Integrating Science And Language For All Students With A Focus On English Language Learners

Brief 7 of 7

FORMATIVE ASSESSMENT IN THE SCIENCE CLASSROOM

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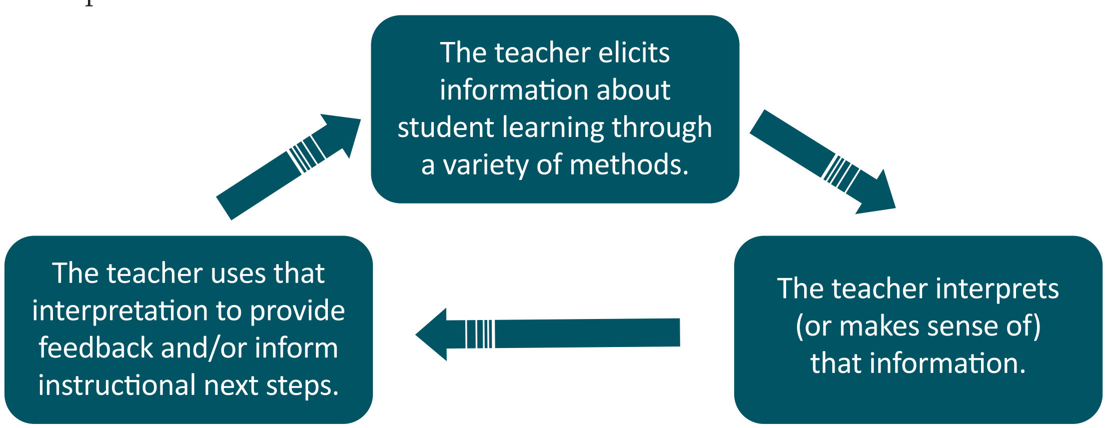
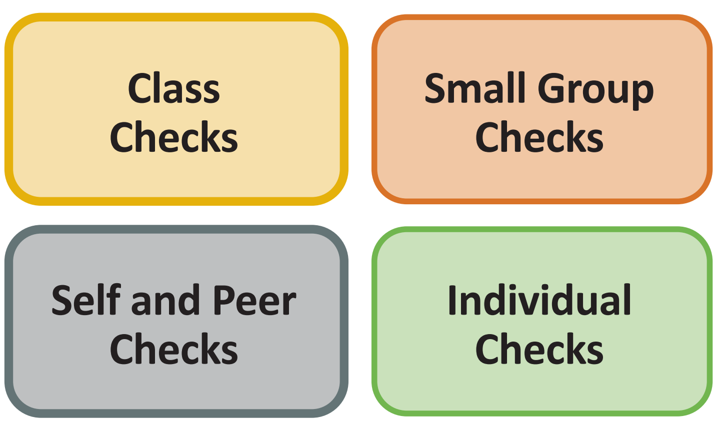
Formative assessment is an essential practice for supporting all students, including English language learners (ELLs), in the science classroom. Formative assessment is assessment that takes place during the course of instruction with the goal of improving teaching and learning. Research suggests that formative assessment is a powerful lever for promoting student learning, and it may be particularly powerful for ELLs. Formative assessment typically consists of three steps:



In this brief, we introduce **four types of formative assessment** that can be embedded into any science instructional unit.



The four types of embedded formative assessment are explained and illustrated in the context of a fifth-grade science unit aligned to the new science standards and designed with a specific focus on ELLs. In this unit, students explain the phenomenon of garbage in their home, school, and community while developing their understanding of key physical and life science ideas. The complete unit is available at nyusail.org for teachers to download and use.

CLASS CHECKS

The purpose of Class Checks is for teachers to read individual student work (in the form of an exit slip or an entry in the science and engineering notebook) and gauge the class's level of understanding. Then, the teacher uses this information to plan or modify instruction.

