SEEd Swap Workshop

2017

8th Grade
Welcome to the 2017 SEEd Swap Teacher Workshop

It’s an exciting time for the world of science instruction; advances in cognitive and pedagogical research are reshaping the way we think about engaging students in science and engineering. The state of Utah has reflected these improvements in the new 6-8th grade SEEd (Science and Engineering Education) Standards, which will be implemented across the state during the 2017-2018 school year. While this change is exciting, it also poses significant challenges. The SEEd standards are built on Disciplinary Core Ideas, as were the previous standards. The new components include the explicit integration of Science and Engineering Practices into every single standard, and the framing of ideas within Crosscutting Concepts to allow instructors to help students organize their thoughts. These three components, called ‘dimensions,’ when anchored to instruction that allows students to explore phenomena they encounter in the world, allows students to act as sense-makers and science/engineering practitioners.

In order to provide 6-8th grade teachers with professional learning support to successfully implement the new standards, the Center for Science and Mathematics Education (CSME) is offering a week-long workshop focusing on the content that has ‘swapped,’ or is new to each grade – the “SEEd Swap.”

USBE Credit:
80% documented attendance, taken 2x daily by your instructor, as well as an accurate CACTUS ID number on record, are required to earn 3 USBE credits.

Supply Stipend
A $150 check will be issued to each attendee who
Completed the pre-assessment by the July 29th deadline
Attend 100% of the workshop
Complete the post-assessment between noon on Aug. 4 and midnight Aug. 8th.

Curricular Resources
The majority of the resources found in this book will be available online at the Center for Science and Mathematics Education website: https://csme.utah.edu/resources/k12curriculum/
Megan Black

Megan Black is an elementary science curriculum specialist in Granite School District. She taught science for twelve years working with students in grades 4 - 9, but most often 6th grade. Megan was on the 6th grade SEEd standards writing committee and has been involved with developing the 6th Grade SEEd OER textbook. She is interested in developing curriculum and instructional strategies that engage students as scientists as they explore and figure out the natural world around them.

Sarah Braden

Sarah K. Braden started her career in education as a high school biology, physics, and English as a Second Language (ESL) teacher. Dr. Braden is currently an Assistant Professor of English Language Learner education in The School of Teacher Education and Leadership at Utah State University. Her research centers on understanding language socialization phenomena and promoting equity the sciences.

Brad Carroll, Professor Emeritus - Physics, Weber State University

Brad Carroll began his career as a high school math and physics teacher in Bakersfield, California. After receiving his Ph.D. in astrophysics from the University of Colorado, Brad spent time as a postdoc at the University of Rochester before joining the Physics Dept. at Weber State University in 1985. At WSU, Brad collaborated with faculty in the Dept. of Chemistry to develop a unique physical science course for elementary education majors. He also co-authored An Introduction to Modern Astrophysics, the standard undergraduate astrophysics text. Brad retired in 2015 after 30 years at WSU, 10 of them as chair of the Physics Department. In retirement, he continues to teach with the Physics Department and Honors Program, and is working on the third edition of his astrophysics text.
Jordan Gerton, Director of CSME and Associate Professor of Physics

I received my Bachelor’s degree in Engineering Physics from the University of Arizona and my Master’s and Doctorate degrees in Physics from Rice University. I have had a number of formative experiences over the years that have stoked my passion for math and science education and have driven me to leadership roles in these areas. Math and Science are among the most important and impactful human pursuits, and I am committed to helping students of all ages and backgrounds develop a passion for and proficiency in these enabling disciplines.

Holly Godsey

Dr. Holly Godsey is the Director of Student Success and Teacher Development at the CSME and an Associate Professor (Lecturer) in the Department of Geology and Geophysics. She has a BS and PhD in Geology from the University of Utah and an MS in Oceanography (Marine Geology and Geochemistry) from the University of Michigan. Since 2004, she has been involved with several science education projects that connect faculty, graduate and undergraduate students to K-12 teachers and students to inspire, empower and educate learners from across generations and disciplines.

Maura Hanenberger

Maura Hahnenberger is an Assistant Professor in the Geosciences Department at Salt Lake Community College. At SLCC she teaches and advises in the Atmospheric Sciences and Geography programs in both face to face and online settings. Maura is the founder of the WaterGirls outreach program which provides middle school girls with field experiences conducting water science. She also serves on the boards of the SLCC Chapter of the Utah Women in Higher Education Network, Utah Chapter of the American Meteorological Society, and the Earth Science Women’s Network.

Emily Harward, 7th & 8th Grade Science & Biology Teacher at Granite Schools

Emily was lucky to grow up in the Salt Lake Valley, with opportunities to spend time exploring nature. She graduated from the University of Utah in 2004, and has been teaching science at Evergreen Junior High in Granite District ever since. For Emily, the most rewarding part of teaching is developing lessons and activities that provide a pathway for students to develop their own understanding and make sense of the world they live in.
Patrice Kurnarth

Patrice received her B.S. in Biology from Ithaca College and worked in academia for a few years at Yale University and UC Berkeley. She earned her Ph.D. in Biology from the University of Utah in 2016. During her doctoral thesis, Patrice worked with middle school science teachers in the Salt Lake valley for two years as part of a GK-12 graduate school fellowship funded by the National Science Foundation. This experience was truly transformative because she learned about pedagogical theory and experienced first-hand the set-backs and successes of teaching.

Candace Penrod, District Science Supervisor at SLC School District

Candace’s teaching career began in California in elementary education. Upon moving to Utah, she transitioned to secondary science teaching, followed by several years as instructional coach. She is currently the District Science Supervisor for Salt Lake City School District. Candace obtained a Master in Education from the University of Utah in 2009 and a Master of Science in Earth Science Teaching from the University of Utah. Candace is passionate about K-12 science education and continually seeks for opportunities to improve science teaching and student learning at all levels.

Scott Roskelley, Science Assessment Specialist at Utah State Board of Education

Scott was born and raised in Chicago, Illinois and from a young age loved science. He holds degrees in wildlife biology, marine biology, teaching and learning, and educational administration. Never expecting to work in education, Scott fell into teaching in 2001 as he entered the alternative route to licensure in Utah. Scott worked for 15 years in the Jordan School District, mostly teaching middle school. Now as the state science assessment specialist, he is responsible for working with Utah teachers to develop the new end-of-year assessment for the new SEEd standards.

