Life Sciences: The Spread of MRSA (methycillin resistant *staphylococcus aureus)* High School, 9th Grade Spring 2013

Project READI Curriculum Module

Technical Report CM #27

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PROJECT READi

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Project READI operated as a multi-institution collaboration among the Learning Sciences Research Institute, University of Illinois at Chicago; Northern Illinois University; Northwestern University; WestEd's Strategic Literacy Initiative; and Inquirium, LLC. Project READI developed and researched interventions in collaboration with classroom teachers that were designed to improve reading comprehension through argumentation from multiple sources in literature, history, and the sciences appropriate for adolescent learners. Curriculum materials in the READI modules were developed based on enacted instruction and are intended as case examples of the READI approach to deep and meaningful disciplinary literacy and learning.

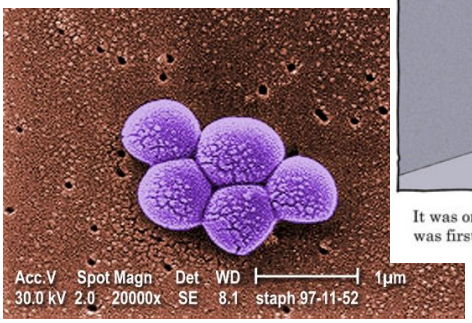
PROJECT READ

Name _____ Date _____
Teacher _____

MRSA

Investigation

It was on a short-cut through the hospital kitchens that Albert was first approached by a member of the Antibiotic Resistance.



The intended use of these materials is in tandem with ongoing professional development focused on supporting reading as scientific practice. This work is funded by the Reading for Understanding Initiative of the Institute for Education Sciences, U.S. Department of Education, through Grant R305F100007 to University of Illinois at Chicago. The opinions expressed are those of the authors and do not represent views of the Institute or the U.S. Department of Education.

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Willard Brown 9/15/2014 3:29 PM

Comment [1]: Teacher Notes

Forward: The teacher notes highlight challenges and opportunities particular to the MRSA investigation, focusing on the READi learning goals and Reading Apprenticeship approaches. Of course, so much more goes into teaching high school science than these notes touch on. The teacher notes are a support for you as you prepare and implement the investigation. The notes are NOT a comprehensive guide. The investigation is NOT scripted curriculum. Teacher expertise, craft and artistry is the foundation of great teaching. It is our sincere aspiration that these notes support you in your deeply important work.

Text and Task Analysis: Do/re-do the reading and writing tasks. Complete or update your Text and Task Analysis for the first bit of the investigation. It is good to do these freshly, not too long in advance. The purpose is always to identify opportunities and challenges, set evidence-based literacy goals, and plan the scaffolds necessary to support student learning.

Grouping: The beginning of an investigation is a great opportunity to switch up groups. Heterogeneous mix of strength and interests is often a successful approach. No one rule for grouping but design all groups to have a good likelihood of success together (with your support!).

Posters Logistics: Decide how you will manage the posters in the investigation. What posters are called for and when? Which are persistent through the investigation? [Reading Strategies List, Evidence interpretation: MRSA, E/I: Antibiotic resistance, E/I: Evolution, Word Wall, Scientific Model Construction Strategy list, Scientific Models Criteria list] Which are temporary? Etc.

Supports for Equity & Engagement: The beginning of a unit is an opportunity to introduce new processes to support equitable participation. Some ideas include using popsicle sticks (craft sticks) with students' names to chose randomly who gets to share in class discussions, assigning colors to students and using the colors to make sure everyone speaks in whole class discussions, or having groups choose a new spokesperson for each class discussion.

MRSA Investigation

MRSA is a serious threat to the public. Scientists have studied this deadly infection for many years because it is an important public health issue. MRSA is also a significant scientific puzzle, because many of the treatments used to cure MRSA infections work less well now than they did forty, twenty, ten, or even five years ago.

One goal for the MRSA investigation is to make sense of the MRSA phenomena through creating explanatory scientific models for how it emerges and spreads.

