Confederation of Oregon School Administrators

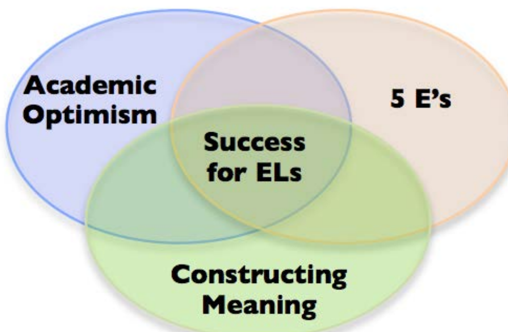
2014 State English Learners Alliance Conference

Secondary *Constructing Meaning* in Science: A Pathway to STEM for English Learners

Scott Townsend & Paul Hanson

March 13, 2014

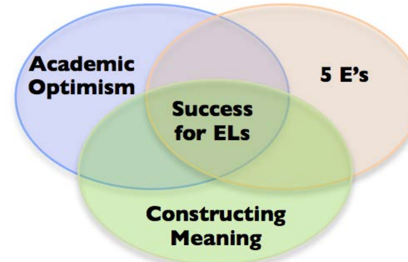
Eugene, Oregon



Welcome!

Language in Action:
Next Generation Science Standards

Science Practice 8: Obtaining, Evaluating, and Communicating Information – "every science or engineering lesson is in part a language lesson, particularly reading and producing the genres of texts that are intrinsic to science and engineering" (NAS, 2012).



Agenda

- **Who are our STEM students? Science instruction for all.**
- Case study: Liberty HS, Hillsboro, Ore. Science instruction that works for ELs
  - – Academic Optimism
  - – 5 E's of strong science pedagogy
  - – *Constructing Meaning* & GRR
- Making the jump to college - with support

Session Outcomes

- Learn how to support English Learners in STEM classes to increase their engagement and achievement.
- Study a pathway of courses and instructional supports to put ELs on track for STEM majors.
- Be introduced to an example of collaboration between secondary and post-secondary schools to support the transition of underrepresented groups into STEM majors.

Constructing Meaning

Why Focus on

Science, Technology, Engineering, & Math?

- It's a growing field. In Oregon alone, employers report being unable to find qualified candidates in STEM with more than 40,000 new and replacement STEM jobs by 2020.
- STEM employees earn 25% higher wages and have lower unemployment rates.
- STEM careers help to keep our nation competitive in a global economy. 33% of U.S. bachelor's degrees are in STEM fields compared to 53% for China and 63% for Japan.

Source: Oregon Employment Department and STEM Advantage (www.stemadvantage.org)

Constructing Meaning

Why Is There a

shortage of STEM workers in the U.S.?

- Women, African Americans, and Latinos today comprise only **20% of the STEM workforce**, yet they are projected to make up **70% of the total workforce** by 2017.
- **Fewer than 50%** of students who enter college **intending** to major in a STEM field **complete a STEM degree**.

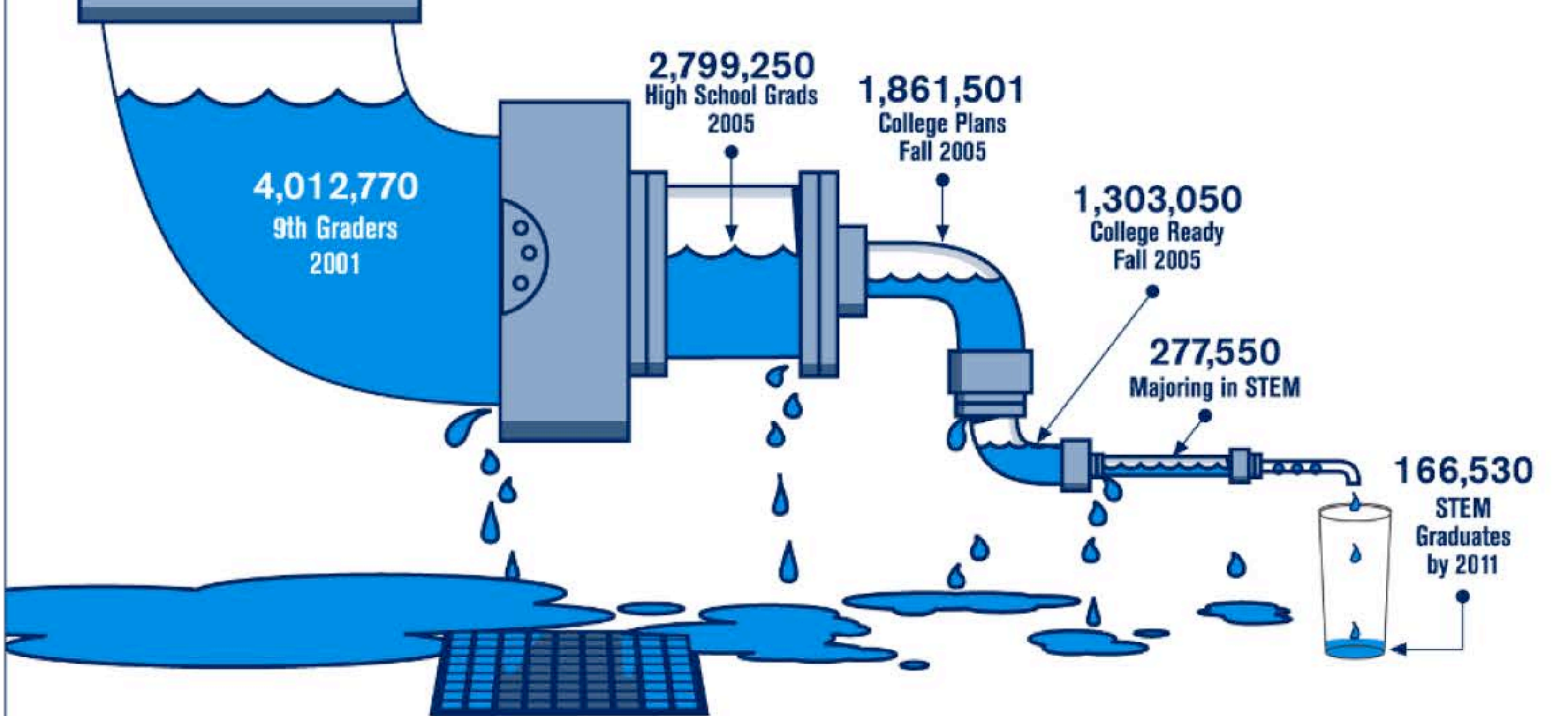
Partner Talk – What can we infer from these stats?