James Ruff

I am an evolutionary biologist studying basic evolutionary topics including sexual selection, and the forces maintaining genetic diversity in populations; furthermore, I apply evolutionary principles and techniques to questions concerning nutrition, toxicology, and pharmaceutical safety assessment. I am passionate about science education and prefer to focus on the process of science relative to the ‘fruits’ of the process. In this vein, I incorporate study designs, data analysis and writing into each of my courses. I have been a teaching fellow at both elementary and middle schools in SLCSD.
Heather Waite

I received my degree and teaching certificate from Weber State University in 2006 in Biology. I’ve been recently teaching 7th and 8th grade science at South Ogden Jr. High for 10 years. This summer I have taken the opportunity to write assessment pieces for the state. I have also worked on a District Level to develop assessments for test review and teacher evaluation. I am currently serving as department chair at SOJH. I also served on the School Transformation Team (Assessment to Achievement) for 2 years.

Tamara Young, Academic Advisor in the Department of Physics & Astronomy

Tamara’s interest in physics began in high school. As an undergraduate at Utah State University, Tamara’s studies focused on nuclear and particle physics. Tamara taught science and math for several years in the public education system. For the last couple years, Tamara has taught astronomy at SLCC, participated in course curriculum development with CSME, and taught a computational astronomy course for Master’s students in Physics Teaching. Tamara is the academic advisor in the Department of Physics & Astronomy at the University of Utah. She also engages in public outreach and education, and loves to talk about physics.
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<th>Wednesday, August 2</th>
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<th>Friday, August 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:30-8:30</td>
<td>Check In</td>
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<td>OPTIONAL Observation Walk: How to Get Students Asking Questions Outside of the Classroom.</td>
</tr>
<tr>
<td>8:30-10:30</td>
<td>8:30-9:15 - Overview</td>
<td>8.2.6 Digital vs. Analog Signals</td>
<td>8.3.3 Energy Flow in Ecosystems Carbon Cycle</td>
<td>8.4.1 Natural Resource - Distribution Part 1</td>
<td>8.4.4 Global Temperature Change Part 1 - Causes</td>
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<td></td>
<td>9:15-10:30 - Modeled Lesson - Experience as a Student</td>
<td>Dr. Judith Neugebauer</td>
<td>Jess Dwyer</td>
<td>Candace Penrod</td>
<td>Jess Dwyer</td>
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<td>10:30-10:45</td>
<td>BREAK</td>
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</tr>
<tr>
<td>10:45-12:00</td>
<td>Intro to 3D Instruction</td>
<td>Digital vs. Analog Signals</td>
<td>Carbon Cycle/Energy Flow</td>
<td>Natural Resource Distribution</td>
<td>Basic Atmospheric Science</td>
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<td></td>
<td>Dr. Brad Carroll</td>
<td>Dr. Patrice Kurnath Connors</td>
<td>Candace Penrod</td>
<td>Dr. Maura Hahnenberger</td>
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<tr>
<td>12:00-1:00</td>
<td>LUNCH</td>
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<td>1:00-3:00</td>
<td>Dr. Sarah Braden's Magnetism and Modeling lesson: Managing your 3D classroom for Equity and Access</td>
<td>Strategies to transition to the 3D classroom</td>
<td>8.1.4 Synthetic Materials</td>
<td>8.4.2 Natural Resource - Distribution Part 2</td>
<td>8.4.4 Global Temperature Change Part 2 - Effects</td>
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<td>Dr. Judith Neugebauer</td>
<td>Jess Dwyer</td>
<td>Candace Penrod</td>
<td>Candace Penrod</td>
<td>Jess Dwyer</td>
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</tbody>
</table>
Introductory Writing Prompt:
Your Finest Moment

Describe a classroom experience that you facilitated that allowed a student to:

- learn content
- act like a scientist
- feel empowered

How, specifically, did you structure that students’ experience to allow them to do and feel those things?
<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Adult Learning Principle</th>
<th>Participant Language Generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:30-8:45</td>
<td><strong>Writing Activity/Discussion (in notebooks):</strong></td>
<td>Needs Assessment</td>
<td>Written Reflection</td>
</tr>
<tr>
<td></td>
<td>• Your Finest Moment – When did you facilitate a classroom experience</td>
<td>Ideas, Feelings, &amp;</td>
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<td></td>
<td>that allowed a student to learn content, act like a scientist,</td>
<td>Actions Clear roles</td>
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<tr>
<td></td>
<td>and feel empowered?</td>
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<tr>
<td>8:45-8:55</td>
<td><strong>Week’s overview</strong></td>
<td>Clear roles</td>
<td>Written Questions</td>
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<td></td>
<td>• PPT: SEEdSwap2017_Overview.pptx</td>
<td>Safety</td>
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<td></td>
<td>Sequence &amp; Reinforcement</td>
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<td>Respect for Learners</td>
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<tr>
<td>8:55-9:05</td>
<td><strong>Cohort member introductions</strong></td>
<td>Teamwork</td>
<td>Individual writing</td>
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<td></td>
<td>1. Writing Activity (in notebooks):</td>
<td>Engagement</td>
<td>Partner Sharing</td>
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<td></td>
<td>• 4x4 matrix: best/worst PD instructors/participants</td>
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<td></td>
<td>2. Participants talk to 12 other people to find out:</td>
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<td></td>
<td>• 3 answers for each quadrant</td>
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<td>o Name</td>
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<td>o District, grade</td>
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<td>o 1 word to describe your experience of Best/Worst</td>
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<td></td>
<td>Instructor/Participant</td>
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<tr>
<td>9:05-9:15</td>
<td><strong>Establish Norms:</strong></td>
<td>Safety</td>
<td>Group Discussion</td>
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<td>&quot;Based on our experiences in PD, what are our norms to make this week</td>
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<td>maximally impactful?</td>
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<td></td>
<td>• Start and End On Time</td>
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<td></td>
<td>• Be present</td>
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<td></td>
<td>• Be yourself</td>
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<td></td>
<td>• What else?</td>
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<tr>
<td>9:15-10:15</td>
<td><strong>Model Lesson #1 – Instructor Choice</strong></td>
<td>Engagement</td>
<td>In Lesson Plan</td>
</tr>
<tr>
<td>10:15-10:30</td>
<td>1. Written reflections of model lessons</td>
<td>Praxis</td>
<td>Written Reflection</td>
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<td></td>
<td>2. Questions from participants: sticky note collage</td>
<td>Accountability is mutual</td>
<td></td>
</tr>
<tr>
<td>10:30-10:45</td>
<td><strong>Break</strong></td>
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<tr>
<td>10:45-11:45</td>
<td>**Direct Instruction: What is 3D science, and why am I being asked to</td>
<td>Immediacy</td>
<td>Planned partner conversation</td>
</tr>
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<td></td>
<td>teach this way?</td>
<td>Sequence &amp; Reinforcement</td>
<td>every 10 minutes</td>
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<td></td>
<td>• SEEdSwap2017_Why_3D_Instruction.pptx</td>
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<tr>
<td>11:45-12:00</td>
<td><strong>Written reflection (5 minutes)</strong></td>
<td>Praxis</td>
<td>Written Reflection</td>
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<td></td>
<td>Questions (10 Minutes)</td>
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<tr>
<td>12:00-1:00</td>
<td><strong>Lunch</strong></td>
<td>Clear Roles Engagement</td>
<td>In Lesson Plan</td>
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<tr>
<td>1:00-2:00</td>
<td><strong>Modeled Lesson # 2</strong></td>
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<tr>
<td>2:00-2:45</td>
<td><strong>Talking Phenomena: Management and Equity in the 3D classroom</strong></td>
<td>Immediacy</td>
<td>Planned partner conversation</td>
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<td>Sequence &amp; Reinforcement</td>
<td>every 10 minutes</td>
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<tr>
<td>2:45-3:00</td>
<td><strong>Written reflection Feedback for tomorrow</strong></td>
<td>Accountability is mutual</td>
<td>Written Reflection</td>
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</table>
Welcome to the 2017 SEEd Swap Teacher Workshop

