Kristin Rademaker
NSTA Professional
Learning Specialist
krademaker@nsta.org
Portrait of a Graduate

Alone Zone (independent thinking time)

● What is your goal for science education?

● Why is it important for students to learn science?
Portrait of a Graduate
Portrait of a Graduate

Small Group

- What is your goal for science education?
- Why is it important for students to learn science?

Be prepared to share
Portrait of a Graduate

North Carolina Graduates…

- Adaptability
- Communication
- Empathy
- Collaboration
- Critical Thinking
- Learner’s Mindset
- Personal Responsibility
# Portrait of a Graduate

<table>
<thead>
<tr>
<th>SCIENCE EDUCATION WILL INVOLVE LESS:</th>
<th>SCIENCE EDUCATION WILL INVOLVE MORE:</th>
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<tbody>
<tr>
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<td>Teachers providing information to the whole class</td>
<td>Students conducting investigations, solving problems, and engaging in discussions with teachers’ guidance.</td>
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<td>Teachers posing questions with only one right answer</td>
<td>Students discussing open-ended questions that focus on the strength of the evidence used to generate claims.</td>
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<tr>
<td>Students reading textbooks and answering questions at the end of the chapter</td>
<td>Students reading multiple sources, including science-related magazine and journal articles and web-based resources; students developing summaries of information.</td>
</tr>
<tr>
<td>Pre-planned outcome for “cookbook” laboratories or hands-on activities</td>
<td>Multiple investigations driven by students’ questions with a range of possible outcomes that collectively lead to a deep understanding of established core scientific ideas.</td>
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<td>Student writing of journals, reports, posters, and media presentations that explain and argue.</td>
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<tr>
<td>Oversimplification of activities for students who are perceived to be less able to do science and engineering</td>
<td>Provision of supports so that all students can engage in sophisticated science and engineering practices.</td>
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## NORTH CAROLINA COMPETENCY SET

**Adaptability**

- North Carolina Graduates...
  - Demonstrate agility in thought processes and problem-solving.
  - Accept feedback, praise, setbacks, and criticism.
  - Balance diverse viewpoints and beliefs to reach workable solutions.
  - Demonstrate flexibility when navigating challenging situations.
  - Exhibit steadfastness despite difficulty, opposition, and/or failure.

**Collaboration**

- North Carolina Graduates...
  - Contribute and respond to diverse perspectives to achieve a common goal.
  - Leverage strengths to resolve conflict and foster teamwork.
  - Interact respectfully with others in digital and in-person interactions.
  - Embrace a variety of roles in a group as a participant and a leader.

**Communication**

- North Carolina Graduates...
  - Articulate thoughts and ideas effectively using oral, written, and nonverbal communication skills.
  - Listen to decipher meaning, values, attitudes, and intentions.
  - Ask questions and synthesize messages to seek understanding.
  - Engage in productive discourse to resolve disagreements.
  - Craft communication for a range of purposes and audiences.
  - Use storytelling and public speaking to express ideas and connect with others.

**Critical Thinking**

- North Carolina Graduates...
  - Analyze, assess, and reconstruct personal thought processes.
  - Apply thinking that is clear, rational, and evidence-based.
  - Evaluate and prioritize solutions to difficult or complex problems.
  - Employ creative improvements to systems, processes, and organizations.
## A New Vision for Science Education

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### Less Like

- Pre-planned outcome for “cookbook” laboratories or hands-on activities
- Worksheets
- Oversimplification of activities for students who are perceived to be less able to do science and engineering

### More Like

- Multiple investigations driven by students’ questions with a range of possible outcomes that collectively lead to a deep understanding of established core scientific ideas
- Student writing of journals, reports, posters, and media presentations that explain and argue
- Provision of supports so that all students can engage in sophisticated science and engineering practices
Agenda

● Introductions and housekeeping
● Introduction to BSCS: Understanding for Life
  ○ Lesson 1 - Anchoring Phenomena
  ○ Lesson 1 - Reflection
● Storyline Build
● CMS Time - Ingrid Humphries
Add questions you have about the unit, the course, the program at any point.
## BSCS Biology Course Pacing Guide

Minimum: 160 days*

*Does not include any suggested extension activities. In the first year of teaching, each unit (especially Unit 1) will likely take longer to complete. Each class may also choose to take more than the minimum time to complete the Culminating Task for some units.