Source: STEM Advantage (www.stemadvantage.org)

Constructing Meaning

STEM Pipeline — Leaking Badly

In 2001, there were a bit more than 4 million 9th graders. Four years later, 2.8 million of them graduated and 1.9 million went on to two- or four-year college; only 1.3 million were actually ready for college work. Fewer than 300,000 are majoring in STEM fields and only about 167,000 are expected to be STEM college graduates by 2011.



Source: NCES Digest of Education Statistics; Science & Engineering Indicators 2008

The Achievement Gap Is the Civil Rights Issue of Our Day!

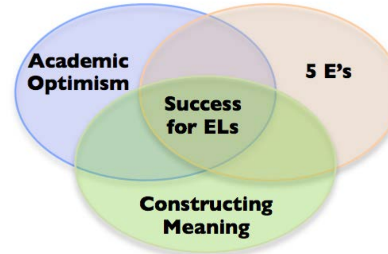
ELs can succeed in STEM classes

I have found that supporting the development of expressive language in students opens so many doors. By offering all students access to the 'honors course' and through the use of sheltered English instruction, student engagement and achievement have increased. Failure rates have dropped and AP numbers have soared and now reflect the cultural and linguistic demographics of Liberty.

- Paul Hanson, science teacher, Liberty HS, Hillsboro, Oregon

Constructing Meaning

Agenda



- Who are our STEM students?
  Science instruction for all
- **Case study: Liberty HS, Hillsboro, Ore.**
  Science instruction that works for ELs
  - **Academic Optimism**
  - **5 E's of strong science pedagogy**
  - ***Constructing Meaning* & GRR**
- Making the jump to college - with support

Constructing Meaning

Science at Liberty High School, Hillsboro, Oregon:

ELs can succeed in STEM classes!

Liberty HS: 46% Economically disadvantaged, 17% EL, 21 languages

'09-'10: 15% freshman failure rate

'10-'11: 6.2% freshman failure rate; 17 students enrolled in AP Biology; 1 section of AP Chemistry (*offered biennially*)