A second goal for our investigation into MRSA is to determine the best measures (or courses of action) to manage the public health challenge presented by the infection, and to share what we have learned with our community.

Our third goal is to uncover powerful practices for reading science texts for the purpose of construction and critique of scientific models – in essence reading, talking, listening, and writing scientifically.

This MRSA investigation has four phases:

- MRSA infection
- Transmission and spread of MRSA
- Evolution of SA to MRSA
- Managing the public health challenge of MRSA

Each phase includes texts to read and make sense of, group and class discussion, and construction and critique of science explanatory models or science recommendations.

Willard Brown 9/15/2014 3:37 PM

Comment [2]: Teacher Notes

The opener: The flow for the opener is not fully articulated in the student materials. Here are some ideas to help you plan out how to launch the investigation:

Read and discuss this introduction. A strong opener for the module could include students reading the cover and introduction. A golden lines protocol could to bring to fore the ideas that stand out to students (both interests and concerns) and put student reading, thinking, and talking in the center stage.

Preview the materials: The opener might also include an opportunity to preview the investigation (both packets) and the reader. Discussion prompts might be: what did you notice? What did you think/predict? What did you wonder?

A routine of reading: The investigation includes several brief introductions of science practices as well as directions. Treat these as texts to be read. Make it a practice for students to do this reading work. Support it with brief clarifying discussions.

MRSA Infection

Beginning With What We Know, Think, and Wonder

Individual think-write

What do you know, think, possibly remember, guess at or wonder about **any two** of the following terms?

bacteria	infection	antibiotic
antibiotic resistance	MRSA	evolution

Pair discussion

- Take turns sharing your ideas for one minute each.
- Add partner's ideas to your chart.
- **Stellar idea**: Select one idea that you or your partner can share with the class. Mark it with a star.

Whole class sharing of our initial thoughts

- Share stellar ideas.
- Listen closely.
- Use science talk stems.
- Add peers' ideas to your chart.

Willard Brown 9/15/2014 3:57 PM

Comment [3]: Teacher Notes

Framing the Think-Write: Important to frame the activation of prior knowledge as gathering up and sharing our current knowledge and ideas about the 6 topics as a way for students to help themselves and each other (to be ready) to learn. Questions and cloudy recollections and even wrong facts are helpful in this regard because they can develop into a reading purpose, and the texts could offer corroborations or counter-evidence that begins to illuminate misconceptions so they may be authentically resolved.

Independence: The goal of this Think-Write is to support students in taking up the practice of strategically and deliberately mining their own and their peers' schema as a practice for reading and knowledge building.

Willard Brown 8/8/2014 1:58 PM

Comment [4]: Teacher Notes

Snooping is essential: Formative assessment at this point helps you get a sense of who may have interesting ideas (both accurate and inaccurate) to share. Helps you be ready to facilitate the dynamics of the whole class discussion.

Willard Brown 9/15/2014 3:58 PM

Comment [5]: Teacher Notes

Our current ideas, not *notes*: It can be valuable to underscore that the point is to gather a set of ideas about each topics as a starting place. So elicit for multiple viewpoints on each. Encourage students to add peers' ideas to their own chart. Might consider eliciting which ideas they chose to add and why.

Talk Stems: Both Science Talk stems and Teacher Talk Stems For Supporting Metacognitive Conversation might be useful support for eliciting students' thinking. Both documents can be found through the box.com link.

Formative assessment of student content knowledge: This is an opportunity to note student conceptions and misconceptions about bacteria, resistance, evolution etc. Based on this, you can identify ideas in the upcoming texts for deliberate attention.

MRSA Infection

MRSA in the News

Reading as inquiry: In the MRSA investigation, our reading supports development of science-reading savvy and building science knowledge. Whenever we read, we'll make our thinking visible so we can consider together how we read science and learn from each other. After we read we'll discuss how we read the text and work through any challenges the text presents. We will record the science reading process that we use on our class science reading strategies list, updating it as we read different texts. We will also discuss what we are noticing and thinking about **MRSA**, **antibiotic resistance** and **evolution**. We will use evidence and interpretation notetakers and posters to keep track of our ideas each time we read.