*1 day = 50 minutes of instructional time

### Unit 1
- **46 days**
- **9–10 weeks**
- Chapter 1: 15 days
- Chapter 2: 13 days
- Chapter 3: 18 days

### Unit 2
- **41 days**
- **8–9 weeks**
- Chapter 4: 13 days
- Chapter 5: 12 days
- Chapter 6: 16 days

### Unit 3
- **36 days**
- **7–8 weeks**
- Chapter 7: 12 days
- Chapter 8: 11 days
- Chapter 9: 13 days

### Unit 4
- **37 days**
- **7–8 weeks**
- Chapter 10: 12 days
- Chapter 11: 12 days
- Chapter 12: 13 days

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How can bacterial infections make us so sick, and why are they getting harder to treat?
Unit 1
How can bacterial infections make us so sick, and why are they getting harder to treat?

CHAPTER 1
We figure out how bacteria live and grow, and how this growth can cause infections.

CHAPTER 2
We figure out how the human body can (and can’t) maintain homeostasis to defend itself against infections.

CHAPTER 3
We figure out how antibiotics can help fight infections, and how over time natural selection can lead to resistance.
Unit 1

How can bacterial infections make us so sick, and why are they getting harder to treat?

**HS-LS1-2** Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

**HS-LS1-3** Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

**HS-LS1-1** Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins, which carry out the essential functions of life through systems of specialized cells. (Partially addressed – continued in Unit 2).

**HS-LS2-1** Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. (Partially addressed – continued in Units 3 and 4).
Unit 1  How can bacterial infections make us so sick, and why are they getting harder to treat?

HS-LS4-2 Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment. (Partially addressed – continued in Unit 4).

HS-LS4-3 Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.

HS-LS4-4 Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
Unit 1  How can bacterial infections make us so sick, and why are they getting harder to treat?

Focal Science Practices
- Asking Questions
- Developing and Using Models
- Constructing Explanations
- Obtaining, Evaluating and Communicating Information

Focal Crosscutting Concepts
- Cause and Effect
- Systems and Systems Models
- Stability and Change
Framing Our Experience
Curriculum Construct
Anchor Inquiry Lesson

This is the first routine of the BSCS curriculum to position students in making sense of a phenomenon, grounding all students in a common experience, and raising student questions.

<table>
<thead>
<tr>
<th>Explore the Phenomena and share Initial Ideas</th>
<th>Define Gaps - Attempt to explain and figure out what they still need to know</th>
<th>Broaden Identify Related Phenomena</th>
<th>Develop Questions and Navigate</th>
</tr>
</thead>
<tbody>
<tr>
<td>What do we notice?</td>
<td>How can we explain this? Do our explanations agree?</td>
<td>Where else does something similar happen?</td>
<td>What should we do to figure out how to explain this?</td>
</tr>
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## Anchor Lesson Tracker

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<td><strong>Where else does something similar happen?</strong></td>
<td><strong>What should we do to figure out how to explain this?</strong></td>
</tr>
<tr>
<td>Notes about what you or the students did.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How does this support <strong>figuring out</strong>?</td>
<td></td>
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</tr>
<tr>
<td>How does this support a classroom culture where all students have access?</td>
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</table>
# Anchor Inquiry Lesson

<table>
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<th>Characteristic of a collaborative culture</th>
<th>Possible norms</th>
</tr>
</thead>
</table>
| **Respectful**                           | - We make sure that everyone feels safe, seen, and valued.  
- We presume others have positive intentions.  
- We recognize that we think, share, and represent our ideas in different ways.  
- We provide each other with support and encouragement.  
- We critique the ideas we are working with, not the people we are working with. |
| **Equitable**                            | - We pause to provide others time to think and share.  
- We paraphrase to acknowledge and understand the perspectives of others.  
- We pay attention to self and others by  
  - Monitoring how much we are speaking  
  - Encouraging other voices we haven’t heard |
| **Shared inquiry**                       | - We pose questions  
  - To explore our own thinking  
  - To help us understand others’ ideas  
- We provide data as evidence to support our ideas.  
- We ask for evidence from others.  
- We base our critique on the strength of evidence and science ideas.  
- We are open to changing our minds in light of new evidence.  
- We challenge ourselves to think in new ways. |
| **Committed to community**               | - We come prepared to work toward a common goal.  
- We place ideas on the table, even if we are not certain we are correct, to help us all learn.  
- We use and build on others’ ideas.  
- We identify areas where we agree and disagree to develop consensus. |
Student Hat

At times throughout our sessions, we will ask you to participate with your “student hat” on—engaging in the activities by thinking as your students would.

How might sitting in the role of student help you support your students’ sensemaking when you teach this unit in the future?
Student Hat

Student hat allows you to:

- Experience the unit as students might, feeling both the excitement and frustrations of deciding what to investigate next and building important science ideas together.
- Get a feel for how all the moving parts work together in storylines.
- Feel more comfortable supporting your students in their sensemaking.
Think of a time when you got sick with some kind of infection.