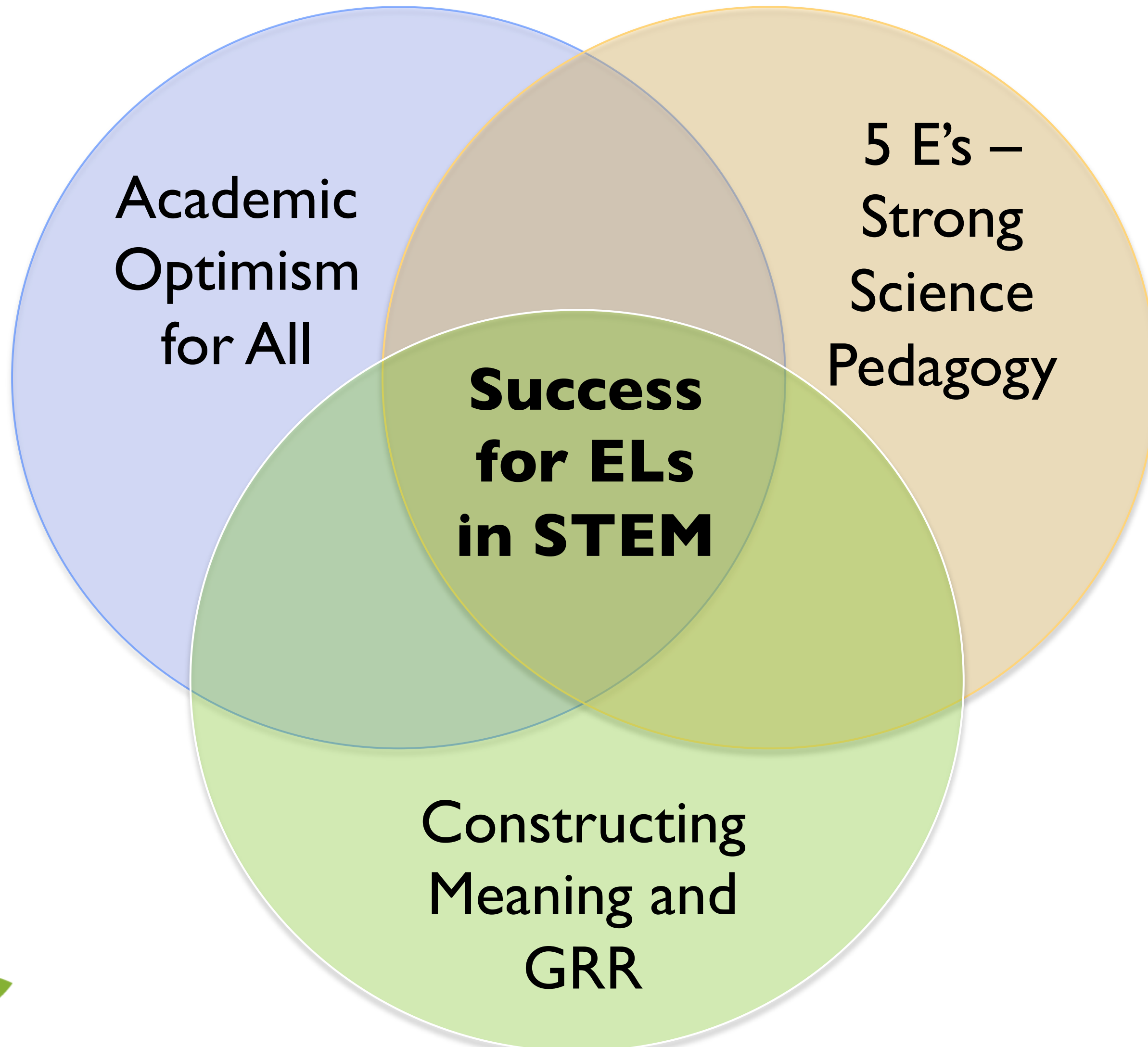
'11-'12: less than 5% freshman failure rate; 60 students in AP Biology

'12-'13: 90 students in AP Biology; 2 sections of AP Chemistry

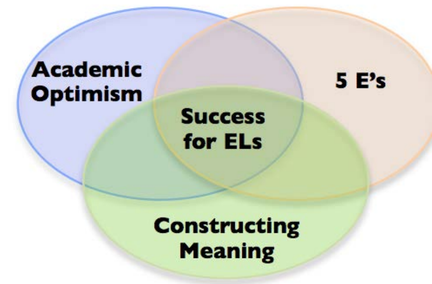
'13-'14: 120 students in AP Biology

Constructing Meaning

Science at Liberty HS, Hillsboro, OR:
The Power of Acceleration



The Power of Acceleration



Science at Liberty HS, Hillsboro, OR:

- *Academic Optimism*: A shift in how teachers view students and how students view themselves as able to be successful with appropriate scaffolding
- *Strong science pedagogy*: Constructivism and the 5 E's (Engage, Explore, Explain, Extend, and Evaluate)
- *GRR & CM*: Backward planning, content and language objectives, chunking content and language instruction, ongoing formative assessment, academic dialogue

Constructing Meaning

Reflect and Debrief – Partner Talk

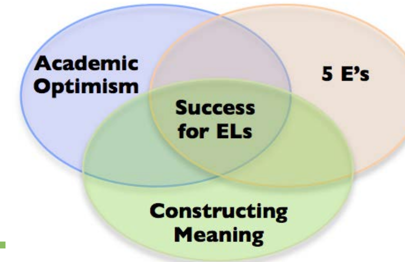
- *What does STEM instruction look like at your school?*
- *How many ELs and/or former ELs are in your advanced math and science classes?*
- Are ELs:
  - underrepresented?
  - about equally represented?
  - overrepresented?

The Story of Jose:
A Former EL Now a STEM Major

- Read the profile of Jose
- Think of a student in your school who has had life experiences similar to Jose
- Get up and find a partner from another table
- Briefly share about the student from your own experience who faced obstacles in school

Video Interview

Listen and Make Connections



What helped Jose keep engaged in science and make it into a STEM field at Portland State University?

Handout page 2

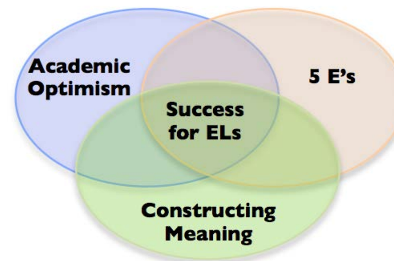
Reflect and Debrief – Partner Talk

- *What teacher and system supports did the student mention in the video clip?*
- *Do you offer these types of supports in your site's STEM courses?*
- Be prepared to share with the large group.