Individual think-write: preview

- Locate the reading strategy list, and the texts "Superbug MRSA Worries Doctors, Athletes," and "Kansas City Teen Gets MRSA from Attempted Lip Piercing, Almost Dies" (MRSA Reader pages R1-5).
- Take two minutes to look over the two texts and respond to the prompts below.
  - What might be challenging about reading these two articles?
  - What might be interesting about reading these two articles?
  - What kind of sources are these?
  - What kind of science information might they contain about MRSA?
  - What might you do to get as much as possible from the reading this article?

Pair discussion

- Take turns sharing your ideas for one minute each.
- Add notes about your partner's ideas onto your own response.
- **Stellar idea**: Select one response that you or your partner can share with the class. Mark it with a star.

Whole class discussion

- Share stellar ideas.
- Listen closely and respond to your peers ideas.
- Use science talk stems.
- Add peers' best ideas onto your own response.

Willard Brown 9/15/2014 3:59 PM
Comment [6]: Teacher notes

Text and Task Analysis Reminder: Do the student reading tasks and analyze the text and the task, both schema and strategies. Identify a literacy goal for your students with the text (i.e. the reading process you used that you want your students to begin using). Prepare a think-aloud model that supports the literacy goal you identified.

Reminder: Orchestrate students' reading and discussing the introduction. Orchestrate the student reading and clarifying the directions. Make these routine.

Willard Brown 9/15/2014 3:59 PM
Comment [7]: Teacher notes

Responses: Student may write responses in the space below. The space is modestly sized because ...

Choice: Offering students the choice to answer any 2-3 of the five questions supports quality thinking over just getting it done. Or, offer some choice and specify a 'must do' question or questions. Frame the choice as an opportunity to share their best thinking. Usually some will have responded to each.

Willard Brown 9/15/2014 4:00 PM
Comment [8]: Teacher note:

Reminder: Snoop on the pair discussions, politely. Notice their schema, interests, trepidations as a formative assessment. All useful information.

Teacher model

- Locate your science reading stems.
- Locate "Kansas City Teen," and "Superbug MRSA Worries Doctors, Athletes," (R1-5).
- Listen and make notes below about the teacher's reading process.

Willard Brown 9/15/2014 4:01 PM

Comment [9]: Teacher Notes

Reminder: Keep the model brief and strategic, one minute long, and use a couple reading processes that support the literacy goal for the text.

If a more extensive model is needed, you might try using a reciprocal model where you model a bit and then orchestrate a Metacognitive Conversation about what you modeled. Then you invite one or more students to model their reading processes for a bit. The you orchestrate a Metacognitive Conversation about what the student modeled. Then you can continue with another bit of teacher modeling.

Recall the video of the teacher and student reading 'Superman and Me.'

Whole class discussion

- What did you notice about how your teacher read the science text?
- What are some science reading processes that you noticed?
- Which were new or particularly useful for this text?
- What additions or revisions can we make on the reading strategies list poster?

Reading and making thinking visible

- **Think aloud:** Partners take turns thinking aloud by paragraph for the first section. One partner thinks aloud while the other partner makes notes in the margin of the text about their partner's thoughts. Help each other make sense of the text.

OR

- **Talk to the text:** Individually talk to the text on the first section. Pairs take turns sharing their talk to the text comments. Help each other make sense of the text.
- Use the science reading stems to help you share your reading process.

Pair discussion

After reading discuss and respond to the prompts.

- **Words:** What new words or word-uses did you encounter? How did you make sense of their meaning?
- **Confusions or clarifications**: What parts of the text were unclear? Where do you have questions? Work together to clarify confusing parts of the text and to answer questions that you have.
- **Reading process:** What other science reading processes were important for your reading?
- **Inquiry:** What are you noticing or wondering now about MRSA, antibiotic resistance or evolution? What is interesting? What is important?
- **Stellar ideas:** Select a new word, a confusion or clarification, or a reading process AND one idea or question about MRSA, antibiotic resistance or evolution that you or your partner can share with the class. Mark them on your text with a star.

