SEEd Swap Workshop

2017

7th 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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Strand: 7.1.3

**Emphasis:** models of forces

**Anticipated Time Required** (assuming 50 minute class periods): 5 periods

**Dominant CCC:** cause and effect  
**Dominant SEP:** constructing models

**Management Strategies** to support equitable access to content: Famous Pairs and Fantastic 4

**Shopping list:**
- Pvc pipe
- Rag
- Match sticks
- Wire
- Glass containers
- Plexiglass (acrylic) sheet
- Tin foil
- Styrofoam balls
- Thread
- Tape
- Plastic grocery bags
- Styrofoam plates
- Bubble solution
- Shallow cardboard box
- Wooden blocks
- Bubble solution
- Balloons
- Glass container
- Cork
- Styrofoam cup
- Whiteboards or poster paper
- Markers
- Sticky notes
**Anchor Phenomenon:**
Pouring water into a glass until no more water can be poured forming a dome that hangs off the edge of the cup or on a penny using a pipet.

**Student Performance Expectation:**
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.

<table>
<thead>
<tr>
<th>Dominant DCI</th>
<th>Dominant CCC</th>
<th>Dominant SEP</th>
</tr>
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<tbody>
<tr>
<td>Physical Science</td>
<td>Cause and effect</td>
<td>Construct a model</td>
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<tr>
<td></td>
<td>Systems and system models</td>
<td></td>
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</table>

### Science Experiences

<table>
<thead>
<tr>
<th>CCC/SEP</th>
<th>What are students doing? (This should match your SEP!)</th>
<th>What specific understandings should students get from this experience? (What pieces of the performance expectation does the experience provide?)</th>
<th>New questions students have to propel us to the next science experience</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cause and effect/Questioning</td>
<td>Pour water into a container until it bulges without spilling (penny or cup)</td>
<td>Why doesn’t the water fall down? What force holds the water together?</td>
<td>OEQ template in journal Define Force in journal Define Field in journal Define Exert in journal Construct a model and an explanation of the forces acting in and out of the water in journal. Some students share explanations with the class. Students transfer questions from their journals and put on sticky notes and bring to a parking lot on the board.</td>
</tr>
<tr>
<td>2</td>
<td>Constructing a model</td>
<td>Examine and generate questions about examples of spheres in nature. Observe many planets and identify pattern that all planets are round. Why is that? Construct a model of the earth, including people at different positions around the earth and showing which way is “down.”</td>
<td>Round is often a default shape in nature. Gravity is a force that pulls everything towards center. There is no such thing as “down.” GRAVITATIONAL FIELDS pull things towards the center. What force is holding water together? When do we see forces pull? When do we see forces push? How far do gravitational fields extend? Does gravity make everything round? Are there other forces that exert fields like gravity? Is that why water forms a sphere in microgravity?</td>
<td>Journal responses; Why is round is such a common shape in nature? Students draw a model of the earth with people around it an indicate down. Preliminary models - gravitational fields. Students ask questions.</td>
</tr>
<tr>
<td>3</td>
<td>Carry out investigations, constructing and using models</td>
<td>Conduct research on several items to explore the properties of static and opposite charges.</td>
<td>Students will observe that some force is being transferred between objects that make them attract.</td>
<td>What is being transferred? How far do electric fields extend? Which is stronger, gravity or electric charge?</td>
</tr>
<tr>
<td>4</td>
<td>Systems and obtaining information using math and computational thinking</td>
<td>Direct Instruction: Students obtain, evaluate and communicate about the structure of Atoms with positive particles in nucleus (protons) and negative charges around the outside (electrons). Review rules for.</td>
<td>All matter is made of ATOMS that are composed of particles. POSITIVE CHARGED particles are in the nucleus (protons) and NEGATIVE CHARGED particles are found around the outside (electrons). How do electrons transfer? What happens when they transfer? Will that make objects attracted to each other?</td>
<td>Journal- answer questions about atomic structure, charges, and balance.</td>
</tr>
</tbody>
</table>
|   | magnetism
Discuss concept of neutrality and balance. | Charged Particles exert an ELECTRIC FIELD
When charges are balanced the atom is NEUTRAL, when charges are not BALANCED then the atom acquires the charge of the greatest charge value. Atoms can gain or lose electrons and acquire a charge. OPPOSITE CHARGES attract and LIKE CHARGES repel. Neutral items do not respond. |   |
|---|---|---|---|
| 5 | Cause and effects/
analyzing and interpreting data. And developing and using a model | Explore positive and negative charges for the objects in the lab. Construct a model of one station showing objects, charges and observed effects. Students should consider how this relates to the phenomenon of water forming a sphere in microgravity. | PVC and balloons acquire a negative charge when rubbed with a towel or fur. Opposite charges attract, negative charges, and neutral objects are neither attracted nor repelled. Charged objects have fields that act at a distance. Water is only attracted to charged objects. Does water have a charge? What is the charge of the water? Is water magnetic? Does water have static electricity? Make observations and construct models of electric fields based on observations. Group models of concepts highlighted at stations. |
| 6 | Cause and effect/ | Students Observe demonstration of water | The polarity of water makes it stick to itself like Is this why water sticks to other Ask Questions about the structure of water. |
| developing and using a model | moving towards charged PVC pipe. Direct instruction: Polarity, polarity of water, and the relationship between atoms and molecules. | little magnets. | things? Is magnetism related to electric charges since the same rules apply | Students construct preliminary a model of magnetic fields between water molecules. Random students selected to share model. |
| Cause and effect /obtaining information systems/ constructing and using models | Students will list all of the forces that are acting on and within the glass of water. Students introduced to the word SYSTEM Direct Instruction- There are 4 forces in the universe | There are many forces acting on every system. There are 4 major forces in the universe: Strong force and Weak force, gravity, electric/magnetic force. Strong and weak forces are found in the atom and will be discussed next year. 7th grade focuses on gravity and electric/magnetic forces and Fields (electromagnetic forces). The structure and behavior of everything in the universe can be explained with these 4 forces. | What is the effect of two or more forces acting in a system? Are these forces universal? Did these forces create the earth? | Vocabulary review game Worksheet- Students construct a model of the forces acting in this system including gravity, electric charges transferred within water molecules and magnetic attraction between water molecules. Complete worksheet questions on 4 major forces Ask Questions |
7.1.3 Episode 1