Why is it called the SEEd Swap?
1. The new SEEd Standards; Science and Engineering Education
2. Focus on CONTENT that has “swapped,” or is new.

*We won’t officially bring in lesson plans to trade with each other, though we will have some shared work time*

Who are we?
Participants:
6th-8th grade teachers who are motivated learners

Instructors:
Classroom teachers who are already implementing 3D instruction with their students.
### What Will We Do Each Day?

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:30-10:30</td>
<td>Modeled Lesson/Reflection/Planning</td>
<td>Demonstrate and integrate 3D instruction</td>
</tr>
<tr>
<td>10:30-10:45</td>
<td>Break</td>
<td></td>
</tr>
<tr>
<td>10:45-12:00</td>
<td>Expert Lecture/Community Resource Panel</td>
<td>Support learning of new content through direct instruction</td>
</tr>
<tr>
<td>12:00-1:00</td>
<td>Lunch</td>
<td></td>
</tr>
<tr>
<td>1:00-3:00</td>
<td>Modeled Lesson/Reflection/Planning</td>
<td>Demonstrate and integrate 3D instruction</td>
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</tbody>
</table>

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### This Week is Planned Intentionally

We respect that you, as adult learners, have:

- rich, real experience to bring to your learning
- The potential to learn from, as well as with, each other
- a need to connect your learning directly to your classroom practice

(Vella, 1994)

---

### 3 USBE Credits and $150 Supply Stipend

Both based on attendance:

**Credit**
- at least 80% participation (may miss up to one day)
- accurate CACTUS number

**$150 Supply Stipend**
- Pre- and Post-assessment
- 100% on-time attendance
- W-9 form
Please fill out and turn in your W-9 forms now.

Meet your colleagues!

Learner Prompt:
1. Writing Activity (in notebooks):
   4x4 matrix: best/worst PD instructors/participants
2. Participants talk to 12 other people to find out:
   3 answers for each quadrant
   Name
   District, grade
1 word to describe your experience of Best/Worst Instructor/Participant.

Norms for the week:

Learner prompt:
In your workbook, list (2 minutes):
What norms would have addressed the worst behaviors?
What norms would have encouraged the best behaviors?
Norms for the week:

Start and End On Time
– because everyone’s time is valuable

Be Present
– because everyone is busy and important
• refrain from having devices (phones, computers) on/in/on during instruction that doesn’t require it
• if you must, feel free to step outside for
  • restroom
  • communication

Be Yourself
– your experience is valuable and welcome.

What else do we need for the week to be successful?
Complete this 4x4 considering your previous professional development experiences.

<table>
<thead>
<tr>
<th>Qualities of Best Facilitators</th>
<th>Qualities of Worst Facilitators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qualities of Best Participants (colleagues)</td>
<td>Qualities of Worst Participants (colleagues)</td>
</tr>
</tbody>
</table>
Notes: Experiential Intro to 3D Instruction
Utah’s SEEd Standards:
Why 3D Instruction?

Presentation Overview
• The history and evolution of classroom science instruction
• What is 3D instruction? Where did it come from?
• How Utah fits in to the national picture
• How instruction will stay the same
• How instruction will change
  • How assessment will work

The History and Evolution of Classroom Science Instruction

Direct instruction
  Hands-On
  Inquiry

3D instruction
"This is great news! We’ll learn why!"
Direct Instruction

**Pros:**
- It's easy
- We teachers feel smart and in control
- It works for some students

**Cons:**
- It doesn't work for everyone: “Students in classes with traditional stand-and-deliver lectures are 1.5 times more likely to fail than students in classes that use more stimulating, so-called active learning methods.” (Freeman, et al. 2014)

Hands-On (1970s)

**Pros:**
- Fun and engaging for students

**Cons:**
- Students can participate without learning
- Scary for teachers

Inquiry (1990s)

**Pros:**
- Engages students in authentic scientific practices.

**Cons:**
- Difficult to teach to teachers
- When done poorly, increased opportunity gap.
Enter . . .
3-Dimensional Science Instruction

3D Science Instruction is Good News!