Whole class discussion

- Share a new word, confusion or clarification, or a reading process.
- Which reading strategies helped make sense of the text?
- What additions or revisions can we make on the reading strategies list poster?
- Share new ideas about MRSA, antibiotic resistance and evolution.
- What ideas and questions can we add to the evidence interpretation posters for MRSA, antibiotic resistance and evolution?
- What new words can we add to our word wall?

Repeat above steps for remaining sections of "Superbug MRSA Worries Doctors, Athletes" and for "Kansas City Teen Gets MRSA from Attempted Lip Piercing, Almost Dies."

Willard Brown 9/15/2014 4:00 PM

Comment [10]: Teacher note

Teacher expertise, not scripted curriculum: The bullets here are an outline for the discussion. The emphasis will depend on the strengths and struggles of your students. For you text and task analysis and formative assessments of process and content you also will have reading challenges, reading processes and ideas from the text you want to emphasize. The Teacher Talk Stems For Supporting Metacognitive Conversation may be helpful here.

First instance of the Persistent Posters: These are used twice here and revisited throughout the MRSA investigation

- Reading Strategies List
- Evidence interpretation: MRSA
- E/I: Antibiotic resistance
- E/I: Evolution
- Word Wall

MRSA Infection
Living and Learning

Individual think-write

Respond to either of the following two prompts.

- What is a word, that for you, the meaning has changed over time? How did it change and why? A response might be like: *I used to think that _____ meant but now I know that it means _____ because _____.*
- Have you experienced learning a new word and then suddenly noticing that word appearing everywhere? What was the word? When did you learn it? Where do you then recall noticing it? How do you account for the phenomena?

Will Brown 9/15/2014 4:03 PM
Comment [11]: Teacher Note

Teacher Model: A prewritten, genuine response for each of these might clarify the prompts for students and show how much you expect them to write in a response. Consider for your model using one word that has a science connection and one word that does not have an explicit science connection to encourage students to think broadly. The big idea is that *everyone* is a language learner and *everyone* has schema for noticing and working with words that have multiple meanings (multiple denotations and even multiple connotations).

Just Because: It may be important here to talk about why and how meanings change. Change may come in the form of a better understanding of that word. Or it may be a more nuanced understanding of the different meanings the same word can have in different contexts. This may be helpful to explore in the teacher model that is used.

Pair discussion

- Take turns sharing your ideas for one minute each.
- Add notes about your partner's ideas onto your own response.
- **Stellar idea**: Select one response that you or your partner can share with the class. Mark it with a star.

Whole class discussion

- Share stellar ideas about word learning.
- Listen closely.
- Use science talk stems.
- Add great ideas from your peers to your own response.

MRSA Infection
MRSA in Our Homes

Individual think-write: preview

- Locate your science reading stems.
- Locate: "How long do microbes like bacteria and viruses live on surfaces in the home at normal room temperatures?" (pages R6-7)
- Take two minutes to look over the text and respond to the prompts below.
  - What might be challenging about reading this article?
  - What might be interesting about reading this article?
  - What kind of text is this? How do you know?
  - What predictions can you make about the kind of science information it may contain and how it might inform our investigation of MRSA?
  - What might you do to get as much as you can from reading this article?

Will Brown 9/4/2014 4:51 PM
Comment [12]: Teacher Note

Leverage Gross-out Factor: This text has a bit of gross-out appeal to it. It may be an opportunity to pull-in some less frequently heard students into the whole class discussion.

Pair discussion

- Take turns sharing your ideas for one minute each.
- Add notes about your partner's ideas onto your own response.
- **Stellar idea**: Select one response that you or your partner can share with the class. Mark it with a star.

Whole class discussion

- Share stellar ideas.
- Listen closely and respond to your peers ideas.
- Use science talk stems.
- Add peers' best ideas onto your own response.

MRSA in Our Homes

Survival words: There are many words, terms and symbols that are used only in science, or that have particular meanings in science texts. Developing your own savvy for dealing with new words while reading – predicting which new words will be the most valuable to focus on learning and having strategies for learning in them while reading – is invaluable for science reading and science knowledge-building.