On the first day of the unit, students enter the classroom to find a pile of their school lunch garbage. After carefully curating the pile to include only safe items and ensuring that students are wearing appropriate safety gear, the teacher prompts students to sort the garbage into categories. Students sort the garbage materials in different ways based on patterns (i.e., a crosscutting concept) in the properties of the materials (i.e., a disciplinary core idea). At this point, when students have finished sorting their lunch garbage, the teacher may want to get a sense of whether students are beginning to develop their understanding of patterns and properties. That's where the Class Check comes in…

CLASS CHECK! Categories and Properties of Garbage

Have students answer the following questions in their science and engineering notebook individually.

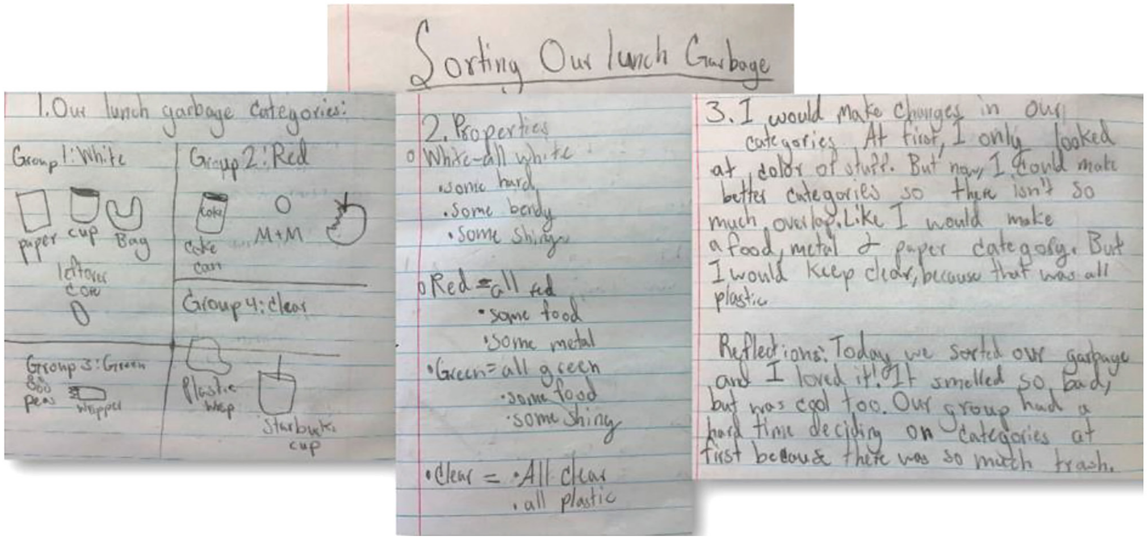
QUESTIONS:

1. What are the categories of garbage that your group chose?
2. What are the properties of the garbage in each category?
3. Based on what you now know about properties, would you change the categories your group chose? If yes, what would be your new categories?

EXTENSION:

4. Think of two objects that you use in your everyday life. What are the properties of each object? How are the properties of the two objects similar or different?

In this Class Check, students answer a series of questions about the categories their group used to sort the garbage and the similarities and differences in properties between the categories. The check also includes an extension question to challenge those students who may be more advanced in their understanding of properties and patterns. Students record their responses in their science and engineering notebook. In the student response on the next page, this ELL chose to use both visual and linguistic modalities to illustrate the categories of garbage selected by their group in response to the first question in the Class Check.



Next, the teacher reads students' responses to get a sense of their initial ideas about properties. The criteria focus specifically on whether students are able to distinguish materials between categories and whether they are able to identify patterns in the properties within and across categories. The purpose of this Class Check is not to grade or correct individual students' responses, but rather for teachers to get a sense of where the class is, overall, in their developing understanding. Also, teachers can use Class Checks to identify particular students who may need additional support during instruction.

Finally, the teacher uses this information to modify instruction. For example, if the class is having difficulty applying the crosscutting concept of patterns or the disciplinary core idea related to properties, the teacher will review these concepts and ideas with additional examples during the next class period.