<table>
<thead>
<tr>
<th>Student Science Performance</th>
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<tbody>
<tr>
<td><strong>Topic:</strong> Forces and Fields</td>
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</table>

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

**Lesson Performance Expectations:** Students will observe two phenomena related to cohesion of water. Students will make observations, attempt an explanation, and ask questions related to the phenomenon in an attempt to determine the cause of the effects they observe in this system. Students will learn the language tools scientists use to model forces and fields.

CCC: Cause and Effect and systems and system models
SEP: Asking Questions, Developing and Using models

<table>
<thead>
<tr>
<th>Students Will . . . To Construct Meaning</th>
<th>Teacher Will . . . To Support Students</th>
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</thead>
<tbody>
<tr>
<td>Management Strategy: Famous Couples</td>
<td>Management Strategy:</td>
</tr>
<tr>
<td>Students should be given a card and matched with their “famous partner” (cookie, milk; french fries, ketchup; Bert and Ernie, etc.)</td>
<td>Have students complete a OEQ template for their observations of both phenomenon in student journals.</td>
</tr>
<tr>
<td>Students construct the Observation/Explanation/Question (OEQ) template in journal.</td>
<td>Management Strategy:</td>
</tr>
<tr>
<td></td>
<td>Provide students with sticky notes to write questions and stick on the board in a ‘parking lot’</td>
</tr>
<tr>
<td></td>
<td>Phenomenon:</td>
</tr>
<tr>
<td>Phenomenon, Students pour water into a container until it bulges over the top without falling. (Students could also drop water on a penny for the same effect if pipettes are available). (Students can film in slow motion with their phones in possible to help with their observations).</td>
<td>Provide students with a container of water and an empty container and paper towels.</td>
</tr>
<tr>
<td>Phenomenon: Student watches the behavior of water in space</td>
<td>Phenomenon:</td>
</tr>
<tr>
<td>Students will observe that the water beads up at the surface, if done well the water will even hang over the edge of the container without spilling. If students are able to watch in slow motion, they will see that the</td>
<td>Students will observe that the water beads up at the surface, if done well the water will even hang over the edge of the container without spilling. If students are able to watch in slow motion, they will see that the</td>
</tr>
</tbody>
</table>

Video from ISS of astronauts wringing out wet rag.
https://www.youtube.com/watch?v=KFPvdNbfY
While students are engaged with the phenomenon they should be recording their observations, constructing explanations from their observations and asking questions.

Construct an inferred model and explanation as a pair that can be shared with the class.

Write questions on sticky notes and bring to parking lot.

Students share their models.

Students return to their journals to record these models and add appropriate arrows and vocabulary if necessary.

Students participate in class discussion and record important questions and new vocabulary.

Water forms a film or sheet at the surface. You can explain to students that this is called surface tension. Students will be aware that something is weird, but as you circulate the room, you may need to help them with the explanation and questioning by asking them to describe what is ‘weird’ about this? Why are they surprised? What did they expect?