Handout page 2

Constructing Meaning

The Power of Acceleration



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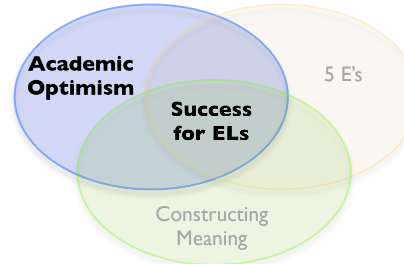
Constructing Meaning

Academic Optimism



A school with high academic optimism is a collectivity in which the faculty believes it can make a difference, that students can learn, and that high academic performance can be achieved.

Hoy, Tarter, & Hoy, 2006

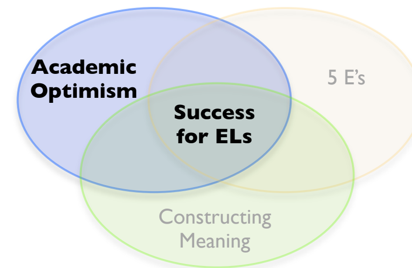
Digital resources pages 3-4

Science Should Be Inclusive, Not Exclusive

Shift attitudes toward science and ELs

- Make personal connections with students and encourage them to consider a STEM field. Let them know that you believe in them.
- Create a class culture of trust and respect so that students feel safe taking risks.
- Shed the expectation that science must be a ‘very difficult’ course and many students are expected to fail if rigor is being upheld.

Reflect and Discuss:
Gap Analysis & Next Steps



- ***Academic Optimism*: Make the shift in school climate & culture**
- *Strong science pedagogy*: Constructivism and the 5 E's
- *GRR & CM*: Scaffold the academic language of STEM

To what extent do teachers at your site believe…
- they can make a difference?
- all students can learn and be successful?
- high academic performance can be achieved?

Take notes and then share with your partner.

page 2

Inquiry Learning!

Strong Science Pedagogy: The 5 E's

Explain

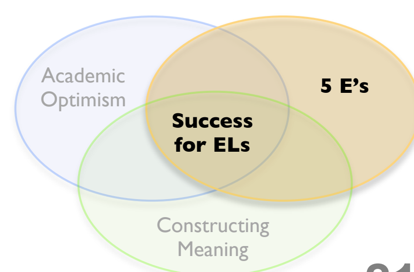
Evaluate

Extend

With a partner, put these in order.