- How did you know you were sick?
- What actions did you/your family take to help you get better?
- How did being sick affect the people around you?

Describe your experience with words or drawings.
Unit 1

How can bacterial infections make us so sick, and why are they getting harder to treat?

Lesson 1

Day 2
On your own

Think of a time when you got sick with **some kind of infection**.

- How did you know you were sick?
- What actions did you/your family take to help you get better?
- How did being sick affect the people around you?

Describe your experience with words or drawings.
Adding to your story:

- **Change Over Time:** When did you start feeling sick? When did you start to feel better? Did your symptoms change over time?

- **Cause and Effect:** What do you think might have caused you to get sick? What do you think might have caused you to recover?

- **Actions/Decisions:** How did you decide what actions to take? Who helped you decide?
Turn and talk

Sharing your story:

1. Share your story with your partner. Then, switch.
2. What was similar/different between your experiences?
3. What does comparing your experiences make you wonder about?
Zach’s story
Turn and talk

1. How does Zach’s story relate to the stories you and your partner shared?

2. What parts of Zach’s story provoked questions for you?

3. What are questions you might have for Zach or Marnie about their experience with this infection?
What did we notice happened in Zach’s story?

What does Zach’s story make us wonder about?
In your science notebook:

We looked closely at the details of a complex case by talking with one another and then generated questions we still had about the case.

- How do you see this as related to the work of scientists?

Write or draw your reflections on these questions.
Unit 1

How can bacterial infections make us so sick, and why are they getting harder to treat?

Lesson 1
Day 3
With your class

WHAT & WHEN

HOW & WHY
On your own

**HOW and WHY did Zach get so sick that he almost died?**

- Create a *sketch* to show how and why you think this *might* have happened.
- This is not about a “right answer.” We are just putting some ideas on paper to think about more. We will revise this later!
BSCS Biology: Understanding for Life

With your class

Zach’s BODY

Healthy and active
- Pain got worse
- Temperature increased
- Inflammation first identified

Fever first identified
- Pain made it difficult to sit still
- Lab results indicate inflammation

Takes temperature again
- High fever
- Hallucinating

Pain made it difficult to sit still
- Severe pain
- Septic shock

Lab results indicate inflammation
- Couldn’t move
- Having trouble breathing

Gives more pain medicine, and takes temperature
- MRSA diagnosis
- High doses of vancomycin (antibiotic)

First doctor visit
- Goes to ER run many tests, given fluids and oxygen
- Given more antibiotics, placed in coma, and put on a respirator

Gives pain medicine
- Transferred to ICU
- Several surgeries to scrape infection out of the bone

First doctor visit
- Checks symptoms, draws blood, gives amoxicillin (antibiotic)

Second doctor visit
- Taps knee finds yellowish liquid inside

Actions Marnie/Doctors took

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Turn and talk

Sharing your sketch:

● What are some ideas you included in your sketch?

● Why did you include them?

● What did your partner include that you did not?
### Class Consensus Model

<table>
<thead>
<tr>
<th>We Agree About:</th>
<th>Our Consensus Model</th>
<th>We Disagree About:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

*With your class*
Looking back at our Notice/Wonder chart …

- Which questions are most important to answer?
- What questions would help us add to our model?
- What new questions do we have?
Unit 1

How can bacterial infections make us so sick, and why are they getting harder to treat?

Lesson 1

Day 4
Broadening Our Scope
With your group
Group Purpose

Become an expert on your new case study, and be ready to share key details with others.

Timing

About 10 minutes

Work as a team to figure out the following about your new case:

- **Perspective**: Who is the case about?
- **Connections**: How is what you read similar to what we know about Zach's case?
- **Differences**: What is different about what you read and Zach's case?
**With your group**

**Group Purpose**
Share out across case studies, and identify patterns that can help us figure out how and why Zach got so sick (and if we could get that sick, too).

**Timing**
About 8 minutes

Work as a team to share about each case. Then, discuss the following:

- What do (or don’t) these cases tell us about whether or not Zach’s case is unique?
- What do (or don’t) these cases tell us about whether an infection like Zach’s could happen to me/us?
- What new questions does this raise?

**Be ready to share out!**
Taking Stock

How and why are people getting so sick from bacterial infections?

Look at the questions we have recorded so far. Which ones could help us figure out this bigger question?

You might refer back to:
- Your science notebook
- Our Notice/Wonder chart
- Your initial sketch
- Our Class Consensus Model

... and any new questions you have thought of.

Write each question on its own sticky note.
Organizing Questions

How could...