Students are aware of the effects of gravity, but will not have any understanding of the internal forces found in this system. They will construct explanations about the interaction of the water with the container, or hypothesize that there is something holding the water together.

Management Strategy: Provide whiteboards or paper and markers for students to construct their first model and explanation of the phenomenon. Wander the room and check out their models. Look for well thought out models and explanations you could share with the class.

Review the questions brought to the board. Best Questions could be written on the board.

Management Strategy: From your observations, select one or two students to come to the board and share their models. Look for drawings that show thought and an attempt at explanation of the phenomenon. Redraw their models on the board for everyone to see. Have the class reconstruct the models you demonstrate in their journals. Help them to add arrows and vocabulary words to their models. Have the class record those models in their journals to help them better understand future expectations.

Direct Instruction in vocabulary would be appropriate to help students form questions and construct explanations. Students should use the words FORCE (a push or a pull) EXERT (the action of a force on an object) and FIELD (a region or zone of influence of that force) in the future to describe the influence of objects acting on each other without touching to either draw them together or push them apart.

Select ‘What force is holding the water together?’ as the questions that will motivate research in next episode.
## Assessment of Student Learning

Students generate questions for research and participate in class discussion. Questions may be about the nature of water or the amount of gravity in space. The guiding question for the next episode will be “What is holding the water together?” Journals notes including OEQ structure may be graded for participation, however this is just an engagement activity.

### OEQ Table

<table>
<thead>
<tr>
<th>Observations (FACTS, things you personally observe with your SENSES or TECHNOLOGY)</th>
<th>Explanations How you EXPLAIN your observations These are INFERENCES or GUESSES based on your observations.</th>
</tr>
</thead>
</table>

**Questions:** These can be questions about anything related to the phenomenon

---

**Episode 1 - Made - Inference with new vocabulary**

Is there a force here?

Gravity is a force that pulls.

Earth has a gravitational field that exerts a force on everything pulling it down.

Gravity is a force that pulls.

Down - why isn't it falling?
7.1.3 Episode 2

<table>
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**Overarching Performance Expectations (Standard) from State Standards or NGSS:**
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.

**Lesson Performance Expectations:**
Students will construct a basic model of gravitational fields by observing patterns in behavior of objects within that field. Students will engage with multiple examples of electric fields (static). Through observations of patterns students will construct a model of electrostatic fields and recognize that electrons can be transferred between objects creating potential.

**CCC:** Patterns
**SEP:** Construct and use a model

---

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

Students observe many images of planets and look for patterns. Students may notice several features but the guiding phenomenon for this episode is that all planets are round!
Students are shown images of man objects that are naturally round. Why does nature often choose round? What role does force play here?

Students are asked to constructing a model of the earth and draw people at different positions around the earth and explain what the model means about why planets are round in their journals.

Students share models and explanations with their partner. Then partners draw one of their models on a white board and compare it to the models of their neighbors and explain their models to each other.

---

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

**Phenomenon:**
Show students images of planets and help students recognize an important pattern, all planets are round. Nature often chooses round: bubbles, tree rings, fruit and vegetables, ripples in water, etc. Show pictures of these round things and ask students to consider,

"Why are all planets round?"
"Which of these shapes were made by a force or energy?"

**Management Strategy:** Think, Pair, Share
Students journal about the question, then share their thoughts with their neighbor, then bring their thoughts to a class discussion.

After discussion, instruct students to draw a planet in their journals and place people all around that planet (stick figures). Students should show with arrows which way is DOWN for every person on this ‘planet’. and write an explanation of their model and an answer to the question in their journals.
Have students pairs choose one of their model to draw on a whiteboard and show to the class. Have them explain their model to two neighbor pairs.
When they have had a chance to discuss their models, bring them together for a class discussion.
Students consider the questions “Why do you think water forms a sphere in microgravity?” and discuss with the class.

Construct the same model on the board and use the force arrow magnets to model the gravitational field produced by earth. Call on a few students to explain the model. Ask students “How far do you think a gravitational field extends?” “How close do you have to be to a gravitational field before it exerts a force on you?”

**Students should carefully consider that there is no end to a force field, it goes on forever, but becomes weaker as it spreads out...kind of like light or ripples in a pond.**

Best student explanations should show an understanding that the gravitational field of the earth pulls everything towards a center of gravity. That planets are round because this force pulls equally in all directions. Ask students: (or check question board, they may have already asked the questions) “Why do you think water forms a sphere in microgravity?” “Is there another force besides gravity acting on or in the water?”

Their answers will vary and should guide students towards the next episode.

**Assessment of Student Learning:**

Students share preliminary models of gravitational fields
Students ask questions: do force fields usually pull things into a circle? What is the force that is holding the water into a sphere shape?
Episode 2 - Model - Why Planets are Round?

