Please label your trifold as shown on the posters. Number the back of your trifold from 1-4 and indicate True or False for each statement:

1. Student hypothesis generation and testing should be reserved for science topics.
2. Students at all grade levels can generate hypotheses.
3. The teacher’s role in Design Question 4 (DQ4 - Helping Students Generate and Test Hypotheses) is guidance, facilitation and providing resources.
4. Hypotheses should only be generated by individual students and not by group collaboration.
DQ 4: HELPING STUDENTS GENERATE AND TEST HYPOTHESES
BEV PERRAULT AND DONNA HUNZIKER
REMINDERS

- Sign-in on Professional Development Session form to obtain stipend.
- Turn in Learning Log at the end of session to obtain Professional Development Points.
- Return materials to back table at the close of session.
- Restrooms and snack machines are located down hall way.
GROUP NORMS

- Are Respectful of Other’s Opinions and Listen with an Open Mind; Limit the Use of Electronics for Checking Emails to Breaks; Focus on Instructional Model and **not** Evaluation Process

- Collaborate in Group Work

- Take Responsibility for Engaging in Learning and Continuous Growth

**It’s Okay to have Fun! Suffering is Optional.**
The participant will be able to describe instructional strategies that engage students in cognitively complex tasks involving generating and testing hypotheses.
From the **DEPARTMENTS** Tab, Choose: *Instructional Model & Evaluation*
Students need involvement in lessons that tap students’ love of learning and investigation which supports the Common Core Standards and course standards through daily application.

Teachers design opportunities for students to:
• Ask questions
• Generate hypotheses and predictions
• Investigate through testing or research
• Analyze and communicate results

- Marzano, Pickering, & Pollock, 2001
WHY DQ 4: GENERATING AND TESTING HYPOTHESES?

- 23% Gain in Student Achievement
- Common Core Standards
- Systematic Problem Solving
- Real-World Application
LEARNING IS MESSY!

During the process, students will go through different stages of emotions. They might feel uncertainty as they begin, optimism when they select a project, then confusion or frustration when they’ve gathered a lot of information and don’t know where to go with it. As they begin to sift through the information, they gain a sense of clarity and direction and begin formulating and executing the project. By the end of the process, they’ll have a sense of satisfaction or disappointment on the outcome of their presentation.

http://blogs.kqed.org/mindshift/2013/03/5-tools-to-help-students-learn-how-to-learn/
During the process, students will go through different stages of emotions. They might feel uncertainty as they begin, optimism when they select a project, then confusion or frustration when they’ve gathered a lot of information and don’t know where to go with it. As they begin to sift through the information, they gain a sense of clarity and direction and begin formulating and executing the project. By the end of the process, they’ll have a sense of satisfaction or disappointment on the outcome of their presentation.
PRIMARY GRADES

• Give younger students sentence stems to prompt their thinking about the process, for example:
  • “I think if I change ________, then ________ will happen.”
  • “While doing this task, I learned ________.”

• Provide experiences where students engage in problem-solving and decision making tasks

• Teach students how to verbalize a hypothesis through discussion and questioning

- Marzano (2008)
Dinosaur Train Video Clip
http://www.pbslearningmedia.org/resource/ecb38af9-e75b-4ffc-a169-5ffba225402c/ecb38af9-e75b-4ffc-a169-5ffba225402c/

A COLORFUL HYPOTHESIS

What Color Will You Get? Make a Hypothesis!

<table>
<thead>
<tr>
<th>Color 1</th>
<th>Color 2</th>
<th>Hypothesis</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Color Swatches" /></td>
<td><img src="image2.png" alt="Color Swatches" /></td>
<td><img src="image3.png" alt="Color Swatches" /></td>
<td><img src="image4.png" alt="Checkmark" /></td>
</tr>
</tbody>
</table>


Let’s make a hypothesis!

Pease porridge hot, Pease porridge cold,
Pease porridge in the pot, nine days old;
Some like it hot, some like it cold,
Some like it in the pot, nine days old.

What would happen if soup or oatmeal remains in a bowl for 9 days?
INTERMEDIATE ELEMENTARY

• Students read specific scenarios and use information to write appropriate “If-Then” statements.
• Intermediate elementary students are ready to formulate and test hypotheses.
SECONDARY STUDENTS

- Student states hypothesis and writes steps for experiment or research
- Student researches or creates experiments to test hypotheses
- Student completes research or experiment, records, and analyzes results
FAIL = FIRST ATTEMPT IN LEARNING!

"We don't have failures here...we have learning experiences."

• “Why Wrong is Not Always Bad”
• Fixed Mindsets: either good at a subject or skill or not; mistakes serve no purpose but to highlight failure
• Growth Mindsets: either better or worse in areas but we all can improve; accept mistakes as part of learning

– Carol Dweck
Diana Laufenberg teaches 11th-grade American History at the Science Leadership Academy in Philadelphia.

TED Talk: Diana Laufenberg
http://www.ted.com/talks/diana_laufenberg_3_ways_to Teach.html
The teacher organizes the class in such a way as to facilitate students working on complex tasks that require them to generate and test hypotheses.