How can bacteria make us so sick, and why are these infections getting harder to treat?

How does...

We need to know how...

Why didn’t...

We need to know why...
How might we investigate some of these questions?

- How could...
- How does...
- We need to know how...
- Why didn’t...
- We need to know why...
Turn and talk

What kind of information or data could we investigate to start exploring some of these questions? What specific information could we look for or what investigations could we do?

● Keep in mind our classroom constraints.

What boundaries should we set for the kinds of investigations we do together?

● Keep in mind: These investigations should all be ethical (not harmful/unfair).
Where are we now? Where are we going?
In your alone zone, fill out the first row of the anchor lesson tracker.
Reflection

How can the steps of the Anchor Lesson support all students in figuring things out?

- Work with a partner to reflect on each element using the Anchor Lesson Tracker.
Reflection

- Whole-Group Discussion
- How did each element of the Anchor Lesson Routine support all students in figuring things out?
LUNCH
Construct the Unit Storyline
Construct the Unit Storyline

Access the materials

**PDF files downloaded here are compressed files. Download the file and double click it. You may be prompted to unzip or extract the files. If not, you may need to choose the Extract tab in your download folder and choose where to save the file.**

- Student eBook
  - Select
  - Go

- Media Library
  - Select
  - Go
  - Unit 1 Slides
    - Select
    - Go
  - Unit 2 Slides
    - Select
    - Go
  - Unit 3 Slides
    - Select
    - Go
  - Unit 4 Slides
    - Select
    - Go

- Teacher Handbook

- Teacher Resources
  - Select
  - Go

- Assessments
  - Select
  - Go

- BSCS Materials List

- Course Pacing Guide

- Scope and Sequence
Construct the Unit Storyline

Access the materials
How can bacteria make us so sick?

PURPOSE | Introduce a puzzling phenomenon or problem and motivate further investigation.

TIME
Four 50-minute class periods

THIS LESSON | After examining a case of an 11-year-old boy with a severe, life-threatening infection, we explore initial ideas about how and why we get infections. We set our unit Driving Question: How can bacterial infections make us so sick, and why are they getting harder to treat? Before we can make progress, we need to know more about bacteria.

NEXT LESSON | We will figure out what bacteria are and where we find them. This will leave us wondering what bacteria need to survive and how they grow.

Lesson Learning Goal
Develop an initial model to ask questions about what could cause people to get seriously sick from bacterial infections and what could cause antibiotics to not work as well as they used to.

Lesson Question
How can bacterial infections make us so sick, and why are they getting harder to treat?

What students figure out
While the Anchor Lesson is mostly about exploring what we don’t yet know and what we want to investigate, students should come away with the following ideas:

- A scientific model is a representation that is used as a tool to explain how or why something in the world works the way it does.
- There are similarities across cases of severe bacterial infection—symptoms worsen and the infections are often difficult to treat with antibiotics.
- Bacterial infections can be life-threatening.
- They can strike seemingly anyone.
- They can be caused by a variety of bacteria, including MRSA, E. coli, and Salmonella.
- It sometimes seems hard to find antibiotics that will work for these infections.
- We are questioning and wondering how and why bacteria can make us so sick and why bacterial infections are getting harder to treat.
- We are starting to consider that science is a human endeavor, and that science, culture, and society are interrelated.

What we are not expecting
Where we are not going yet
- We are not yet trying to answer our unit question (how and why bacteria make us so sick and why bacterial infections are getting harder to treat); rather, we are surfacing initial ideas and questions about the phenomenon.
- We are also not trying to explain or understand the concept of antibiotic resistance; rather, students should simply notice that in many of the cases the antibiotics don’t seem to be working as well as they used to.

Boundaries
- We do not expect students to memorize which types of bacteria cause various diseases and how.

Relevant common student ideas
- Antibiotics can cure viral diseases. (Antibiotics are effective treatments for bacterial diseases only.)
- Antibiotics are always effective. (Antibiotics are effective treatments only for infections caused by bacteria. Furthermore, many bacteria are resistant to one or more antibiotics; in these cases, antibiotics are ineffective.)
- If your immune system is healthy, you don’t need medicine when you get sick. (People with suppressed immune systems are not the only ones who need antibiotics to support fighting an infection. People with healthy
## Construct the Unit Storyline