Hey! Down is always towards the center!

No such thing as DOWN

Gravitational Field goes out forever - gravity weakens from all directions.

Force of gravity pulls towards center equally so it forms a sphere.

Water in space? Inference
# 7.1.3 Episode 3

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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.

**Lesson Performance Expectations:** Students will engage with multiple examples of electric fields (static). Through observations of patterns students will construct a model of electrostatic fields and recognize that electrons can be transferred between objects creating potential.

**CCC:** Cause and effect  
**SEP:** Carrying out an Investigation, Construct and use models

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</table>
| Students organize into groups of 4 by find a famous couple that would get along with them | **Management Strategy:** from famous pairs to FANTASTIC 4  
Organize students into lab groups by having famous pairs become The FANTASTIC 4 by having them pair up with a famous pair that would complement them (Bert and Ernie with Kermit and Miss Piggy or Milk and Cookies with pillow and jammies) |
| Students engage with 8 lab stations involving electric charges. | Set up 8-9 lab stations involving Electric charges: This video has 9 excellent examples of lab stations that would help students to learn about electric charge. **Save the one with moving water until episode 6.** |
| Students fill out OEQ template in their journals. | **Management Strategy:** Each station should have a set of instructions for how to successfully and carefully observe the phenomenon. Students should engage in conversation with their lab partners and complete an OEQ template in their journals. **Materials list is found in video but include:**  
- 1 inch Pvc pipe (about 18 inches long)  
- Rag |

https://video.search.yahoo.com/search/video;_ylt=A0LEVw_XQmVZSYUAv.ZXNyoA;_ylu=X3oDMTEyNXBwOxxtBGNvbG8DYmYxBHcvwMxBHZ0aWQDQiQyMTRfMQRzZWMDc2M-?p=labs+with+static+electricity&fr=tightropetb#id=7&vid=8f34e19295cfca55bca733b62e7c4f1&action=view
As a group, students should decide on 2 questions to write on **sticky notes** and bring to the PARKING LOT.

- Match sticks
- Wire
- Glass containers
- Plexiglass (acrylic) sheet
- Tin foil
- Styrofoam balls
- Thread
- Tape
- Plastic grocery bags
- Styrofoam plates
- Bubble solution
- Shallow cardboard box
- Wooden blocks
- Bubble solution
- Balloons
- Glass container
- Cork

**Management Strategy:** Question Parking Lot

Students should meet with their lab group and discuss their questions. They should choose their 2 BEST questions, write them on **sticky notes**, and bring them to the Parking Lot on the board for class discussion.

**Questions students may generate**

```
“Is something being transferred between the towel and the pvc pipe or the balloons?”
“Is this like magnetism?”
“Would this work with...?”
```

**Assessment of Student Learning**

Students will demonstrate engagement by completing OEQ template and producing questions. Journals may be graded for participation by asking students to have a required number of observations, explanations and questions.
These are famous couples that can also become FANTASTIC 4

<table>
<thead>
<tr>
<th>Couples</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Bert and Ernie</td>
<td>Oscar and Trash can</td>
</tr>
<tr>
<td>Peanut Butter and Jelly</td>
<td>Milk and Cookies</td>
</tr>
<tr>
<td>Bacon and Eggs</td>
<td>Juice and Toast</td>
</tr>
<tr>
<td>Hugs and Kisses</td>
<td>X and O</td>
</tr>
<tr>
<td>Batman and Robin</td>
<td>Superman and Lois Lane</td>
</tr>
<tr>
<td>Ghost and Vampire</td>
<td>Candy and Halloween</td>
</tr>
<tr>
<td>Ketchup and Fries</td>
<td>Burger and Drink</td>
</tr>
<tr>
<td>Beach and Sun</td>
<td>Shark and Swimmer</td>
</tr>
<tr>
<td>Angels and Demons</td>
<td>Sam and Dean Winchester</td>
</tr>
<tr>
<td>Mickey and Minnie Mouse</td>
<td>Disney Prince and Princess</td>
</tr>
<tr>
<td>Dr Who and Tardis</td>
<td>Time and Space</td>
</tr>
<tr>
<td>Darth Vader and Yoda</td>
<td>Princess Leah and Han Solo</td>
</tr>
<tr>
<td>Miss Piggy and Kermit the Frog</td>
<td>Kanye West and Kim Kardashian</td>
</tr>
</tbody>
</table>
### 7.1.3 episode 4

**Student Science Performance**

<table>
<thead>
<tr>
<th>Topic: Forces and Fields</th>
<th>Title: Forces and Fields</th>
</tr>
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</table>