Engage

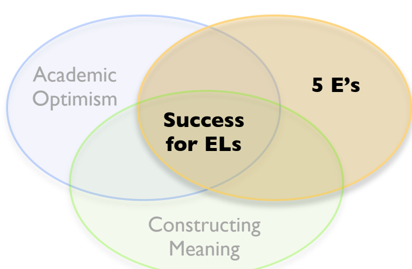
Explore



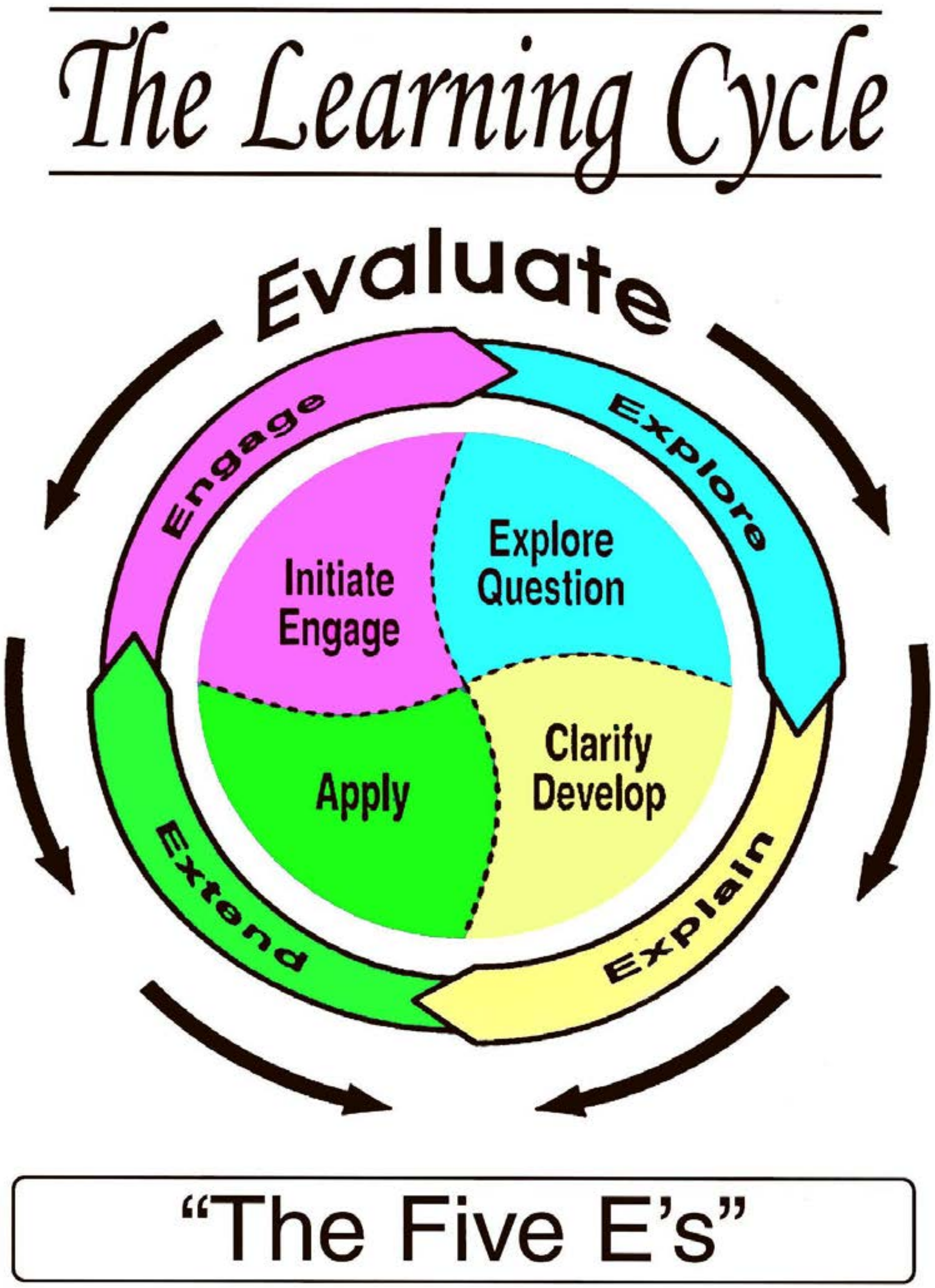
Constructing Meaning

Inquiry Learning!

- Engage
- Explore
- Explain
- Extend
- Evaluate



page 5



Source: Biological Sciences Curriculum Study (BSCS)

Teaching with the Five E's Instructional Model in the STEM Courses

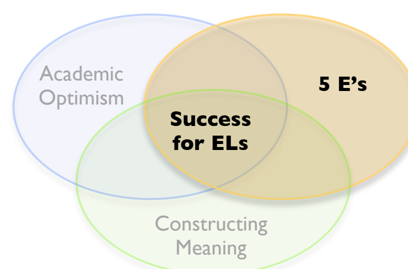
5Es	Suggested Activity	What the Teacher Does	What the Student Does
Engage	• Demonstration • Reading • Free Write • Analyze a Graphic Organizer • KWL • Brainstorming	• Creates interest. • Generates curiosity. • Raises questions. • Elicits responses that uncover what the student know or think about the concept/topic.	• Asks questions such as, Why did this happen? What do I already know about this? What can I find out about this? • Shows interest in the topic.
Explore	• Perform an Investigation • Read Authentic Resources to Collect Information • Solve a Problem • Construct a Model	• Encourages the students to work together without direct instruction from the teacher. • Observes and listens to the students as they interact. • Asks probing questions to redirect the students' investigations when necessary. • Provides time for students to puzzle through problems.	• Thinks freely but within the limits of the activity. • Tests predictions and hypothesis. • Forms new predictions and hypotheses. • Ties alternatives and discusses them with others. • Records observations and ideas. • Suspends judgments.
Explain	• Student Analysis and Explanations • Supporting Ideas with Evidence • Structured Questioning • Reading and Discussion • Teacher Explanation • Thinking Skill Activities: compare, classify, error, analysis	• Encourages the students to explain concepts and definitions in their own words. • Asks for justification (evidence) and clarification from students. • Formally provides definitions, explanations, and new labels. • Uses students' previous experiences as basis for explaining concepts.	• Explains possible solutions and answers to others. • Listens attentively to others' explanations. • Questions others' explanations. • Listens to and tries to comprehend explanations the teacher offers. • Refers to previous activities. • Uses recorded observations in explanations.
Extend	• Problem Solving • Decision Making • Experimental Inquiry • Think Skill Activities: Compare, classify, apply	• Expects the students to use formal labels, definitions, and explanations provided previously. • Encourages the students to apply or extend the concepts and skills in new situations. • Reminds the students of alternative explanations. • Refers the students to existing data and evidence and asks, What do you already know? Why do you think…? • Strategies from Explore apply here also.	• Applies new labels, definitions, explanations, and skills in new, but similar situations. • Uses previous information to ask questions, propose solutions, make decisions, and design experiments. • Draws reasonable conclusions from evidence. • Records observations and explanations. • Checks for understanding among peers.
Evaluate	• Any of the Above • Develop a Scoring Tool or Rubric • Test • Performance Assessment • Produce a Product • Journal Entry • Portfolio	• Observes the students as they apply new concepts and skills. • Assesses students' knowledge and/or skills. • Looks for evidence that the students have changed their thinking or behaviors. • Allows students to asses their own learning and group-process skills. • Asks open-ended questions, such as: Why do you think…? What evidence do you have? What do you know about X? How would you explain X?	• Answers open-ended questions by using observations, evidence, and previously accepted explanations. • Demonstrates an understanding or knowledge of the concepts or skill. • Evaluates his or her own progress and knowledge. • Asks related questions that would encourage future investigations.