**Teacher Evidence**
- Teacher establishes the need to generate and test hypotheses
- Teacher organizes students into groups to generate and test hypotheses

**Student Evidence**
- When asked, students describe the importance of generating and testing hypotheses about content
- When asked, students explain how groups support their learning
- Students use group activities to help them generate and test hypotheses
The teacher engages students in complex tasks (e.g. decision making, problem solving, experimental inquiry, investigation) that require them to generate and test hypotheses.

**Teacher Evidence**
- Teacher engages students with an explicit decision making, problem solving, experimental inquiry, or investigation task that requires them to generate and test hypotheses
- Teacher facilitates students generating their own individual or group task that requires them to generate and test hypotheses
The teacher engages students in complex tasks (e.g. decision making, problem solving, experimental inquiry, investigation) that require them to generate and test hypotheses.

**Student Evidence**
- Students are clearly working on tasks that require them to generate and test hypotheses
- When asked, students can explain the hypothesis they are testing
- When asked, students can explain whether their hypothesis was confirmed or disconfirmed
- Student artifacts indicate that they can engage in decision making, problem solving, experimental inquiry, or investigation
The teacher acts as resource provider and guide as students engage in cognitively complex tasks.

**Teacher Evidence**
- Teacher makes himself/herself available to students who need guidance or resources
  - Circulates around the room
  - Provides easy access to himself/herself
- Teacher interacts with students during the class to determine their needs for hypothesis generation and testing tasks
- Teacher volunteers resources and guidance as needed by the entire class, groups of students, or individual students
The teacher acts as resource provider and guide as students engage in cognitively complex tasks

**Student Evidence**

- Students seek out the teacher for advice and guidance regarding hypothesis generation and testing tasks
- When asked, students can explain how the teacher provides assistance and guidance in hypothesis generation and testing tasks
INVESTIGATION

Testing Hypothesis about past, present or future events

**Historical Investigations**
- Answering questions about what really happened.
- Why did “x” happen?

**Projective Investigations**
- What would happen if…?

**Definitional Investigations**
- What are the important features of…?
- What are the defining characteristics of…?
THE INVESTIGATION PROCESS

1. Am I focusing on something that has to be defined better, something that happened in the past, or something that might possibly happen?
2. What do I think I will find out?
3. What is known about my subject?
4. What confusions or contradictions exist about my subject?
5. What confusions or contradictions exist about my subject?
6. What do I think is the resolution to these confusions and contradictions?
7. Did my findings fit with my original prediction?
8. If not, how should my thinking change?
The Singing Revolution
http://www.youtube.com/watch?v=DA9PmZo-2jo

The Singing Revolution – The Protest
http://www.youtube.com/watch?v=LDhJnYdx6T8&list=PL0358C13F89D9D296

The Singing Revolution – Human Chain
http://www.youtube.com/watch?v=GPkA_r2-vas&list=PL0358C13F89D9D296
HISTORICAL INVESTIGATION

After viewing the video,
A. Choose one of the following questions or create a question that you would like to explore.
B. Generate a hypothesis (A statement of your tentative assumption).
C. Test your hypothesis.
D. Present your findings and the relationship to your hypothesis.

1. How might history have been affected if the Estonians had chosen another revolutionary approach?

2. What might be some of the negative outcomes that may have occurred from a successful non-violent revolution in Estonia?

3. What conditions might allow for a peaceful independence, such as happened in Estonia?

4. What impact did the Singing Revolution have on Estonia’s Independence? Where might a peaceful revolution have happened in the past or could it happen anywhere else?
PRESENT YOUR FINDINGS

Include the following on your chart paper:

1. Identify the question # that you selected.
2. Hypothesis – A statement of your tentative assumption
3. Research Findings – Short List
4. Conclusion: Did your research confirm or refute the hypothesis? Explain.
5. What new questions do you have?
6. What are the implications of what you’ve learned? (Why does this matter?)
1. Consider how you felt as you went through this process and briefly list the emotions you experienced.

2. Identify elements of the activity that created changes in your emotion.

3. How did you feel after your presentation?
During the process, students will go through different stages of emotions. They might feel uncertainty as they begin, optimism when they select a project, then confusion or frustration when they’ve gathered a lot of information and don’t know where to go with it. As they begin to sift through the information, they gain a sense of clarity and direction and begin formulating and executing the project. By the end of the process, they’ll have a sense of satisfaction or disappointment on the outcome of their presentation.
SOLVING A WORD PROBLEM IS NOT PROBLEM SOLVING

Determine the Goal
Identify New Context or Constraint
Predict Impact to Results
Test the Prediction
Report Results with Constructed Supports
Real-World Problem Solving: Designing an iPad
https://www.teachingchannel.org/videos/high-school-engineering-lesson
PROBLEM SOLVING

• What is the goal?
• What obstacle, constraint or unusual situation makes this difficult?
• What are ways I might overcome the obstacle?
• What solution do I predict?
• What actually happened?
• Do the results fit with my original prediction?
• If not how should my thinking change because of the problem?
EXPERIMENTAL INQUIRY