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

**Lesson Performance Expectations:**

**CCC:** Systems and System Models and Structure and Function

**SEP:** Obtaining Information, Mathematical and Computational Thinking

<table>
<thead>
<tr>
<th>Students Will. . . To Construct Meaning</th>
<th>Teacher Will. . . To Support Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students will receive direct Instruction and engage in note taking in journals: Students obtain, evaluate and communicate about the structure of Atoms with positive particles in nucleus (protons) and negative charges around the outside (negative)</td>
<td>Management Strategy: Review and Recognize</td>
</tr>
</tbody>
</table>

- The 6th grade SEED standards cover atoms and molecules and their relationship, however, the depth of that conversation is unclear and it is important that students recognize that the atom is made of charged parts for them to understand electric fields.
- All matter is made of ATOMS that are composed of particles. Some of those particles are: POSITIVE CHARGED particles which are found in the nucleus (protons) and NEGATIVELY CHARGED particles which are found moving very quickly around the outside of the atom (electrons).

**Students model electric fields**

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

**Management Strategy:** Review and Recognize

- Draw a simple atom model with charged particles in their proper position.

- Explain to students that charged particles exert an ELECTRIC FIELD

**In journals:** have students write 2 sentences using the word NEUTRAL. There are many applications of the word, but they all have the same implied meaning: neither this nor that, not one thing, not another.
Students review and recognize rules for magnets that state that opposites attract and like charges repel.

Discuss concept of neutrality and balance.

Bringing a balance similar to this may help students understand the idea of Balanced charges (balanced forces) recognizing that the balance doesn’t move if the masses are equal, likewise, if forces and charges are balanced motion does not occur. This could help them understand why the water did not fall and also sets them up for understanding of Newton’s laws later.

When charges are BALANCED the atom is NEUTRAL, when charges are not BALANCED then the atom acquires the charge of the greatest charge value.

Atoms can GAIN electrons and acquire a negative charge or LOSE electrons and acquire a positive charge.

OPPOSITE CHARGES ATTRACT and LIKE CHARGES REPEL. Help students recognize that Electrically charged particles follow the same rules as magnets. (is there a connection between electricity and magnetism? This question may come up, this can be floored until 7.1.4)
Find your partner: Students receive charge value cards and organize themselves into different partnerships as if they were the positive and negative parts of an atom. If the charges are opposite and the value is the same they are a NEUTRAL atom. If the charges are opposite and their number values are different than they will be a charged atom. Students should pair up according to their instructions.

Pair up and be a NEUTRAL atom
Pair up and be a POSITIVELY charged atom
Pair up and be a NEGATIVELY charged atom

Students could also imagine that their card represents the charge of an entire atom that has gained or lost electrons and acquired a charge.

Have students match with some they would REPEL and match with someone they would ATTRACT.

The atom is typically a neutral object with an equal number of positive and negative charges and do not respond to each other except to bond. Bonding is the exchange or sharing of electrons that creates electric potential.

**Management strategy: Find Your Partner (Do Si Do)**
To reinforce the concept, each student can be given a card with a charge value (1+, 2+ 3+, 1-, 2-, 3- etc.) Tell students that they are going to make a NEUTRAL atom by finding a partner that has the opposite charge but an EQUAL value so (3+ pairs with 3-)
Then students pair up with a partner that would give the atom a NEGATIVE charge (1+, 2-) This will leave 1- out of the activity temporarily.
Then students pair up with a partner that would give the atom a POSITIVE charge (2+, 1-) This time 1+
It is not important that students understand the complete nature of bonds at this time, but ionic bonding can help students understand the transfer of electric charge and covalent bonding can help students understand polarity.

Images from: Willliams Science Power School

**Assessment of Student Learning**

Students construct models of electric fields and review and recognize rules for magnetism and recognize that these rules also apply to charged objects. Students Assessment is participation in learning activity.
<table>
<thead>
<tr>
<th>1+</th>
<th>1-</th>
</tr>
</thead>
<tbody>
<tr>
<td>2+</td>
<td>2-</td>
</tr>
<tr>
<td>3+</td>
<td>3-</td>
</tr>
<tr>
<td>4+</td>
<td>4-</td>
</tr>
<tr>
<td>5+</td>
<td>5-</td>
</tr>
</tbody>
</table>
Episode 4 - Electric Charges

- Negative charges are attracted to + parts in the fleece.

- This makes the pipe (+) charged, so it will be attracted to - charged things like water or bubbles and repelled by + charge things like a plastic bag or balloon!
### Student Science Performance

| Topic: Forces and Fields | Title: Forces and Fields |

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

**Lesson Performance Expectations:**
Students will listen and participate in direct instruction on the transfer of electric charge between objects and observe the behavior of water in an electric field. Students will construct and use models of electric fields in different situations based on evidence.