About Class Checks

- Class Checks typically provide opportunities for students to respond using multiple modalities, including drawings, written English (both words and full sentences), and/or home language. This allows all students, including ELLs, to demonstrate their thinking.
- Class Checks support learning progressions—the idea that students develop their science understanding over time. Teachers can use Class Checks to get a sense of their students' thinking at various points, not to "correct" this thinking (which could short-circuit opportunities to develop deep science understanding), but to use the information to create meaningful opportunities for students to revise their thinking moving forward.
- Class Checks are particularly important with ELLs, as teachers can collect a continuous stream of information about ELLs' content and language learning needs and then use this information to modify instruction.

SMALL GROUP CHECKS

The purpose of Small Group Checks is to assess student understanding and promote deeper discussion among students when they are working in small groups.

Over the course of the unit, students carry out an investigation where they put food and non-food materials in landfill bottles and observe changes over time. The purpose of the investigation is to find out whether the properties of the food and non-food materials change. Also, students keep one landfill bottle open and the other closed to find out whether the amount of matter in each bottle changes over time. Students make observations at the beginning of the landfill bottle investigation and then again 1 week later. By this time, students start to notice an unpleasant smell coming from the open landfill bottle system and ask, "What is that smell?"

To answer their questions about smell, students engage in a series of investigations. In one investigation, they compress air in a syringe. This investigation produces evidence that air is in fact something, which will eventually lead to the idea that air and smell are gases made of particles too small to see. The particle nature of gas is a key disciplinary core idea in fifth grade.

As students carry out the syringe investigation in small groups, the teacher engages students in a Small Group Check. The teacher circulates around the class and listens to each group's discussion to get a sense of students' current thinking. Then, the teacher draws flexibly on the probing questions to promote deeper discussion and to move students' thinking forward.

SMALL GROUP CHECK! Gases

As students work, circulate among the groups.

Possible prompts to guide student thinking:

- When you push down, you feel the pressure of the air pushing back on the plunger. What does this tell you about air?
- Why can't you push the plunger all the way down?
- What do you feel when you release the plunger?
- What do you think the air is made of?
- What did you figure out from this investigation about gases (such as air)?

About Small Group Checks

- Small Group Checks are a form of dynamic or interactive formative assessment in which the teacher gains insight into student understanding and provides immediate feedback in the form of probing questions (not "correct" answers) that guide students' thinking forward.
- The probing questions are discipline-specific. In other words, they target specific science concepts and ideas that are the focus of the task at hand. For example, the question, "Why can't you push the plunger all the way down?", is meant to draw students' attention to the key idea that air takes up space and is something. These discipline-specific prompts go beyond the type of general-purpose talk moves that teachers typically use with ELLs (e.g., "Say more about that").
- The interactive nature of Small Group Checks can be particularly beneficial to ELLs, as it allows teachers to modify their own language as well as scaffold their students' language in real time.

SELF AND PEER CHECKS

The purpose of Self and Peer Checks is for students to assess their own work as well as the work of their peers.

After carrying out several investigations and having developed a new understanding of particles, students develop models to explain what is happening in their landfill bottle models. Specifically, they represent smell as gas particles flowing out of the open system but staying inside the closed system. At this point, the teacher may want to get a sense of students' developing understanding of the science concepts and ideas represented in their models as well as well as their engagement in the practice of modeling.

In this Self and Peer Check, groups assess and provide feedback on each other's models. Specifically, they assess the extent to which another group's model includes key components, processes, and modeling conventions. Then, students use this information to ask questions that will help their partner group revise their model. For example, if one group's model includes wavy lines instead of particles to represent smell, the other group may ask, "What is the smell made of? How could you represent the idea of gas particles in your model?"