1. Make a prediction based on observations.
2. Design an experiment to test the predictions.
3. Examine the results in light of the original prediction.
4. Explain the results and your conclusions.
Ideas worth Spreading

TED

Lion Lights

http://www.ted.com/talks/richard_turere_a_peace_treaty_with_the_lions.html
MODELING EXPERIMENTAL INQUIRY FOR YOUNG STUDENTS

1. What do I see or notice?
2. How can I explain it?
3. Based on my explanation, what can I predict (hypothesize)?
4. How can I test my prediction (hypothesis)?
5. What happened? Was my prediction (hypothesis) confirmed? What new questions do I have?
MODELING EXPERIMENTAL INQUIRY FOR OLDER STUDENTS

1. Observe something that interests you and describe what has occurred.
2. Explain what you have observed. What theories or rules could explain what you have observed?
3. Based on your explanation make a hypothesis.
4. Design an experiment or activity to test your hypothesis.
5. Examine results and determine if evidence supports your hypothesis. What new questions do you have?
DECISION MAKING

- Identify Alternatives
- Determine Criteria on which Alternatives will be Judged.
- Predict which will be the Best Alternative
- Complete the Decision Making Task
- Determine Best Alternative based on Decision Matrix
- Contrast Findings with Original Predictions & Support Conclusions.
DEcision Making

1. What alternatives am I considering?
2. What criteria am I using to select among alternatives?
3. What do I predict will be the best alternative?
4. Which alternative came out on top?
5. Do the results fit with my original prediction?
6. If not, how should my thinking change?
## Decision Making

### Decision Matrix

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Alternatives</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>University</td>
</tr>
<tr>
<td>Time Needed for Completion</td>
<td></td>
</tr>
<tr>
<td>Major</td>
<td></td>
</tr>
<tr>
<td>Tuition/Financial Aid</td>
<td></td>
</tr>
<tr>
<td>Quality of Program</td>
<td></td>
</tr>
</tbody>
</table>
WE’RE GOING ON A VACATION!

What are our Alternatives?
• Disney World
• The Beach
• The Mountains

What are our Criteria?
• Activities
• Cost
• Time
## QUANTITATIVE DECISION MATRIX

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Panama City Beach House</th>
<th>Disney World</th>
<th>Appalachian Cabin</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Activities</strong></td>
<td>• Appealing to entire family</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Variety</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cost</strong></td>
<td>• Transportation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Lodging</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Food</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Time</strong></td>
<td>• Length of Vacation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Travel</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## QUANTITATIVE DECISION MATRIX

### CHOOSING A SUMMER VACATION

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Panama City Beach House</th>
<th>Disney World</th>
<th>Appalachian Cabin</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Activities</strong>&lt;br&gt;• Appealing to entire family&lt;br&gt;• Variety</td>
<td>$3 \times ____ = $</td>
<td>$3 \times ____ = $</td>
<td>$3 \times ____ = $</td>
</tr>
<tr>
<td><strong>Cost</strong>&lt;br&gt;• Transportation&lt;br&gt;• Activities&lt;br&gt;• Lodging&lt;br&gt;• Food</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Time</strong>&lt;br&gt;• Length of Vacation&lt;br&gt;• Travel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## CHOOSING A SUMMER VACATION

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Panama City Beach House</th>
<th>Disney World</th>
<th>Appalachian Cabin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activities</td>
<td>3 × ___ =</td>
<td>3 × ___ =</td>
<td>3 × ___ =</td>
</tr>
<tr>
<td></td>
<td>• Appealing to entire family</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Variety</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost</td>
<td>2 × ___ =</td>
<td>2 × ___ =</td>
<td>2 × ___ =</td>
</tr>
<tr>
<td></td>
<td>• Transportation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Activities</td>
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<td></td>
<td>• Lodging</td>
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<td></td>
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<tr>
<td></td>
<td>• Food</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>1 × ___ =</td>
<td>1 × ___ =</td>
<td>1 × ___ =</td>
</tr>
<tr>
<td></td>
<td>• Length of Vacation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Travel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Quantitative Decision Matrix

### Choosing a Summer Vacation

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Panama City Beach House</th>
<th>Disney World</th>
<th>Appalachian Cabin</th>
</tr>
</thead>
</table>
| **Activities** | • Appealing to entire family  
• Variety | \(3 \times 3 = 9\) | \(3 \times 2 = 6\) | \(3 \times 3 = 9\) |
| **Cost** | • Transportation  
• Activities  
• Lodging  
• Food | \(2 \times 2 = 4\) | \(2 \times 1 = 2\) | \(2 \times 3 = 6\) |
| **Time** | • Length of Vacation  
• Travel | \(1 \times 1 = 1\) | \(1 \times 3 = 3\) | \(1 \times 1 = 1\) |

**Total**: 12, 11, 16
1. Share a daily example at your table of daily decision-making.

2. Plan an example of a decision-making task that is related to your curriculum.
REVISE BELL WORK ANSWERS

1. The best place for students to generate and test hypotheses is science.

2. Students at all grade levels can generate hypotheses.

3. The teacher’s role in DQ4 is guidance, facilitation and providing resources.

4. Hypotheses should only be generated by individual students and not by group collaboration.