What, exactly, are the three dimensions?

<table>
<thead>
<tr>
<th>Science and Engineering Practices</th>
<th>Crosscutting Concepts</th>
<th>Core Ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asking questions and defining problems</td>
<td>Patterns</td>
<td>Earth &amp; Space science</td>
</tr>
<tr>
<td>Developing and using models</td>
<td>Cause and Effect</td>
<td>Life Science</td>
</tr>
<tr>
<td>Planning and carrying out investigations</td>
<td>Scale, Proportion, and Matter</td>
<td>Physical Science</td>
</tr>
<tr>
<td>Analyzing and Interpreting Data</td>
<td>Quantity</td>
<td>Engineering</td>
</tr>
<tr>
<td>Using mathematics and computational thinking</td>
<td>Systems/Systems Models</td>
<td>Engineering</td>
</tr>
<tr>
<td>Engaging in argument from evidence</td>
<td>Energy and Matter</td>
<td>Engineering</td>
</tr>
<tr>
<td>Obtaining, evaluating, and communicating information</td>
<td>Structure and Function</td>
<td>Engineering</td>
</tr>
<tr>
<td>Phenomenon or Authentic Problem</td>
<td>Stability and Change</td>
<td>Engineering</td>
</tr>
</tbody>
</table>
Phenomena:

“are observable events in nature (or our lives) that connect to multiple disciplinary core ideas.”

Throughout a unit, students work towards explaining the science concepts behind the phenomenon in their own words.

Phenomena? Or PhenomeNOT?

Students manipulate Oreos to mimic tectonic plate movement.

What could the phenomena be?

NOT!

Phenomena? Or PhenomeNOT?

A water bottle freezes and breaks.

What disciplinary core ideas could be taught with this phenomenon?
I’ll know it’s a phenomenon when . . .

See Phenomena Yes Test in workbook.
In pairs, determine; are these phenomena?

![Glow stick](image)

The glow stick contains two chemicals and a suitable dye (sensitizer, or fluorophor). This creates an exothermic reaction.

![Flowers](image)

Some plants have flowers.

Pause to process:

**Learner Prompt:**
In your workbook, identify and reflect on the:
- Phenomena
- Content (disciplinary core ideas)
- Science and Engineering Practices
- Cross-cutting concepts

Involved in the morning’s modeled lesson.
3-Dimensional Science Instruction

Pros:
+ No vague cognitive verbs like "know" and "understand"
+ Stated what students should be able to do to demonstrate their knowledge
+ Identify progressions as part of expectations

Cons:
- No road map, no curriculum
- None of us learned this way
- Standards need to be "unpacked"

The bad news: it’s hard

You might think to yourself . . .

I’m a great teacher. I already teach that way!

Even excellent teachers don’t yet have much experience explicitly integrating all 3 dimensions.

I already do great stuff in my classroom. Do I have to get rid of it?

NO! Not at all!

Keep - and adapt - your favorite labs, activities, and assignments.
Long-term planning looks the same – and different.

Old: UNIT plan
A collection of activities related to the disciplinary core idea

New: Storyline
A carefully crafted series of cumulative experiences that allows students to build understanding, skills, and organize their thinking.

Confused?
Open to a Storyline Overview in your workbook.

Learner Prompt:
Write:
What similarities do you see with your current planning process?
What differences?

Pair:
Did you have similar reactions to the Storyline overview?
What is exciting about a Storyline? What is concerning?

Share:
Biggest concern, biggest new idea.
Short-term planning looks the same — and different.

**Old:**
Lesson Plan

An activity aimed at supporting a learning objective.

---

**New:**
Learning Episode

A science experience motivated by questions from a phenomenon or previous experience — may answer questions, or create more.

---

Confused?
Open to a Learning Episode in your workbook.

**Learner Prompt:**
Solo free write
Compare a lesson plan and a learning episode:

- Is the difference clear to you?
- Does the difference feel useful to you?
- What questions/concerns do you have?
Confused?
Open to a Learning Episode in your workbook.
Solo free write:
Compare a lesson plan and a learning episode:
- Is the difference clear to you?
- Does the difference feel useful to you?
- What questions/concerns do you have?

**We will have time to process these concerns as we model learning episodes all week.

This sounds great, but it won’t work for my kids.

It WILL work for your kids.
You are the expert on your students.
As long as students are engaged in making meaning, excellent 3D instruction can include:
- student choice
- vocab support strategies
- explicit direct instruction

Good news:
Your math/ELA colleagues are already supporting you.

Diagram on workbook pg .........
Good news: you don’t have to do it all tomorrow.

Learner Prompt:

Listen for -
What did this teacher do to begin transitioning to 3D instruction?

You decide how to implement.

Don’t let this drain you.

To avoid frustration: *Explore the suggested implementation guides in the back of your workbook.*

Pause to Process:

Learner Prompt:

In your workbook, describe:
- your planning process
- your planning resources (including colleagues as thinking partners)
- how you’ll use both to systematically consider 3D science
More good news: Assessment is changing with you.

Each SAGE item will be a part of a ‘cluster’ of questions, which will all:

- Begin with a named ‘phenomenon’
- Name the Science/Engineering Practice the student will engage

Example Assessment Items Are Available

Using a five-powered telescope, you can see four of Jupiter’s closest moons orbiting the planet.

A ruler on the line of the telescope is used to take measurements in inches. The animation shows the movements of the moons as Jupiter over the course of several days. Only part of the telescope view is shown. Click on the small gray arrow at the bottom left of the picture to begin the animation.

SAGE 3D Assessments Withstand Interrogation

Pause to process:
Open to page ...... to STEM Tool #30.
Consider 3D assessment.
Write at least 3 questions for Scott Roskelley, USBE Director of Assessment, for our working lunch session.
Regarding SAGE, you should know:
- Reading load is ⅔ of grade-level reading expectation

- Math is 1 grade below the tested grade level

- Each cluster takes an average student 8-12 minutes to complete

SAGE is built to reflect 3D learning IN SCIENCE
- If you’re teaching 3D, you’ll do well
- DOK 1 doesn’t exist any more – it can’t any more, because 3D is automatically 2-4
- No more vocab lists – ESL strategies are ALWAYS welcome, teachers identify requisite vocab (vocab resources on pg...... of your workbook

Activity: 3D Classrooms and Assessments Look Different

Learner Prompt:
1. Separate the cards into 3 piles by color.
2. Use 2 orange cards for column titles.
3. Each partner takes a pile of cards (white, shaded), and may only touch their color.
4. Arrange the strips in a T-chart:

<table>
<thead>
<tr>
<th></th>
<th>Science education will involve</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Less</td>
</tr>
</tbody>
</table>
3D Classrooms and Assessments
Look Different

Consider the sorting activity.