Teacher model

- Listen and make notes below about the teacher's reading process.
- The text for the teacher model is not a source of information for MRSA investigation.

Methanotrophic bacteria occupy benthic microbial mats in shallow marine hydrocarbon seeps, Coal Oil Point, California

Microbial mats composed of giant sulfur bacteria are observed throughout the benthos along continental margins. These communities serve to oxidize dissolved sulfides to sulfate, and are typically associated with the recent exposure of sulfide-rich sediments. Such mats are also ubiquitous in areas of hydrocarbon seepage, where they are thought to consume sulfide generated in underlying sediment. Despite the high abundance of dissolved methane in hydrocarbon seeps, few studies have considered the importance of methanotrophy in mat communities.

Source: Ding, H., and D. L. Valentine (2008), Methanotrophic bacteria occupy benthic microbial mats in shallow marine hydrocarbon seeps, Coal Oil Point, California, J. Geophys. Res., 113, G01015, doi: 10.1029/2007JG000537.

Willard Brown 9/15/2014 4:15 PM

Comment [13]: Teacher Notes:

Preplan your model. Keep it short and sweet. Focus on puzzling through one or two words only. Possible processes to model: how you decide which words to work on, how you try to make sense of them, and how you decide if you have made enough progress with the word. Consider using talk stems from the science reading talk stems list/bookmark.

Background Info: Just in case you want to read the rest of the article -- probably not necessary for the purpose of modeling your reading processes with the excerpt. Nevertheless, the link is: http://onlinelibrary.wiley.com/doi/10.1029/2007JG000537/pdf

Whole class discussion

- What did you notice about how your teacher handled new words while reading?

Individual reading

Note new words.

- Locate: "How long do microbes like bacteria and viruses live on surfaces in the home at normal room temperatures?" (pages R6-7)
- Underline words in the text that are **new to you** or are **familiar but used in unfamiliar ways.**
- Circle any of these words that you predict that you will need to understand in order to understand the main ideas of the text. These are your **survival words** for this text.

Will Brown 9/9/2014 4:13 PM

Comment [14]: Teacher Notes:

Framing word learning as normal: For instance, "Word learning is cool. Noticing and grappling with new words is truly a way of being smart. Reading texts in which you meet new words is how to learn new words. If we never read texts with new and challenging words then we are not learning as much as we could be. So meeting and learning new words is normal. It is often a bit of work but that is okay because we can handle it."

Framing word learning as pivotal to science learning: Part of learning to be a scientist involves learning the new vocabulary and new meanings of old and new words in the context of science learning. Grappling with words can give us clues that help us make sense of complicated words. Working with words and new language is an important part of what it means to do science.

Pair discussion

Take turns sharing your own survival words and your reading processes.

- **Survival words:** Discuss why you picked the word:
  - Is it an unfamiliar word or a familiar word used in an unfamiliar way?
  - What clues in the text suggest that it will be important to clarify the word's meaning to understand the main ideas of the text?
- **Stellar idea:** Select one survival word that you or your partner can share with the class. Mark it with a star. Be ready to explain why you picked it and why you decided that it was an important word for this text.

Whole class discussion

- Share survival words and reasons for picking them.
- Help clarify the meaning of your peers' survival words if you already know them.
- If you uncover new survival words circle them in the text, or if you learn what they mean *in this text* make a note on the text.
- Which reading strategies helped in deciding which words are worth understanding?
- What additions or revisions can we make on the reading strategies list poster?

MRSA in Our Homes

Reading and making thinking visible

- **Think aloud:** Partners take turns thinking aloud by paragraph with "How long do microbes like bacteria and viruses live on surfaces in the home at normal room temperatures?" One partner thinks aloud and the other partner makes notes in the margin about their partner's thoughts.

OR

- **Talk to the text:** Individually talk to the text on "How long do microbes like bacteria and viruses live on surfaces in the home at normal room temperatures?" Pairs take turns sharing their talk to the text comments paragraph by paragraph.
- Help each other figure out what the survival words mean in this text.