Students will ask questions
CCC: cause and effect
SEP: analyzing and interpreting data, developing and using models

<table>
<thead>
<tr>
<th>Students Will... To Construct Meaning</th>
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<tbody>
<tr>
<td><strong>Direction Instruction:</strong> Recognize positive and negative charges for the objects in the lab. Students will be assigned to a lab station with their Fantastic 4 group. There they will Construct a model of that one station showing objects, charges and observed effects. They should elect a voice from the group and prepare to ‘stand and deliver’</td>
<td><strong>Direct Instruction:</strong> PVC and balloons acquire a negative charge when rubbed with a towel or fur. <strong>Management Strategy:</strong> Prepare to Stand and Deliver Once students have this information they should be asked to return to one lab station. (this could be assigned based on difficulty) and draw a model of the cause of the phenomenon they observed on their whiteboards or paper. Students should be able to INFER from the information given to them where electric charge is found and where it is being transferred to. Students prepare to come to the front of the class and show and explain their model. The fantastic 4 should elect a spokesperson for the group, but they should all stand and deliver. <strong>Management Strategy:</strong> Walk the room while students are working and asking guiding questions like: “If the balloon is negatively charged and it attracts hair, then what could you infer about the charge of the hair?” “How would you model that?” “How would you draw what you just told me?” “How are you going to explain that to the class?”</td>
</tr>
</tbody>
</table>
Students Observe water moving towards charged PVC pipe
Make observations and construct models of electric fields based on observations.
Students will complete a OEQ template and turn in for assessment. Their explanation could be a model.

Management Strategy: Questions are just as important as answers.
Groups should take turns presenting their models. Listening students should be asked to take notes and ask good questions. Bonus points could be awarded to students who ask GREAT QUESTIONS.
As a class have students construct a list of BIG IDEAS they have learned from the lab.

Demonstration: To end this episode, show students that pouring water will move towards a charged PVC pipe.
Assessment: Have students complete a OEQ template as an exit ticket and turn in. Their explanation could be a model.

Assessment of Student Learning
Students ask questions and journal.
OEQ Exit ticket on water phenomenon: When evaluating the assessment, look for correct use of vocabulary, accuracy in the model and questions about the nature of water.

Episode 5 - Exit ticket model

phenomenon: Water is pulled toward water when PVC is rubbed with towel.

Explanation:
- Pipe acquires + charge when it transfers e- to towel
- Stream of water - this means water must have - charge! Because opposites attract.
- Gravity pulls it.

Questions:
- Is water negatively charged?
- Is water magnetic?
Exit Ticket

Name ______________________________

Observe: Describe the phenomenon:

Explain: Explain the cause of this effect in words and pictures. Be sure to label all charges and use arrows to show the forces and fields that are involved.

Questions

Exit Ticket

Name ______________________________

Observe: Describe the phenomenon:

Explain: Explain the cause of this effect in words and pictures. Be sure to label all charges and use arrows to show the forces and fields that are involved.

Question:
Episode 5 - Exit ticket model

Phenomenon: Water is pulled toward water when PVC is rubbed with towel.

Explanation: Pipe acquires charge when it transfers electrons to towel. This means water must have charge because opposites attract. Stream of water is gravity-induced. Is water negatively charged? Is water magnetic?
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**Lesson Performance Expectations:**

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<th>Students Will. . . To Construct Meaning</th>
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<tr>
<td>Direct instruction on polar nature of water molecules. Review concept of polarity. Review the relationship between atoms and molecules.</td>
<td>Direct Instruction: Student Note taking in journals Have students draw a magnet and label the sides of the magnet N and S.</td>
</tr>
<tr>
<td>Students will learn that water molecules are polar and act like little magnets with a positive and negative side attracted to each other</td>
<td>Management Strategy: Think/pair/share Ask students to write a definition of POLAR and to think of other objects that are POLAR. Walk the room as they are drawing and writing and observe their thoughts and prepare for class discussion. Ask students to help define the word POLAR and to give examples of polar objects. Definitions should describe POLAR objects as having two opposing forces or charges on either side. Other polar objects might include the earth or a battery.</td>
</tr>
<tr>
<td></td>
<td>Review and Recognize that atoms combine to make MOLECULES and that this occurs as negative particles are exchanged or shared. Sometimes molecules do not share negative charges evenly and one side of the molecule becomes negatively charged and the other side becomes positively charged. Water is an example of a molecule that has unequal sharing of negative charges (oxygen hoggs them) making water a POLAR object.</td>
</tr>
</tbody>
</table>

This polarity means that water molecules are attracted
to each other like this

It also causes water to be attracted to any other Polar molecules, like salt and sugar (this is why things dissolve in water
https://www.youtube.com/watch?v=xdedxhcppWo
Shows how the polar water molecules are attracted to polar salt molecules)

However, polar molecules are repelled by NON POLAR molecules, for example oil, or nail polish or plastic (or our cell membranes which is why we don’t dissolve in water)

Explain that polar things are attracted to the opposite pole of other polar things.
NON POLAR things will only interact with other nonpolar things.

