?* *Who can rephrase _____'s idea?*	Investigation Video (first half)
Encourage students to provide evidence that supports their predictions. .	*How do you know that?* *What have you seen in the world that makes you think that?*	
Have students document their ideas to revisit later.	*Let's record our ideas so we can come back to them and see how our ideas change.*	**Predictions Tool**

What we see in the videos that DOES support talk and writing goals for this phase:

- Teachers help students see how the investigation can help them test their initial ideas and answer particular questions about the phenomenon.
- Students understand that they will be expected to share their predictions, even if they may turn out to be incorrect.
- Students are expected to share their ideas about the evidence that they have seen in the world that leads them to make their predictions.
- Students understand that their predictions can be different than other students' predictions, and can explain the differences or similarities.

What we see in the videos that DOES NOT support talk and writing goals for this phase:

- The introduction to the predictions tool is about how the investigation will unfold (e.g., the technical details), and lacks a focus on what will happen to matter and energy during the investigation.
- Teachers give students the opportunity to record their ideas on the process tool, but do not hold student ideas up to discussion in a class or group.



Observations Phase

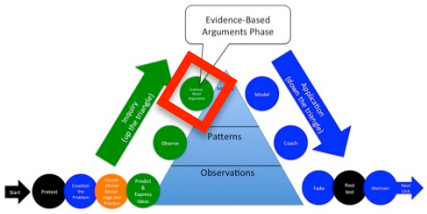
Talk and Writing Goals for the Observations Phase	Teacher Talk Strategies That Support This Goal	Curriculum Components That Support This Goal
Help students discuss data and identify patterns.	*What patterns do we see in our data?* *How do you know that is a pattern?* *What about _____ data. What does this mean?*	Class Results Poster Class Results Spreadsheet
Encourage students to compare their own conclusions about the data and evidence with other groups and other classes.	*What about this number? What does this tell us?* *How is group A's evidence different from Group B's data?* *How do our class's data differ from another classes' data?*	Class Results Spreadsheet Class Results Poster Investigation Video (second half).
Make connections between the observations and the data/evidence.	*It says here that our BTB turned colors. What does that mean?* *You recorded that your ethanol lost weight. What does that mean?*	
Have students consider how their predictions and results compare.	*Let's revisit our predictions. Who can explain the difference between our class predictions and our results?* *Who had predictions that were similar to our results? Has your explanation changed? How?*	

What we see in the videos that DOES support talk and writing goals for this phase:

- Students are asked to review their data in pairs and small groups.
- The purpose of the investigation is framed as a way to make observations and find patterns in the data in order to explain the phenomenon.

What we see in the videos that DOES NOT support talk and writing goals for this phase:

- The students complete their results worksheets and posters but do not discuss the numbers.
- The purpose of the activity is framed as a means to completing the worksheets and making sure the investigation is conducted correctly.



Evidence-based Arguments Phase

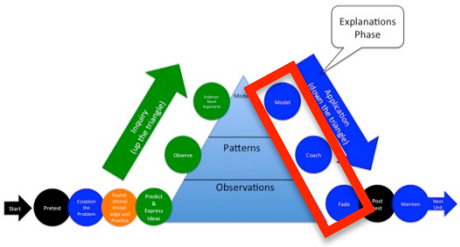
Talk and Writing Goals for the Evidence-Based Arguments Phase	Teacher Talk Strategies That Support This Goal	Curriculum Components That Support This Goal
Press for details. Encourage students to examine, compare, and contrast their ideas with the ideas of other students.	*Who can add to that argument?* *What do you mean by _____? Say more.* *So I think you said _____. Is that right?* *Who has a different argument?* *How are those arguments similar/different?* *Who can rephrase _____'s argument?*	Investigation Video (second half)
Students provide evidence from the investigation (not just experiences in the world) to develop arguments.	*Does your argument include evidence from the investigation?* *What evidence is most important here?* *What does this evidence tell us about what happened?* *What evidence do we still need for a complete picture of what happened?* *How do you know that?*	**Evidence-Based Arguments Tool** Class Results Poster Class Results Spreadsheets Investigation Video (second half) Data from other classes
Focus on how matter and energy were transformed at different scales.	*What does this evidence tell us about how matter is changing?* *What does this evidence tell us about how energy is changing?*	**Three Questions Handout** **Evidence-Based Arguments Tool**
Revisit predictions and examine change in thinking.	*Let's revisit our Predictions and see how our thinking changed now that we know what happened.*	**Evidence-Based Arguments Tool** **Predictions Tool**
Encourage students to consider the questions they don't have answers to.	*This investigation told us many things about what happen to matter and energy during ____. But what questions do we still have?*	

What we see in the videos that DOES support talk and writing goals for this phase:

- Students always use evidence from the investigation to support their arguments.
- Arguments that use problematic evidence, or evidence from other sources, are questioned and examined.
- When arguments differ from other classmates, the differences are discussed.
- Careful attention is given to the unanswered questions column of the EBA tool. It is these questions that will drive the modeling activities that come next.

What we see in the videos that DOES NOT support talk and writing goals for this phase:

- Students write their arguments in a journal or worksheet but do not discuss them.
- Students are told the answers instead of developing arguments on their own.
- The discussion focuses on memorizing the chemical equation for the investigation without attention to how matter and energy were changing.



Explanations Phase

Talk and Writing Goals for the Explanations Phase	Teacher Talk Strategies That Support This Goal	Curriculum Components That Support This Goal
Examine student ideas and correct them when there are problems. It's ok to give the answers away during this phase! Help students practice using **precise language** to describe **matter and energy**.	*Let's think about what you just said: air molecules. What are air molecules?* *Are you talking about matter or energy?* *Remember: atoms can't be created. So that matter must have come from somewhere. Where did it come from?* *Let's look at the molecule poster again… is carbon an atom or a molecule?*	Molecule Poster Three Questions Poster
Focus on making sure that explanations include multiple **scales**.	*The investigation gave us evidence for what was happening to matter and energy at a macroscopic sale. But what is happening at an atomic-molecular scale?* *What is happening to molecules and atoms?* *How does energy interact with atoms and molecules during chemical change?* *Why doesn't the macroscopic investigation tell us the whole story?* *Let's revisit our scale poster… what is happening to matter at the molecular scale?*	Molecular Models Molecular Modeling Worksheets **Explanations Tool** PPT Animation of chemical change Powers of Ten Poster
Encourage students to recall the investigation.	*When did this chemical change happen during our investigation?* *How do we know that? What is our evidence?* *What were the macroscopic indicators that this chemical change took place?*	**Evidence-Based Arguments Tool** Investigation Video
Elicit a range of student explanations. Press for details. Encourage students to examine, compare, and contrast their explanations with others'.	*Who can add to that explanation?* *What do you mean by _____? Say more.* *So I think you said _____. Is that right?* *Who has a different explanation?* *How are those explanations similar/different?* *Who can rephrase _____'s explanation?*	**Explanations Tool**

What we see in the videos that DOES support talk and writing goals for this phase:

- Students' explanations address multiple scales.
- Students expect their explanations to be held up for discussion and dialogue.

What we see in the videos that DOES NOT support talk and writing goals for this phase:

- The molecular modeling activity is not discussed in relation to the investigation.
- Students are told the explanations instead of developing them on their own.
- Students record their explanations individually but do not share their ideas with others.