SELF AND PEER CHECK! Group Model of Landfill Bottle Systems

Does the model include the following components?	YES
Open and closed landfill bottles	❏
Garbage materials	❏
Gas particles (smell)	❏
Does the model include the following processes?	
The properties of the food materials changed over time.	❏
The weight of the closed system stayed the same, but the weight of the open system decreased.	❏
Gas particles (smell) are produced in both systems and move freely out of the open system.	❏
Does the model follow modeling conventions?	
Components and processes are clearly identified using labels and/or a key.	❏

Identify one area for improvement in your peer group's model.

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About Self and Peer Checks

- Self and Peer Checks can be used with a variety of student products, including models, arguments, and explanations.
- By engaging in Self and Peer Checks, students become explicitly aware of task expectations and criteria. For example, students become aware of how models require labels or a key to ensure effective communication. As students revise their models based on their partner group's feedback, they learn to use multiple modalities strategically to communicate their ideas.
- Self and Peer Checks can be especially beneficial to ELLs. For example, by engaging in this type of assessment, ELLs become more explicitly aware of what counts as precise presentation of evidence in a science argument.

INDIVIDUAL CHECKS

The purpose of Individual Checks is for teachers to assess the science understanding of individual students and provide written feedback on their performance.

Another week passes, and students return to their landfill bottles to make their final observations. They notice that, while the weight of the closed system has stayed about the same during the investigation, the weight of the open system decreased at each time point. Students are asked to construct an argument to answer the question: "Does the amount of matter change in a landfill bottle?" At this point, the teacher can use students' arguments to assess, in a more formal way, the extent to which students have developed science understanding over the course of the unit.

INDIVIDUAL CHECK! Arguing About the Amount of Matter in Landfill Bottles

Arguing from Evidence

Question: Does the amount of matter change in a landfill bottle?

Claim: The amount of matter changes in the open system but it stays the same in the close system.

Evidence:	**Why did you use these data?**
According to my system weight table the open system was 2.38 in time point 1 and in time point 3 was 0.877. My closed system weigh in time point 1 was 1.2 and in time point 3 was 1.2.	I chose this data because the open system kept losing weight and the closed system stayed the same

Reasoning: Since our open system lost weight and our close system stay the same then whe know the amount of matter changes only in the open system.

The teacher then assesses students' arguments using a task-specific rubric. Specifically, the teacher looks for whether the arguments include a claim that is correct and answers the investigation question, evidence that supports the claim using specific data from the investigation, and reasoning that links the evidence to the claim.

Teacher Rubric
Arguing About the Amount of Matter in Landfill Bottles

	Claim	Evidence	Reasoning
0	Claim is incorrect, irrelevant, or missing. Examples: • *(None)* • *We weighed the landfill bottle at different time points.*	Evidence is incorrect, irrelevant, or missing. Examples: • *(None)* • *The food materials vanished.* • *The properties of the orange changed, but the properties of the plastic spoon did not.*	Reasoning is incorrect, irrelevant, or missing. Examples: • *(None)* • *Since the properties of the food materials changed, the amount of matter must have also changed.*
1	Claim is correct and answers the investigation question. Example: • *The amount of matter does not change in a closed landfill bottle system, but the amount of matter decreases in an open landfill bottle system.*	Evidence supports claim using data from open <u>OR</u> closed landfill bottle system. Examples: • *The weight of the closed landfill bottle system was 1,550 g at time points 1, 2, and 3.* • *The weight of the open landfill bottle system decreased over time, and there was a smell coming from the bottle.*	Reasoning links evidence from open <u>OR</u> closed landfill bottle system to claim. Examples: • *In the closed system, the weight stayed the same, so the amount of matter did not change.* • *In the open system, the weight decreased because a gas (which has weight) left the bottle so there was less matter in the bottle.*
2		Evidence supports claim using data from open <u>AND</u> closed landfill bottle systems. Example: • *The weight of the closed landfill bottle system was 1,550 g at time points 1, 2, and 3. The weight of the open landfill bottle system decreased over time, and there was a smell coming from the bottle.*	Reasoning links evidence from open <u>AND</u> closed landfill bottle systems to claim. Example: • *In the closed system, the weight stayed the same, so the amount of matter did not change. In the open system, the weight decreased because a gas (which has weight) left the bottle so there was less matter in the bottle.*

TOTAL: _____ out of 5

The teacher then provides individual feedback to the student using a form like this.