The polar nature of the water molecule makes them act like little magnets.
Bring up an image of the phenomenon of water in space.

In their journal have them model the forces acting
Students will construct a model of the forces acting within a drop of water in their journals, then share with their group. Then the group will construct a model to share with the class for discussion.

Within a drop of water. When they are done, they should share their models with their group. Then the group should draw a group model on the whiteboard or paper. Students bring their images to the front and teacher will lead a discussion on similarities and differences within the models. Draw a correct model and have students correct or add to their notes appropriately.

Student Questions should be directed towards the original phenomenon of surface tension and the drops on a penny or water hanging over the edge of a glass of water. “How many forces are acting in this system??

Assessment of Student Learning
Students will construct models of forces acting within water drop and share them with the class.
7.1.3 episode 7

<table>
<thead>
<tr>
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<td><strong>Topic:</strong> Forces and fields</td>
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**Overarching Performance Expectations (Standard) from State Standards or NGSS:**
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.

**Lesson Performance Expectations:**
Students will model forces and fields acting in phenomenon
Students will engage in discussion on the forces that act on matter and within matter including electromagnetic forces and gravitational forces.

**CCC:** Cause and Effect, Systems
**SEP:** develop and use a model, mathematical and computational thinking

---

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

Students will list all of the forces that are acting on and within the glass of water. Primarily: gravity, and electromagnetic forces.

Direct Instruction - There are 4 forces in the universe students construct a model of the forces acting in this system including gravity, electric charges transferred within water molecules and magnetic attraction between water molecules.

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

Remind students that we are trying to understand this SYSTEM by recognizing the many forces that are acting in this system and are the cause of the effects we see.

**Direct Instruction**
there are 4 major forces in the universe:
- Strong force and Weak force, gravity,
- electric/magnetic force (which go together we will discover) we can call these electromagnetic forces.  
**strong and weak forces** are found in the atom and will be discussed next year.
This year we focus on gravity and electric/magnetic forces (electromagnetic forces)
The structure and behavior of every atom and molecule, object and substance in the universe can be explained with these 4 forces. So far... :)

The word SYSTEM describes a set of connected things or parts forming a complex (complicated) whole.

**Assessment:** Students should discuss with their groups how to construct a model of the system above and include electromagnetic forces between charged atoms, electromagnetic forces between molecules and gravity pulling down on all of it. Each student should produce a model and explanation of the cause of the phenomenon.

See examples: and rubric

**Assessment:** Students should complete worksheet on content.

**Next Guiding Question:** Are these forces universal? Are these the forces that made the earth? The solar system? The universe? Or are these just earthly phenomena. 7.1.5

**Assessment of Student Learning**

Students complete worksheet on forces and fields
Students construct a model of the phenomenon demonstrating an understanding of the forces acting within and on this system. Students should recognize that there are many forces and fields acting on matter.
Assessment: Forces and Fields

Use the vocabulary to complete the statements below.

**Force**  **Field**  **Neutral**  **Polar**
**Exert**  **Balance**  **Positive Charge**  **Atom**
**Negative Charge**  **Molecules**  **Attract**  **Repel**

1. The basic unit of matter is called the _____________. It is made of positive parts and negative parts that are usually in _____________ to make the atom neutral.

2. When two like (same) charges come close to each other they will ________________, when opposite charges come close to each other they will ________________.

3. Specific properties of matter create fields that _____________ forces on other objects.

4. If something is marked with a (+) we say that thing has a _____________, if something is marked with a (-) we say that thing has a _____________. If there is no charge or charges are balanced then the object is _____________.

5. When something pushes or pulls on another thing without any attachment we can see, we say that thing possess a ________________.

6. Forces reach out in every direction to produce a ________________ which is a zone in which other objects can be affected by the force.

7. When atoms bond they form ________________ which sometimes have opposite charges on either side which makes them ________________.

8. Add Arrows to show the direction of force. Indicate if the force is a PUSH or a PULL.

A.  

B.  

C.  

D.
9. If an atom has the following number of Positive and Negative charges, then the charge of the atom will be?

A. $\text{6}^+$ $\text{7}^-$ The charge of this atom is ______________

B. $\text{4}^+$ $\text{3}^-$ The charge of this atom is ______________

C. $\text{6}^+$ $\text{6}^-$ The charge of this atom is ______________

D. $\text{6}^+$ $\text{8}^-$ The charge of this atom is ______________

10. Draw the lines showing what direction force will act on these water molecules in these situations.

A.