Constructing Meaning

Source: www.docstoc.com

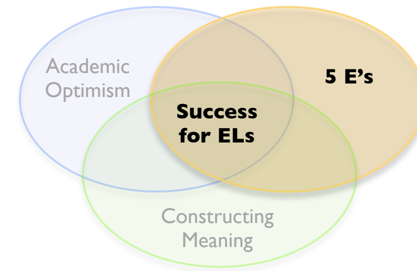
Teaching the Five E's

- Suggested Activities
- Teacher role
- Student role



page 5

Reflect and Discuss:
Gap Analysis & Next Steps



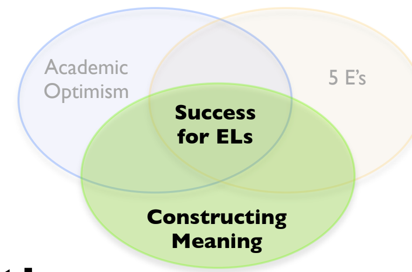
- *Academic Optimism:* Make the shift in school climate & culture
- ***Strong science pedagogy:* Constructivism and the 5 E's**
- *GRR & CM:* Scaffold the academic language of STEM

To what extent do teachers at your site…
- work to create authentic student interest in the topic?
- prompt students through a successful struggle?
- teach students to build a scientific argument?

Take notes and then share with your partner.

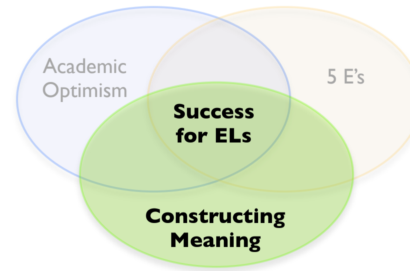
page 2

Constructing Meaning:
Explicit Language for Content



- Couple the 5 E’s inquiry model with academic language support to hit the sweet spot of motivation and student success.
- **Don’t start with dense reading**. Use reading to extend and evaluate the learning of the inquiry process.
- Use the Gradual Release model to ensure students have internalized new content and academic language.

A Multi-Year
Pathway to STEM Fields

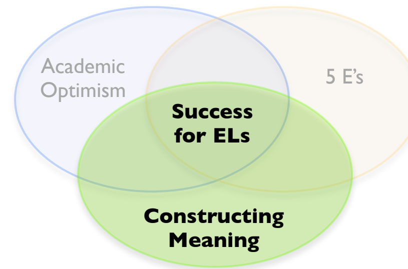


How can schools structure the instructional supports in the science courses to create a path that prepares students for the increasing demands of higher level courses?

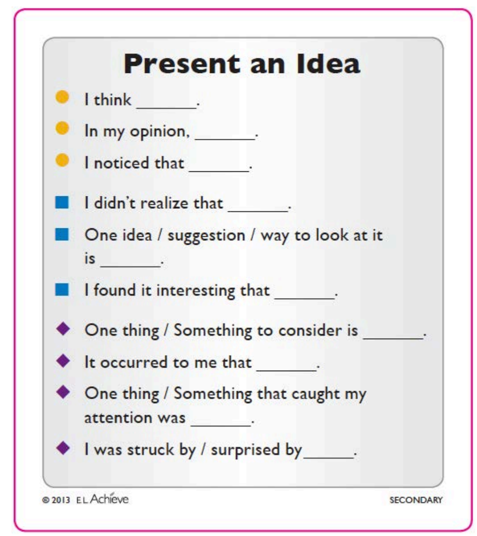
- Initial Support: 6^{th} – 9^{th} grade
- Further Support: 9^{th} – 11^{th} grade
- Advanced Support: 11^{th} – 12^{th} grade

Initial Support: 6th – 9th Grade:

Future Scientists



- Discussion Cards
- Dialectical Journal
- 2-page lab report with sentence patterns
- Structured language practice



Present an Idea

- I think ______.
- In my opinion, ______.
- I noticed that ______.
- I didn't realize that ______.
- One idea / suggestion / way to look at it is ______.
- I found it interesting that ______.
- One thing / Something to consider is ______.
- It occurred to me that ______.
- One thing / Something that caught my attention was ______.
- I was struck by / surprised by ______.

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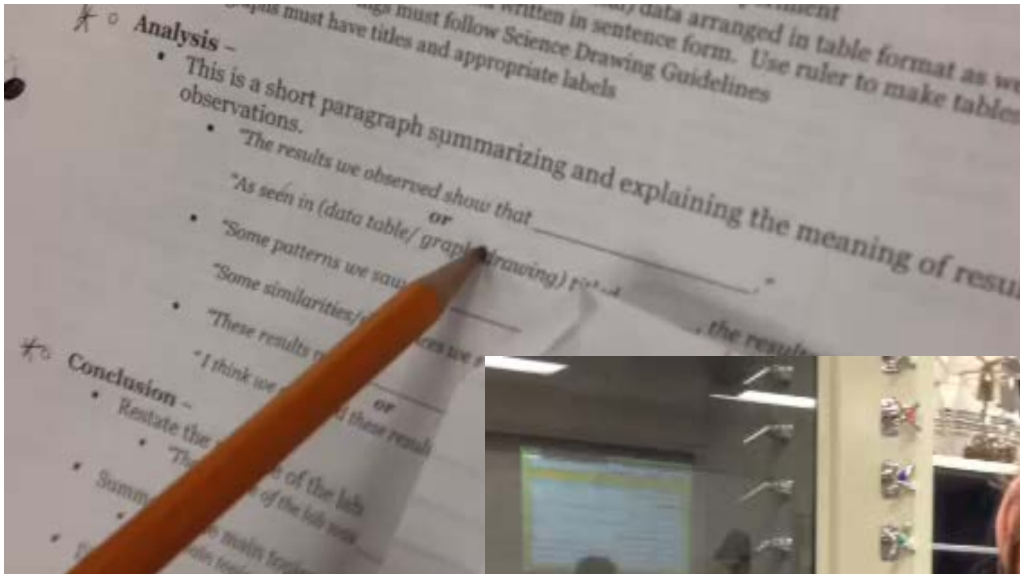
Initial Support: 6th – 9th Grade:

