5E Model for Integrated STEM Education

Educator Effectiveness Academy
STEM Follow-Up Webinar
December 2011
Presenters

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Educator Effectiveness Academy
2011 STEM Goals

• To provide participants an awareness of the necessity to prepare students to enter the national and global STEM workforce.

• To engage participants in activities focused on the why, what, and how of Maryland STEM Education.
STEM Fall Webinar Format

• Asynchronous Delivery

• Intended Audience: STEM 2011 Participants

• Team Discussion Icon

  • Pause the webinar to allow for team discussion or activity.
  • Upon completion, re-start the webinar.
  • Webinar Capture Sheet
Educator Effectiveness Academy Fall 2011 Webinar Capture Sheet

Webinar Format
- Asynchronous Delivery
- Intended Audience: STEM 2011 Participants
- Team Discussion Breaks

<table>
<thead>
<tr>
<th>Discussion Break</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1 Engagement</td>
<td></td>
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<tr>
<td>#2 Exploration</td>
<td></td>
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<tr>
<td>#3 Explanation</td>
<td></td>
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<tr>
<td>#4 Elaboration/Extension</td>
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<tr>
<td>#5 Evaluation</td>
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Participants will...

• view the definition of STEM Education.

• review the 5E Model for Integrated STEM Education.

• develop a plan for sharing this professional development with their STEM Professional Learning Communities and school faculty.
STEM Education in Maryland
MSDE STEM Education Definition

STEM education is an approach to teaching and learning that integrates the content and skills of science, technology, engineering, and mathematics. STEM Standards of Practice guide STEM instruction by defining the combination of behaviors, integrated with STEM content, which is expected of a proficient STEM student. These behaviors include engagement in inquiry, logical reasoning, collaboration, and investigation.

The goal of STEM education is to prepare students for post-secondary study and the 21st century workforce.
5E Model

- Engagement
- Exploration
- Explanation
- Elaboration or Extension
- Evaluation
STEM 5E Model

- Engagement
- Exploration
- Explanation
- Elaboration or Extension
- Evaluation
Engagement

The activities in this phase are designed to capture the student's attention, stimulate their thinking, and help them access prior knowledge.
Engagement in STEM Education

- Teacher or student poses a real world problem, complex question, or global issue.
- Students brainstorm potential solutions or construct explanations.
Example: Health – Sports Safety

http://www.youtube.com/watch?v=Q-I4h0s2jnU&feature=related
Engagement in STEM Education

- What types of forces are absorbed by a helmet during a collision like this?
- What about the medical concern of concussions occurring during a football collision?
Discuss: List three or more engagement activities that you could use with your students.

- Record the ideas on the Webinar Capture Sheet.

- Pause the webinar. Return upon completion of the discussion activity.
# STEM Engagement

<table>
<thead>
<tr>
<th>Teacher</th>
<th>Student</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poses potential problems</td>
<td>Asks relevant questions</td>
</tr>
<tr>
<td>Raises questions to reveal discrepancies</td>
<td>Develops a need to know</td>
</tr>
<tr>
<td>Elicits responses</td>
<td>Access prior knowledge</td>
</tr>
<tr>
<td>Identifies a real life problem, issue, or challenge to explore further</td>
<td>Identifies a real life problem, issue, or challenge to explore further</td>
</tr>
</tbody>
</table>

Adapted from Llewellyn, D. (2005)
STEM 5E Model

- Engagement
- Exploration
- Explanation
- Elaboration or Extension
- Evaluation
Exploration

Students are given time to think, plan, investigate, and organize collected information. For example, students may perform experiments, conduct research, and design test models or prototypes.
Exploration in STEM Education

Students explore and make connections between

- Science
- Technology
- Engineering
- Mathematics
- Other disciplines

Students select and apply the appropriate systematic approaches to answer complex questions, investigate global issues, and to develop solutions for challenges and for real world problems.
Discuss: **What strategies, tools, and/or resources would support the exploration of a complex question, issue, or challenge?**

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STEM Exploration

Teacher

- Asks probing questions related to STEM content and processes
- Provides time for students to think through the STEM disciplines related to a real world problem or issue

Student

- Researches various content and processes
- Conducts experiments, plans investigations, and designs models
- Records observations

Adapted from Llewellyn, D. (2005)
Explanation

Students are involved in an analysis of their exploration. They clarify understandings discovered and communicate in various ways.
Explanation in STEM Education

Students

• Analyze and interpret data
• Communicate understandings and possible solutions
• Use technology appropriately for analysis and communication
Discuss: What types of analysis and communication methods or tools would you expect students to use to show evidence of their comprehension of their exploration?

Record the comments on the Webinar Capture Sheet.

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## STEM Explanation

<table>
<thead>
<tr>
<th>Teacher</th>
<th>Student</th>
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</thead>
<tbody>
<tr>
<td>Encourages students to collaborate to explain concepts</td>
<td>Listens critically to and questions others’ explanations</td>
</tr>
<tr>
<td>Asks for justification (evidence) and clarification</td>
<td>Uses recorded observations in explanations</td>
</tr>
<tr>
<td>Uses students’ previous experiences as the basis for explaining concepts</td>
<td>Generates graphs, charts, reports, diagrams, and sketches</td>
</tr>
</tbody>
</table>

Adapted from Llewellyn, D. (2005)
Elaboration or Extension

Students are given the opportunity to expand and solidify their understanding of the concept.
Elaboration in STEM Education

Students

- Refine solutions, prototypes, and/or models
- Modify experimental procedures for further exploration
- Identify and analyze connections to STEM careers
Discuss: *What strategies could be used to explore related STEM careers?*

- Record the comments on the Webinar Capture Sheet.
- Pause the webinar. Return upon completion of the discussion activity.
STEM Elaboration

Teacher

- Encourages students to apply learned concepts and skills in new situations
- Reminds the students that there are multiple solutions to real world problems
- Encourages perseverance when challenges occur

Student

- Applies learned concepts and skills in new situations
- Uses previous information to ask additional relevant questions
- Draws connections between STEM careers and their project work

Adapted from Llewellyn, D. (2005)
STEM 5E Model

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Evaluation

Evaluation occurs throughout the 5E Model. Rubrics developed by teachers and students target what students must know and do.
Evaluation in STEM Education

Students

• Reflect on their solutions to the complex question, issue, challenge or problem
• Participate in peer reviews
• Demonstrate understanding through performance-based tasks
Discuss: *What are some examples of performance-based tasks that could be used to evaluate a STEM application?*

*Record the comments on the Webinar Capture Sheet.*

*Pause the webinar. Return upon completion of the discussion activity.*
# STEM Evaluation

<table>
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<tbody>
<tr>
<td>• Assesses students’ knowledge and/or skills</td>
<td>• Answers open-ended questions</td>
</tr>
<tr>
<td>• Looks for evidence that the student demonstrates understanding</td>
<td>• Evaluates his or her own progress and knowledge</td>
</tr>
<tr>
<td>• Asks open-ended questions</td>
<td>• Asks related questions that would encourage future exploration</td>
</tr>
</tbody>
</table>

Adapted from Llewellyn, D. (2005)
5E Model for Integrated STEM Education

IS APPLICABLE IN ALL CONTENT AREAS
Suggested Webinar Extension Activity

Develop a plan for sharing this professional development with your STEM Professional Learning Communities and school staff.
Next Steps

- Spring STEM Webinar
- 2012 Educator Effectiveness Academies
Thank You

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References