Teacher Feedback:

	Comments
Claim	
Evidence	
Reasoning	

About Individual Checks

- Individual Checks are useful later in a unit of instruction when students are constructing written arguments or explanations based on the science understanding they have developed over the course of the unit.
- In Individual Checks, the teacher uses detailed rubrics that attend to both the science ideas and the precision with which those ideas are communicated, thus encouraging teachers to attend to the content and language needs of all students, including ELLs. For example, the rubric for the landfill bottle argument expects students to be precise in comparing the weights of the open and closed systems at different time points. The teacher then uses the criteria outlined in the rubric to provide specific comments to individual students.

Conclusion

To summarize, we have presented four types of formative assessment that can be embedded in science instruction to support the learning of all students, including ELLs.

	Elicited Student Performance	Interpretation	Feedback
Class Checks	Written responses (both linguistic and visual modalities)	Class	Classroom instruction (oral)
Small Group Checks	Student's oral participation in small group work as well as group products (e.g., models)	Small group and individual students	Real-time feedback in the form of discipline-specific prompts (oral)
Self and Peer Checks	Students' oral presentations and/or products	Small group and individual students	Oral and/or written comments
Individual Checks	Written responses	Individual students	Written comments

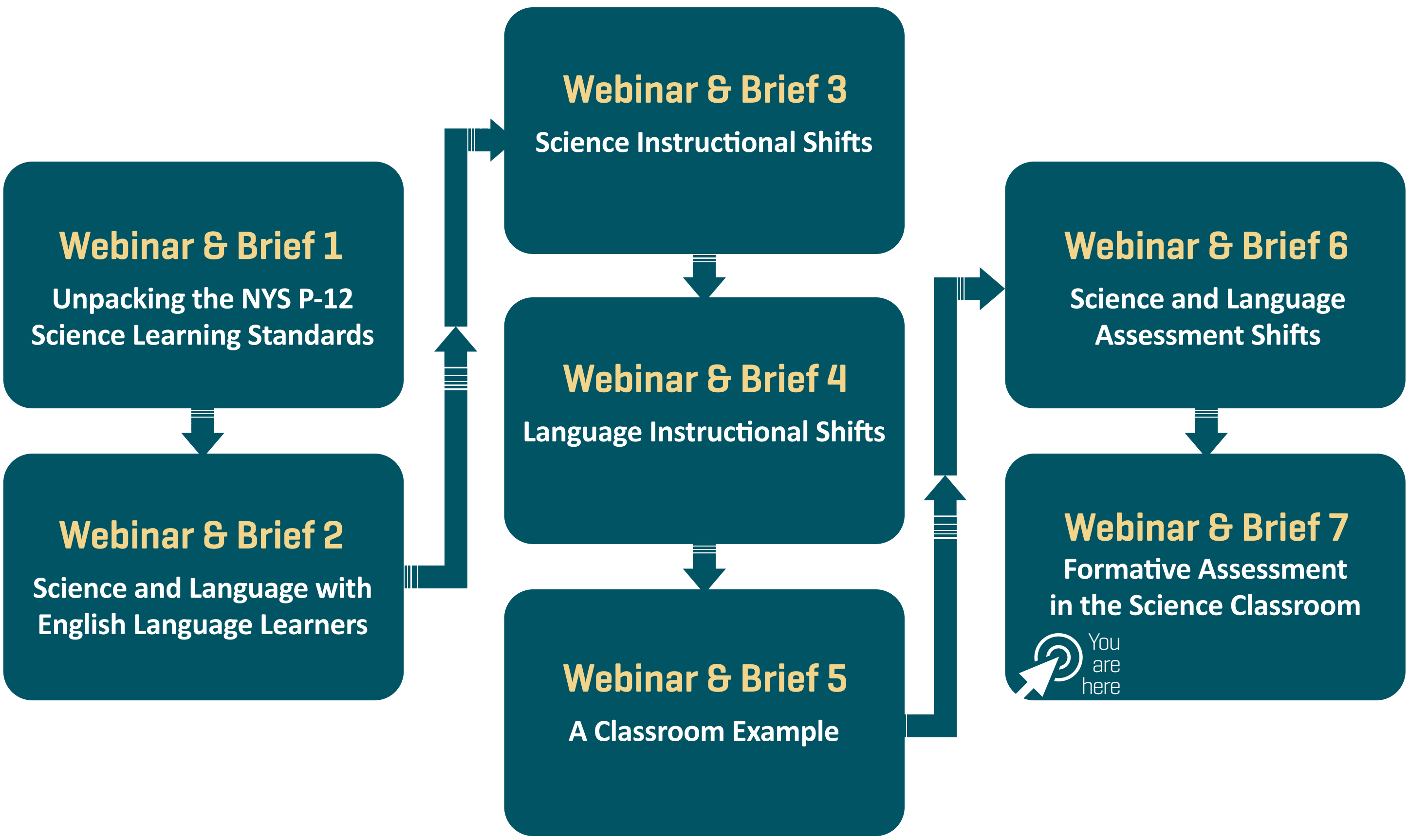
Although each type of assessment serves a different purpose, what makes them all formative is that they involve the same three steps of formative assessment.