Learner Prompt:
Write:
What differences are you most reluctant to accept?
What differences are you most excited about?
Pair:
Where are you already aligned with 3-D instruction? What will be the easiest shift for you?
Share:
Your partner’s area of strength.

There are resources to help your students succeed on SAGE.

STEM Tool #30 (pg. ........ In workbook)

This whole workshop!

Get on Scott Roskelley’s USBE listserve:
https://goo.gl/HlaAi7

The best news: it’s better for students.

Teacher-members of pilot programs who were specifically trained in 3-D instruction taught the ‘wrong’ content, ‘covered’ much less, and still improved growth scores and overall proficiency in SAGE.
Questions?

1. When did the Pigeons land at Flap/script/ito's book?

2. Help.

As you can see, I've been busy these last few months. Helping them with their research even in my free time. I've continued to read and study. Having thought for so many years, I've concluded that this is the only way.

They say the satisfaction of teaching means more than the looks.
### Modeling Phenomena; Strategies to Support Equitable Access to Learning

#### Student Science Performance

| Topic: Magnetism | Title: Modeling magnetism: the floating paper clip |

**Overarching Performance Expectations (Standard) from State Standards or NGSS:**

This lesson directly addresses Utah SEEEd standard 7.1.3 but could easily be extended to include standard 7.1.4 because the exploration of electromagnets and generators can be used to extend students’ models for how magnetism works.

**Standard 7.1.3** Construct a model using observational evidence to describe the nature of fields existing between objects that exert forces on each other even though the objects are not in contact. Emphasize the cause and effect relationship between properties of objects (such as magnets or electrically charged objects) and the forces they exert.

Standard 7.1.4 Collect and analyze data to determine the factors that affect the strength of electric and magnetic forces. Examples could include electromagnets, electric motors, or generators. Examples of data could include the effect of the number of turns of wire on the strength of an electromagnet, or of increasing the number or strength of magnets on the speed of an electric motor.

**Lesson Performance Expectations:**

- Ss will develop and revise models of magnetism anchored in a particular phenomenon (floating paper clip). Ss will then test their models’ ability to account for new phenomena (generators, electromagnets, or iron filings).
- Ss will use appropriate language (made explicit by the teacher in sentence frames) for describing their models and asking questions of peers to extend their thinking. Ss will share leadership responsibilities required for consensus modeling. Ss will participate in whole class discussions by repeating/rephrasing, adding new ideas, asking questions, providing counterevidence or a counter argument.

**Students Will. . . To Construct Meaning**

*Engage with a Phenomenon: Floating paper clip.*

- Gather: Observations (drawings & notes) about how magnets interact with different objects under various conditions.

- Reason: Hypothesize/model HOW the magnets produce the observable properties students collected/noticed at the stations by focusing on the floating paperclip phenomenon. The model must be consistent with the observable evidence!

- Communicate: Using verbal contributions to both peer group and whole class discussions, students will describe and explain their drawings/models of magnetism & ask questions to clarify their understanding of their peers’ models.

**Teacher Will. . . To Support Students**

- Prep lesson with valued/appropriate language of participation made explicit to students at multiple points throughout the lesson.
- Manage students’ participation in groups using colored cards & explicit instructions for leadership roles & the process of forming consensus models.
- Circulate while students are working independently and in groups to provide feedback and ask strategic questions to push students’ thinking. Also help individual Ss prepare to share their models – particularly EL students.
- Provide built in wait time by allowing sufficient time for independent work before group work.
- Use strategic talk moves to promote broader participation in whole class discussions and shift classroom culture away from valuing only once correct answer.
- Draw students’ attention to evidence, counter evidence, and additional scenarios strategically to push their thinking about their models (independent, small group, and whole class settings).
- If T wants students to model at the micro-level, will need to ask students specifically to think about and draw what is happening inside the magnet and the paperclip to allow this phenomenon to occur.
Assessment of Student Learning

Proficiency will be determined based on whether or not students models show the desired level of specificity at the macro or micro levels, whether the models are static or dynamic, whether they account for observable evidence (experientially provided in class), and whether or not students models demonstrate increased sophistication/change over time. A simple 0/1 scoring could be set up for each of these dimensions if grades must be applied.

### Management Strategies:

**Materials Required:**
- Station labels & instructions
- Magnets, nails, pencils, string, paper clips, tape.
- Paper for students to draw
- Chart paper for students to depict consensus models
- White board or chart paper to record ideas during whole class discussions.
- T may want a clipboard w/ a chart to keep track of notes on students’ thinking AND notes on Ss participation according to instructions for how to collaborate.