B.
Construct a model of the forces acting within and on a glass of water filled beyond its capacity.

The model should include:

- Gravitational forces (acting on everything)
- Electric Forces (between atoms in water molecules)
- Magnetic Forces (between molecules of water)
- Description of your model in words
- Arrows and labels of forces
It looks like the attraction between atoms is really strong. Because water molecules aren’t pulled apart even though they are attracted to each other.

The magnetic forces between water molecules are enough to resist the force of gravity pulling them down. — When will it fall? When gravity is strong, then.
Assessment: Forces and Fields

Use the vocabulary to complete the statements below.

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<td>Molecules</td>
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<td>Repel</td>
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1. The basic unit of matter is called the ____________. It is made of positive parts and negative parts that are usually in ____________ to make the atom neutral.

2. When two like (same) charges come close to each other they will ____________, when opposite charges come close to each other they will ____________.

3. Specific properties of matter create fields that ____________ forces on other objects.

4. If something is marked with a (+) we say that thing has a ____________ charge. If something is marked with a (-) we say that thing has a ____________ charge. If there is no charge or charges are balanced then the object is ____________.

5. When something pushes or pulls on another thing without any attachment we can see, we say that thing possesses a ____________.

6. Forces reach out in every direction to produce a ____________ which is a zone in which other objects can be affected by the force.

7. When atoms bond they form ____________ which sometimes have opposite charges on either side which makes them ____________.

8. Add Arrows to show the direction of force. Indicate if the force is a PUSH or a PULL.

A. 

B. 

C. 

D. 

---

**The Center for Science and Mathematics Education**

**THE UNIVERSITY OF UTAH**
9. If an atom has the following number of Positive and Negative charges, then the charge of the atom will be?

A. [Diagram of an atom with 7 negative charges] The charge of this atom is \(-1\)

B. [Diagram of an atom with 3 positive charges] The charge of this atom is \(+1\)

C. [Diagram of an atom with 6 positive charges] The charge of this atom is \(\text{Neutral}\)

D. [Diagram of an atom with 8 negative charges] The charge of this atom is \(-2\)

10. Draw the lines showing what direction force will act on these water molecules in these situations.

A. [Diagram of water molecules with arrows indicating attraction]

B. [Diagram of water molecules with arrows indicating repulsion]

These questions could make FLASHCARDS for a study GAME!
Construct a model of the forces acting within and on a glass of water filled beyond its capacity.

The model should include:

- Gravitational forces (acting on everything)
- Electric Forces (between atoms in water molecules)
- Magnetic Forces (between molecules of water)
- Description of your model in words
- Arrows and labels of forces
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
3D Science Instruction is Good News!

What, exactly, are the three dimensions?
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 phenomenon be?

NOT!

Phenomenon!

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?

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

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 and 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>Science education will involve</th>
<th>Less</th>
<th>More</th>
</tr>
</thead>
</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. Where did the Pigeon land at Pigpen's bank?

2. Huh.

As you can tell, I've been feeling rather tired lately and have been trying to drag myself through my days. So I was excited to spend a Saturday morning teaching with the Math Teacher Certification program students.

We discussed the role of teaching mathematics and the importance of engaging students in meaningful activities. I shared some of my experiences and strategies for making math enjoyable and accessible.

They say the satisfaction of teaching styles up the teacher's ego.

Let's make teaching fun again!!
## Modeling Phenomena: Strategies to Support Equitable Access to Learning

### Student Science Performance

<table>
<thead>
<tr>
<th>Topic: Magnetism</th>
<th>Title: Modeling magnetism: the floating paper clip</th>
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</table>

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

This lesson directly addresses Utah SEEd 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.

<table>
<thead>
<tr>
<th>Management Strategies:</th>
<th>Materials Required:</th>
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<tbody>
<tr>
<td>-Station labels &amp; instructions</td>
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<td>-Magnets, nails, pencils, string, paper clips, tape.</td>
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<tr>
<td>-Paper for students to draw</td>
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<td>-Chart paper for students to depict consensus models</td>
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<td>-White board or chart paper to record ideas during whole class discussions.</td>
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<td>-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.</td>
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### Sequence of Instruction

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<th>Teacher Does</th>
<th>Students Do</th>
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<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</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>
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<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>
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<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>
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<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>
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<tr>
<td>Sharing consensus models → building towards class consensus T facilitates ‘science talk’ about the models. (See PPT)</td>
<td>Sharing consensus models Ss listen, present, and ask Qs following the participation framework.</td>
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<tr>
<td>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>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>
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<tr>
<td>Ss revise models.</td>
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<td>Ss use models to explain or make predictions of a novel scenario.</td>
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