For example, in Class Checks, teachers elicit information about student learning through written responses in the form of entries in the science and engineering notebook or exit slips. Teachers then review those responses with specific criteria in mind to make interpretations about the level of understanding of the class as a whole. Finally, teachers use their interpretations to inform instructional next steps (e.g., a whole-class review).

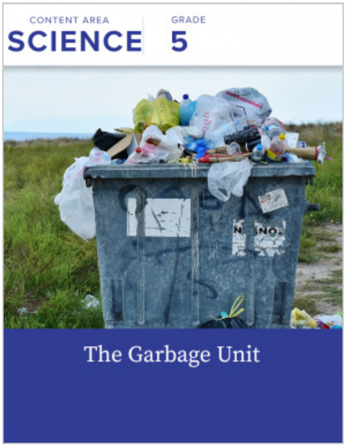
In Small Group Checks, teachers elicit information about student learning by structuring a small group task and discussion. Teachers listen to that discussion and examine the artifacts produced by the group. Teachers then make interpretations about the group's level of understanding and provide feedback in the form of real-time, discipline-specific prompts.

Ultimately, to enact instruction aligned to the new standards, we must think about assessment differently. First, we need to think about assessment as ongoing rather than something that happens only at the end of instruction. When formative assessments are embedded throughout science instruction, teachers can use assessment information to improve teaching and learning. With ELLs in particular, teachers can collect real-time information about their science and language learning and then modify instruction accordingly. Second, we need to ensure that the assessments we embed in our instruction reflect our broader instructional approach, specifically the science and language instructional shifts discussed in previous webinars in this series. For example, assessments can be sensitive to student learning progressions by avoiding "correcting" student responses too early in instruction. When teachers embed a range of formative assessments into their instruction in ways that are consonant with their overall instructional approach, all students, and especially ELLs, benefit.

Map of brief and webinar series on integrating science and language with ELLs



Additional Resources



Science And Integrated Language (SAIL)

Visit our research team's website and access the unit: www.nyusail.org

NYS P-12 Science Learning Standards:
http://www.nysed.gov/curriculum-instruction/science

NYSED Office of Curriculum and Instruction:
http://www.nysed.gov/curriculum-instruction

Office of Bilingual Education and English as a New Language:
http://www.nysed.gov/bilingual-ed

Engage NY:
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