Future Scientists



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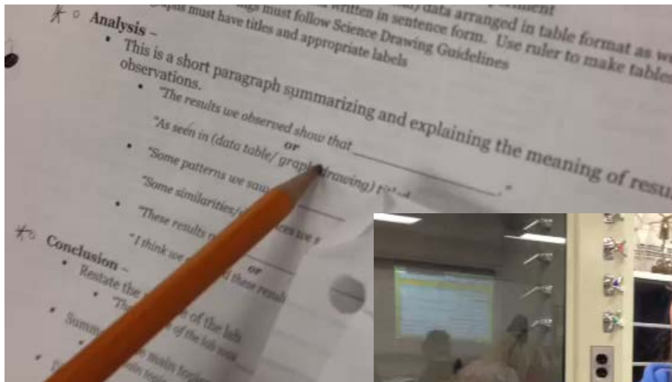


Tell your partner: *What did the teacher provide to support these students? Do students at your school benefit from these types of supports?*

Further Support: 9th – 11th Grade:

pages 6-7

The Language of Science

Lab Report Template

Crafting an Argument through Experimental Design

I. Introduction

The introduction is also often referred to as the 'purpose' or plan section. It should include the following:

Possible Sentence Starters

- ❑ **Purpose or objective** of the experiment expressed clearly in one or two sentences, including the method used to accomplish the purpose.

The purpose of the experiment was to_____________ by ______________________________.

To gain a greater perspective on _________________________, _____________________ was ____________________________.

- ❑ **Background and theory** pertaining to the experiment. This can include:
  - Information from previous research
  - Explanations of theories
  - Methods or equations

________________ is related to __________________________.

________'s (year) work in this area demonstrates _______.

_______'s work has___________.

This experiment builds upon __________________________.

Work in this area includes _______.

Other scientists have ___________.

- ❑ **A hypothesis** what is expected to happen based on background information.

The question under consideration is ___________.

I intend to show________________.

This experiment determines ______.

- ❑ **Safety Information** if applicable (MSDS sheets).

Safety considerations for __________________________ include __________________________

II. Materials and Procedure

A simple listing of the equipment used in the form of a bulleted list and the process of the experiment exactly as it was done in the laboratory.

- ❑ **Bulleted list of materials**, complete and accurate (include units)
- ❑ **Step-by-step numbered list**, include enough information so that others who read the report would be able to duplicate the experiment at a later date.

III. Results

This section contains all the results of the experiment, including:

- ❑ **Raw data** (weights, temperature, etc.) organized into labeled and titled graphs, figures or tables.
- ❑ **Calculations** one sample of each calculation is needed then mention if it was repeated.
- ❑ **Important outcomes** including both those expected and unexpected.

The process revealed / showed_____________________________.

As expected / Surprisingly, we observed___________________________

The process led to / resulted in_________________________.

IV. Analysis

This is the section where the results are explained, and where you show that you have a thorough understanding of the concept of the experiment and the results obtained. The main question to be addressed is: "What is the significance of the findings?"

Possible Sentence Starters

- ❑ **Compare expected results with actual results**

The results are consistent/inconsistent with ____.

The results show ____________ and reinforce/refute ____________.

It was observed that _____________. This observation supports/ contradicts ________.

Contrary to expectations, _________________________.

- ❑ **Analyze experimental error**

Errors in the process included ____________________________.

An error was made when ________________________________.

Although ____________was expected to occur. Possibly due to _____________, ____________happened instead.

- ❑ **Explain how the methods could be improved.**

The experiment could be improved by _______.

The experiment would have been more effective if _________.

Future experiments should ______.

- ❑ **Build a claim of significance based on the results.**

As a result of ________, it can be determined that______________.

The results indicates that ________.

It was apparent that __________.

The findings demonstrate/confirm/suggest____________.

V. Conclusion

Incorporate the following components into the final section of your lab report.

- ❑ **Explain the results in terms of the purpose. Return to the hypothesis.**

The experiment successfully/unsuccessful _______.

The experiment was effective/ineffective because ___________.

- ❑ **Support the claim with evidence from other, similar experiments/studies.**

The results relate to _________.

The findings are similar to those of___________________.

- ❑ **One or two sentences that summarizes definitive conclusions from the results.**

From _________, it can be concluded that ________________________.

The process proves that _________________________.

There can be no doubt that these findings ________________________.