### Sequence of Instruction

<table>
<thead>
<tr>
<th>Teacher Does</th>
<th>Students Do</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present the phenomenon &amp; Q: How does a magnet make a paperclip float in air? Think-Pair-Share T refrains from commenting too much on Ss ideas at this point. Make record of Ss initial ideas on the board.</td>
<td>Ss watch demo &amp; do Think-Pair-Share Messing about: Ss visit different stations constructed by the teacher to make observations about how magnets interact with each other and other materials. Ss keep track of ideas with notes and pictures.</td>
</tr>
<tr>
<td>Messing about: T circulates while students visit stations, and listens to student thinking and/or is available to answer procedural Qs. Can ask probing Qs as relevant.</td>
<td>Messing about: Ss visit different stations constructed by the teacher to make observations about how magnets interact with each other and other materials. Ss keep track of ideas with notes and pictures.</td>
</tr>
<tr>
<td>Initial Modeling – Independent work time Circulate and ask probing Qs, help Ss who aren’t sure how to get started, visit EL students (&amp; others) to make sure they are ready to share their models with their classmates.</td>
<td>Initial Modeling – Independent work time Ss generate drawings and initial answers to the anchor question. Ss plan how they will share their drawings with their peers.</td>
</tr>
<tr>
<td>Initial Modeling – Sharing models T circulates to collect info on student thinking – what’s in the models, and to ensure Ss follow the participation framework and that no one student is dominating the conversation or “playing teacher/expert”.</td>
<td>Initial Modeling – Sharing models Ss share their models in a small group using the participation &amp; explanation structure provided by the teacher.</td>
</tr>
<tr>
<td>Consensus Modeling T circulates to monitor Ss participation according to the framework AND to ask probing Qs about Ss thinking – to push Ss thinking.</td>
<td>Consensus Modeling Ss work together using the suggested participation framework to create a consensus model for the anchoring phenomenon.</td>
</tr>
<tr>
<td>Sharing consensus models → building towards class consensus T facilitates ‘science talk’ about the models. (See PPT) Ss revise their models based on whole class discussion (2nd round of small group consensus modeling). Repeat process as above, assign different roles to students.</td>
<td>Sharing consensus models Ss listen, present, and ask Qs following the participation framework.</td>
</tr>
<tr>
<td>Ss test their models on a new phenomenon (e.g., electromagnets, generators, and/or behavior of iron filings (if not used in initial stations &amp; depending on T goals)) May have independent and/or small group work here. Activities can/should involve standard 7.1.4.</td>
<td></td>
</tr>
<tr>
<td>Ss revise models.</td>
<td></td>
</tr>
<tr>
<td>Ss use models to explain or make predictions of a novel scenario.</td>
<td></td>
</tr>
</tbody>
</table>
Magnetism Stations

Created by, Dr. Sarah Braden & Dr. Lauren Barth-Cohen

- Each slide is a station label, however, you will need modify these pages to use with students (add drawings & delete target observation boxes)
- Each slide contains a box with the target observations we want students to make at that station. These are the pieces of evidence students will use to construct initial models of how magnetism works.
Station 1

- What materials are attracted to a magnet?
  - String
  - Paper
  - A nut or washer
  - A paper clip
  - Cardboard
  - Plastic
  - Metal hole-puncher
  - Pick something from your backpack that you are curious about!
Station 2

- What happens when you put 2 magnets on one side of a pencil and one magnet on the other side?

- Test out different ways to put the magnets on the pencil.
Station 3

- How many paper clips can you pick up with a magnet through a piece of wood or cardboard?
Station 4

- How can you make a paperclip float with magnets?
Station 5

• How many paperclips can you pick up with a nail with a magnet touching the nail?
Station 6

- What happens to your ability to pick up paperclips with a nail after you rub a magnet across the nail 20 times?

1. Rub magnet across nail in the same direction

2. Use nail to touch paperclips without the magnet touching the nail.
Station 7

- What happens to the paperclips on the end of a nail when you flip the magnet?
PROMOTING INTERACTION & PARTICIPATION IN 3D STEM LESSONS: A MODELING EXAMPLE

Dr. Sarah Braden
Urban Institute for Teacher Education
University of Utah
June 29, 2017

Agenda
1. Modeling: an NGSS Practice
2. Promoting Student Participation – Literature
3. Promoting Student Participation – Strategies
4. Sample/Model/Demo Lesson – Modeling Magnetism
5. Debrief
6. Resources, References & Contact Information

MODELING AS AN NGSS PRACTICE
Aspects of effective modeling instruction (Passmore, Schwarz & Mankowski, 2017)

• Models are always FOR not OF.
  • Compare:
    • A model for explaining planetary motion.
    • A model of the solar system.

• “The essence of the Developing and Using Models practice is to figure out and use specific ideas about theoretical and actual objects and the relationships between them to account for the behavior of systems in the natural and designed world”. (Passmore, Schwarz & Mankowski, 2017, p. 113)

• All of the NGSS practices are interconnected.

Aspects of effective modeling instruction (Kenyon, Schwarz & Hug, 2008)

• Sequence for modeling instruction
  1. Initial exploration of a phenomenon
  2. Ss construct a model
  3. Ss test the model
  4. Ss evaluate the model
  5. Ss test the model again.
  6. Ss revise the model
  7. Ss use the model to predict or explain.

PROMOTING STUDENT PARTICIPATION: THE LITERATURE
Some reasons why students may not participate in classroom conversations

1. Not enough time provided to think before speaking!
2. Ss are uncertain of appropriate discourse structures for participating in conversations.
3. Structure & frequency of questions posed by the teacher (Zwiers, 2008)
   - Classroom culture that values transmission teaching (banking model) and IRE sequences (displaying knowledge for the teacher) (Carnine, Ruze-Fish & Web, 2011).
   - Cultural differences between students’ home and school environments (Philips, 1983).
4. The teacher only validates some students’ language backgrounds not all (Rymes & Anderson, 2004).
5. Peers can be domineering! (Braden, 2016)
   - Students from majority/privileged backgrounds can inadvertently (or on purpose) recreate the power dynamics that subjugate traditionally minoritized students. This can have a snowball effect in terms of the development of science expertise.

Potential barrier to participation | Ways to overcome this barrier
--- | ---
Not enough time to think or wait | 1. Strategies to increase wait time.
Lack of knowledge or experience using appropriate discourse structures | 2. Make discourse structures for participation explicit and provide feedback on their use.
IRE questioning structure (which supports the one-right-answer view of science) | 3. Use open-ended questioning* 4. Replace unnecessary WC discussions with small group tasks.
Certain students dominate WC and small group discussions | 5. Help children manage their participation with explicit strategies.
Teachers inadvertently create unsupportive environments for minoritized students | 6. Manage teacher reactions to students during all interactions and use alternative moves to draw out student thinking.
1. Providing sufficient wait time

- Build “think” time into your lesson plans.
  - Use a timer, tell all students they have X min. to think about their answer before they will share.
- Give students a heads up on who will be asked to share and when.
- Use peer interaction before whole class discussions.*
  - Think-pair-share
  - Find your partner

2. Make academic language explicit

- Brainstorm – how would you agree or disagree with the statements below? What exactly would you say?
  1. French fries are better than potato chips.
  2. Genetically modified foods are safe and should not be banned.