### ANCHOR LESSON SNAPSHOT

**Lesson 1: How can bacteria make us so sick?**

**BIG IDEA** | Sometimes, bacterial infections make us very sick with potentially fatal infections.

<table>
<thead>
<tr>
<th>Routine</th>
<th>Part</th>
<th>Time</th>
<th>Summary</th>
<th>Slide</th>
<th>Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>35 min</td>
<td><strong>Course Launch</strong>&lt;br&gt;Students introduce themselves to peers and share their ideas about science class. The teacher shares how in this course we will work together to figure things out and supports students to see connections between science, their daily lives, and larger societal issues.&lt;br&gt;&lt;br&gt;<em>Purpose:</em> to orient students to each other, the goals of the course, and the approach of BSCS Biology.&lt;br&gt;-15 minutes are left to attend to other administrative needs.</td>
<td>A-G</td>
<td>Student Sheet 1.1A: Students, Teachers, and Scientists, 4 pieces of chart paper</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>10 min</td>
<td><strong>Personal experiences: a time we got sick</strong>&lt;br&gt;Students think back to a time they got sick and write or draw a brief description of their experience. They talk with a partner and compare similarities and differences.&lt;br&gt;&lt;br&gt;<em>Purpose:</em> to orient students to the central phenomenon for the unit by asking them to recall personal experiences about a time they got sick.</td>
<td>H-J</td>
<td>Science notebooks</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>40 min</td>
<td><strong>Zach's story: MRSA</strong>&lt;br&gt;Students watch a video and hear from Zach Dubek, a teen who experienced a life-threatening MRSA infection when he was 11 years old. Using a class version of a timeline that highlights the important</td>
<td>K-O</td>
<td>Science notebooks, Student Sheet 1.1.B: Zach's Timeline, Student Sheet 1.1.C: Zach's Timeline</td>
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### COURSE LAUNCH

**PURPOSE** | To orient students to the goals and approach of BSCS Biology.

**Students consider expectations for “science class.”**

This unit ideally would be taught at the beginning of the school year. Consider incorporating the following sequence to support your launch of the year and start of this unit.

In addition to framing the course and the unit, the suggested sequence will provide context about your students’ prior experiences in science classrooms and will allow them to practice discussion routines that will be used across this first lesson.

Display **Slide A.** Hand out one copy of **Student Sheet 1.1.A: Students, Teachers, and Scientists.** Ask students to take a moment to consider the following prompts:

1. **On your own**
   - In a science class
     - What do you expect students to do?
     - What do you expect teachers to do?
     - How is this similar to or different from what scientists do on a daily basis?

Give students a minute or two to think individually. You might invite students to optionally write or sketch their ideas if it helps them organize their thinking.

**Students share their experience with an elbow partner.**

Display **Slide B.** Ask students to turn and talk with an elbow partner. Let students know that they will be listening...
Construct the Unit Storyline

1. Read over the lesson plan for your assigned lesson.
2. Use colored stickies to write down
   a. the question
   b. phenomenon/problem/activity
   c. what we figured out for each lesson

3. Write a question to help students navigate from one lesson to the next: From a student’s perspective, what are we wondering about now? BUT…. What don’t we know? What question do we have now?
1. Read over the lesson plan for your assigned lesson.
2. Use colored stickies to write down
   a. the question
   b. phenomenon/problem/activity
   c. what we figured out for each lesson

There is only so much that can fit into the post-it notes. Be prepared to verbally explain what happens during a given lesson!

Think about this from the student perspective—what would students say they are doing, figuring out, and still wondering at the end of the lesson?
Construct the Unit Storyline

1. Read your assigned lesson in your alone zone (15 min)

2. Discuss your lesson with your group members and create your sticky notes (10 min)

Construct Storyline: Lesson 1

Lesson Question
What happens when a bath bomb is added to water (and what causes it to happen?)

Phenomenon/Activity
Observe diff. kinds of bath bombs + what they do when added to water

What we figured out
The solid bath bomb was no longer there. Gas bubbles appear. cloudy

Navigation
But... Is the stuff in the solid still there? + Where is the gas coming from
Construct Storyline: Lesson 2-16

1. We’ll go in order, starting with Lesson 2 and ending with Lesson 16. Each group will have 3-4 minutes to share about their lesson.

2. When other groups are presenting, ask clarifying questions so that the whole group understands what is happening during each lesson.
Assess Alignment: DQB / Ideas for Investigation

1. Use colored dots to identify questions/ideas that are aligned with your lesson (Lessons 2-16).
2. Write your lesson # on the dot and post them on the question post-it. Partial coverage is OK.

Do all bacteria make you sick?
Reflection: Alignment between our Questions/Ideas and the Storyline

1. How aligned was our unit with our questions and ideas for investigation?

2. What questions and ideas for investigation were not explicitly addressed in this unit?
   a. In light of the overall goals of the unit and the storyline, what would you do with them?
Teacher Driving Question Board

Add questions you have about the unit, the course, the program at any point.