Works Cited

Basic rules

- ❑ Begin your Works Cited page on a separate page at the end of your lab report. It should have the same one-inch margins and last name, page number header as the rest of your paper.
- ❑ Label the page Works Cited (do not italicize the words Works Cited or put them in quotation marks) and center the words Works Cited at the top of the page.
- ❑ Double space all citations, but do not skip spaces between entries.
- ❑ Indent the second and subsequent lines of citations by 0.5 inches to create a **hanging indent**.
- ❑ List page numbers of sources efficiently, when needed. If you refer to a journal article that appeared on pages 225 through 250, list the page numbers on your Works Cited page as 225-50.
- ❑ https://owl.english.purdue.edu/owl/resource/747/05

Advanced Support: 11th – 12th Grade:

Discourse Patterns in Science

- They Say, I Say: The Moves That Matter in Academic Writing
- The language of argument in academia

They Say/ I Say paragraph, or starting paper structure.

In recent discussions of (broader topic)____,
a controversial issue has been whether (your research paper focus)________________________
____
____.

On the one hand, some argue that (one perspective on your focus)__________________________
____

From this perspective (same line of thinking, further developed)__________________________
____.

On the other hand, however, others argue that (another perspective) ________________________
____.

In the words of (expert's name)________________________, one of this view's main proponents, (good quote) "____
____"

(in-text citation: ____________________). According to this view, __________________
____
____.

In summary, then, the issue is whether (summary of thinking) ________________________
____
or ____.

My own view is that ____
____
____.

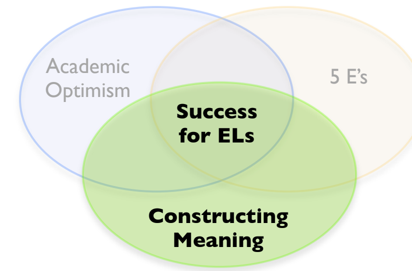
Though I concede that (a weakness of the side you're advocating for)______________________
____.

I still maintain that (your refutation or rebuttal that weakness)__________________________
____.

For example, ____
____.

Constructing Meaning

Reflect and Discuss:
Gap Analysis & Next Steps



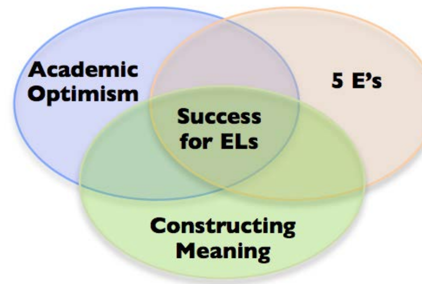
Constructing Meaning: Scaffold the academic language of STEM

Have science and math teachers at your school received training in sheltered English instruction strategies like SIOP? Have they received Constructing Meaning training? Are there holes in the STEM course pathway at your school where teachers are not providing language supports?

Take notes and then share with your partner.

page 2

Agenda



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Louis Stokes Alliance for Minority Participation

Bridging to Post-Secondary STEM

What organizations are in place at the post-secondary level to assist students from underrepresented groups in their pursuit of STEM majors and careers?

Leading Real Change for Students

How do we systematically change both STEM instruction and the broader school culture to support and encourage ELs in their study of STEM fields?

Leading Real Change for Students

It's not just about helping ELs get through an assignment or score proficient on state tests. It's about supporting them to discover science on a personal level and develop interest and confidence with STEM topics and applications.

Initially, they may believe that they don't have the skills or aptitude for science. School systems need to be established to provide all students with a level of ***science literacy*** *that allows them to learn and achieve in science courses and make an informed choice about whether a STEM field is right for them!*

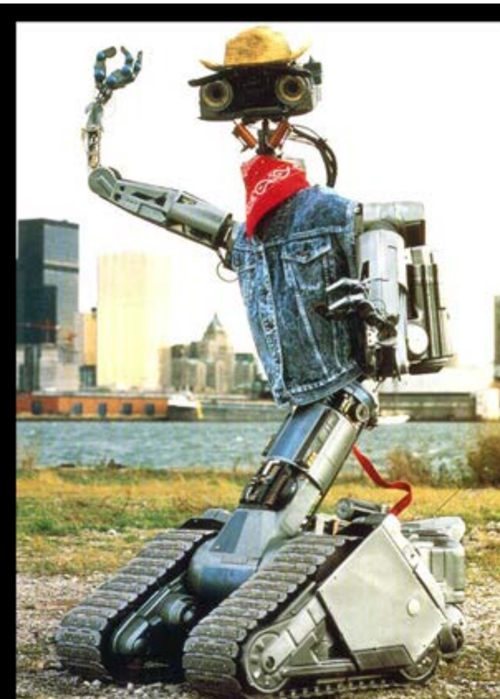
page 2

Think, Write, Pair, Share:
Let these ideas travel home with you

What are two steps you can take next week to begin the dialogue about ramping up instructional supports and expectations for ELs in STEM classes at your school?

Take notes and then share with your partner.

Thank You!



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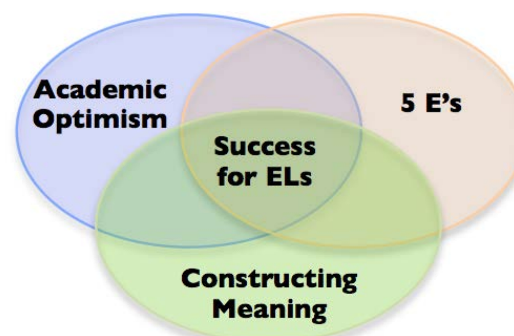

Thank You!

Constructing Meaning