  - We must make functional academic language explicit
    - Agreeing & disagreeing
    - Suggesting
    - Informing
    - Listing
    - Comparing
    - Argumentation
    - Etc.

Academic Practices in 3D STEM Lessons

1. Asking questions & defining problems.
2. Developing and using models.
3. Planning & carrying out investigations.
4. Analyzing & interpreting data.
5. Using mathematics & computational thinking.
7. Engaging in argument from evidence.
8. Obtaining, evaluating & communicating information.
2. Make academic language explicit - Resources


  - Discipline specific language

---

2. Make academic language explicit - Resources

<table>
<thead>
<tr>
<th>Academic Language Functions</th>
<th>Language Structures/Key Signal Words</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Commonly Asked Questions</td>
</tr>
<tr>
<td></td>
<td>Expressing an Opinion*</td>
</tr>
<tr>
<td></td>
<td>Paraphrasing*</td>
</tr>
<tr>
<td></td>
<td>Defining a Response*</td>
</tr>
<tr>
<td></td>
<td>Language of Summarizing</td>
</tr>
</tbody>
</table>


---

2. Make academic language explicit - Resources

Expressing an Opinion*
- I think/believe that . . .
- In my opinion, . . .
- Based on my experience, I think . . .

Paraphrasing*
- So you are saying that . . .
- In other words, you think . . .
- What I hear you saying is . . .

Defining a Response*
- What do you think?
- We haven't heard from you yet.
- Do you agree?
- What answer did you get?

Language of Summarizing
On the whole,
- Basically he/she is saying that . . .
- To support the main claim, the author provides evidence that suggests . . .

2. Make academic language explicit – 4th grade
Science Example

Content Objectives
- SWBAT predict how an extinct organism looked and the environment it lived in based on evidence from the living things that they know about from their everyday lives (by completing a graphic organizer, working independently).
- SWBAT construct an argument for why they included particular physical features or environmental features in their fossil/organism drawings.

Language Objective
- SWBAT use description & justification sentence stems (e.g., I drew X because...; My evidence is...) provided on the board to verbally justify their choices for their organism drawings working in pairs and in a whole class discussion.

3. Small group tasks, alternatives to WC discussions

  - Cooperative learning
    - Think-Pair-Share (TPS)
  - Round tables, numbered heads together
  - Jigsaw
  - Concentric circles
  - Role plays & simulations
  - Acting out stories/scenarios
  - Interview grid/find someone who
  - Take a side
  - Debates

As long as students are working on developing arguments, explanations, and/or modeling, these are all NGSS-consistent ways to promote learning in small groups!

4. Questioning practices to promote speaking

- Use open-ended HOW and WHY as opposed to known answer questions.
- Ground science lessons in anchoring phenomena that Ss can directly experience.
  - Ask students how or why questions related to these phenomena!
- Additional tips for constructing open-ended questions (Zwiers, 2008)
  - Use hindsight to explain how a problem could have been avoided.
  - Explain how information/analysis of X can help future generations.
  - Explain/provide multiple solutions to a problem.
  - Change in thoughts over time.
  - Etc....
5. Helping students manage their participation in groups

- 10 coins in a hat
- 5 Ss, 2 post-its each
- Colored & ordered participation cards
- Assign roles, make the practices of the roles explicit (rubrics/instructions), hold students accountable through feedback on how they are occupying these roles.
- Provide Ss with explicit feedback on their performance on language objectives.
- Exit slips/tasks that require reflection on HOW Ss participated in their groups

6. Managing whole class discussions

- Teacher Moves for Open-Ended Discussions (Michaels & O’Connor, 2012)
  - Repeating & Rephrasing - Who can rephrase what X said? Who can tell us what their partner said?
  - Challenge an idea with a counterexample - Does it always work that way? How does X idea fit with Y person’s idea?
  - Agree or disagree - Are you saying the same thing as X? Why or why not? Does anyone want to respond to X?
  - Add on – who can add onto the idea X is building?
  - Explaining what someone else means – Who can explain what X meant? What did you hear X say?

- Open-ended discussions are challenging! You should make the rules of the game explicit for learners through use of language objectives & scaffolding

6. Managing whole class discussions

- Teach students HOW to participate! Build a culture where having “the right” answer is NOT what is most valued.
- Valuable ways for students to contribute to the conversation – focus on evidence and explanations:
  1. Repeat/rephrase what someone else has shared
  2. Add a new idea (evidence or explanation)
  3. Ask a question about an idea
  4. Provide counter evidence or a counter argument

- When teachers hear students doing these things they can label and positively evaluate students’ contributions.
MODELING MAGNETISM: SAMPLE LESSON

Task
- Participate-ish (©) in a magnetism lesson centered on modeling.
- After participating, identify the strategies Sarah included to promote participation.
- Identify additional barriers to student participation and possible solutions.

SEEd
- Standard 7.1.3 Construct a model using observational evidence to describe the nature of fields existing between objects that exert forces on each other even though the objects are not in contact. Emphasize the cause and effect relationship between properties of objects (such as magnets or electrically charged objects) and the forces they exert.
- Standard 7.1.4 Collect and analyze data to determine the factors that affect the strength of electric and magnetic forces. Examples could include electromagnets, electric motors, or generators. Examples of data could include the effect of the number of turns of wire on the strength of an electromagnet, or of increasing the number or strength of magnets on the speed of an electric motor.
Lesson Overview

- In this lesson we will develop a model for how magnetism works.

- This exploration is anchored in the demonstration and answering the following question:
  - How does a magnet make a paperclip float in the air?

- We will work through the first two steps of the modeling cycle presented earlier.

Sequence for modeling instruction
1. Initial exploration of a phenomenon
2. Ss construct a model
3. Ss test the model
4. Ss evaluate the model
5. Ss test the model again.
6. Ss revise the model
7. Ss use the model to predict or explain.

Initial Thoughts (T-P-S)

- How does a magnet make a paperclip float in the air?

Messing About

- You will visit 7 stations that contain materials and questions geared to helping you collect data to construct your argument to answer our anchor question.

- At each station, play with the materials and think about the question posed at the station.

- Keep track of your thoughts by taking notes and drawing pictures.
Anchor Question Revisited –
Forming initial models independently

How does a magnet make a paperclip float in the air?

1. Work independently (X min)
   - Draw a picture (this is your model) to help you answer the anchor question.
   - Get ready to share your model with your group.
     - In my drawing you can see.......... I included X,Y,Z because..... OR My drawing has..... because......
     - My evidence for this model is......
     - Something I observed today......
     - Something I observed somewhere outside of class......
     - Something I read......
     - Something I learned in another science class......

2. When directed by Sarah, form a rainbow group.

Anchor Question Revisited – Sharing models

Q: How does a magnet make a paperclip float in the air?

Instructions: Each person shares his/her model with the group and explains his/her reasoning & evidence for the model. Follow the sharing order!

Language for Presenting Your Model
   - In my drawing you can see.......... I included X,Y,Z because..... OR My drawing has..... because......
   - My evidence for this model is......
   - Something I observed today......
   - Something I observed somewhere outside of class......
   - Something I read......
   - Something I learned in another science class......

Language for Active Listeners
   - I noticed you have X in your drawing, can you explain..........
   - Can you explain why you chose to depict/draw X (like Y)?
   - Can you say more about X?
   - Do you have evidence for X?

Today’s Sharing Order:
   - Pink
   - Orange
   - Blue
   - Green

Develop a consensus model in small groups

Q: How does a magnet make a paperclip float in the air?

Instructions: Combine your ideas to make a consensus model. Each person will lead part of the conversation & work.

- Pink: What are the similarities and differences in our models?
  - I noticed X# have......
  - I noticed only X’s has......
- Orange: What do we agree should be in our model?
  - I think we should include... because......
  - I agree/disagree because......
- Yellow: Are we ready to draw? How should we start?
  - I think we should draw... because/for example
- Blue: Is there anything missing in our drawing?
  - We need to add......
- Green: What’s our evidence for this model?
  - Our evidence is......
### Students share their consensus models

- Teacher strategically selects presentation order.
  - Teacher may allow students to pick who will be the presenter or assign this role. Either way – give students time to practice/prepare what they will present to the class – Ss should use their own variations on the template provided for small group sharing.
- Teacher leads a science talk about the models (Use the poster re: types of participation!)
  - Make comparisons between the models
  - Encourage students to point out similarities, differences, consistencies, inconsistencies.
  - Provide counter evidence to challenge student thinking
  - Ask questions that probe students’ thinking
  - Asks students to rephrase or repeat others’ thinking/ideas
  - Build consensus, “who else thought XYZ?”, “Do we agree or disagree with QRS idea and why?" (focus on ideas not ppl)
  - List ideas on the board to guide talk (be sure to be inclusive, as in don’t hesitate to add incorrect ideas to the ongoing list of options)

### Remaining modeling sequence for this lesson…..

- Students revise their group models after science talk.
- Ss test their models on a new phenomenon (Ss can make predictions beforehand & test those predictions)
  - Behavior of iron filings $\rightarrow$ gets at structure of magnetic fields (pushes macro-level models)
  - Electromagnets $\rightarrow$ gets at relationship between electricity & magnetism (pushes macro & micro-level thinking)
  - Generators $\rightarrow$ gets at relationship between electricity & magnetism (pushes macro & micro-level thinking)
- Ss revise models as needed based on testing.
- Ss use models to explain or predict in a novel scenario.

### SEEd Revisited

- Standard 7.1.3 Construct a model using observational evidence to describe the nature of fields existing between objects that exert forces on each other even though the objects are not in contact. Emphasize the cause and effect relationship between properties of objects (such as magnets or electrically charged objects) and the forces they exert.
- Standard 7.1.4 Collect and analyze data to determine the factors that affect the strength of electric and magnetic forces. Examples could include electromagnets, electric motors, or generators. Examples of data could include the effect of the number of turns of wire on the strength of an electromagnet, or of increasing the number or strength of magnets on the speed of an electric motor.
What would a good student generated explanation for magnetism involve? (Cheng & Brown, 2015)

1. **Elements that are not observable**
   - Does the explanation account for unobservable elements or observable phenomena?

2. **Interactions between those unobservable elements**
   - Does the explanation account for the arrangement of unseen elements or their interaction?

3. **Those unobservable elements are microscopic**
   - Are the unseen elements macroscopic or microscopic?

Students models can be categorized based on…

- Static / dynamic
- Macroscopic / microscopic → dynamic & microscopic

Assessments (not necessarily grades! ☺)

- Collect & categorize models
  - Macro-level components (presence/absence)
  - Micro-level components (presence/absence)
  - Accounts for observed evidence about how magnets work (Y/N)
  - Static vs. dynamic (movement, interaction/relationships)

- Track progress of thinking in individual models & group models
  - Ss model revisions show…
    - Increased sophistication
    - Movement in thinking based on the indicators listed above
    - New models can account for new evidence/multiple phenomena

- Keep notes on how students participate in small group and whole class discussions & have students complete reflections on their participation. Can be in checklist form to streamline recording

Promoting Interaction & Participation in the Magnetism Lesson – Examples? Additional thoughts?

<table>
<thead>
<tr>
<th>Potential barrier to participation</th>
<th>Ways to overcome this barrier</th>
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<tr>
<td>IRE questioning structure (which supports the one-right-answer view of science!)</td>
<td>3. Use open-ended questioning* 4. Replace unnecessary WC discussions with small group tasks.</td>
</tr>
<tr>
<td>Certain students dominate WC and small group discussions.</td>
<td>5. Help children manage their participation with explicit strategies.</td>
</tr>
<tr>
<td>Teachers inadvertently create unsupportive environments for minoritized students.</td>
<td>6. Manage teacher reactions to students during all interactions and use alternative moves to draw out student thinking.</td>
</tr>
</tbody>
</table>
Resources (happy to send PDFs!)

- **Modeling**

- **Talk Moves**

- **NGSS Practices & Language Learners**

- **Student thinking re: magnetism**

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Thank you!
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References