Pair discussion

- **Reading process:** What science reading processes were important for your reading?
- **Inquiry:** What are you noticing or wondering now about MRSA, antibiotic resistance or evolution? What is interesting? What is important?
- **Stellar ideas**
  - Select one survival word or science reading process that you or your partner can share with the class. Mark it with a star. Be ready to tell what you or your partner did, where in the reading/text you did it and how it helped.
  - Also, select one new idea or question about MRSA, antibiotic resistance, or evolution that you or your partner can share with the class. Mark them on your text with a star.

Will Brown 9/15/2014 4:17 PM

Comment [15]: Teacher Notes:

Formative Assessment: As you listen you can identify students to share ideas that can enrich the whole class discussion.

Equity: Work to hear from less frequently heard students. Can ask them to be ready to share an idea in the whole class discussion.

Whole class discussion

- Share how we clarified survival words and what they mean in this text.
- Help each other figure out the meanings of any remaining survival words.
- Which reading strategies helped in deciding which words are worth understanding?
- What additions or revisions can we make on the reading strategies list poster?
- Share new ideas about MRSA, antibiotic resistance and evolution.
- What ideas and questions can we add to the evidence interpretation posters for MRSA, antibiotic resistance and evolution?
- What new words can we add to our word wall?

Will Brown 9/5/2014 11:45 AM

Comment [16]: Teacher Notes

Posters: Add to the same posters again.

- Reading Strategies List
- Evidence interpretation: MRSA
- E/I: Antibiotic resistance
- E/I: Evolution
- Word Wall

MRSA Infection
Cause, Effect, Mechanism, and Explanation

Individual

What do you know, think, possibly remember, predict or wonder about the following terms?

cause	effect
mechanism	explanation

Pair discussion initial thoughts

- Take turns sharing your ideas for one minute each.
- Add partner's ideas to your own chart.
- **Stellar idea**: Select one idea that you or your partner can share with the class. Mark it with a star.

Whole class sharing

- Share your stellar idea.
- Listen closely to your classmates' ideas.
- Use science talk stems.
- Add peers' ideas to your chart.

Will Brown 9/15/2014 4:18 PM
Comment [17]: Teacher Notes:

Formative assessment: Elicit many voices and many ideas. Defer responding until many ideas have been surfaced. Rather, listen closely for students' notions about cause, effect, mechanism, and explanation. Consider how the ideas students shared relate to the scientific use of these terms needed for the MRSA investigation, biology, and science methods writ large.

Responsive instruction, short-term: If needed and possible in a few words, leverage student response as a foundation for clarifying how these terms will be used in this investigation.

Responsive instruction, long-term: It may be helpful to return to these words and follow up on students' changing understandings of their meanings in the context of the MRSA investigation.

MRSA Infection

Finding Evidence

The most important goal of science is developing explanations (or models) of how natural phenomena work. For the MRSA investigation, you and your classmates do the work of forming explanations for how MRSA works. For now the focus is finding evidence that might relate to the inquiry question:

How does MRSA infect people?

Teacher model

- Make or locate: A MRSA evidence and interpretation notetaker
- Locate: "Superbug MRSA Worries Doctors, Athletes," "Kansas City Teen Gets MRSA from Attempted Lip Piercing, Almost Dies," and "How long do microbes like bacteria and viruses live on surfaces in the home at normal room temperatures?" in the MRSA Reader, pages R1-7.
- Listen and make notes below about the teacher's reading process.

Source	Evidence	Interpretation

Whole class discussion

- What did you notice about how your teacher identified evidence and formed interpretations?

Willard Brown 9/15/2014 4:19 PM

Comment [18]: Teacher notes:

Reminder - Preplan the teacher model

Focus on the HOW: Focus the teacher model on the how more than on the what: model how you came up with the evidence and interpretation; how you decide the idea from the text was evidence for the question at hand, how you decide what sort of note to make, how you came up with the interpretation that tied the evidence to the question.

Reciprocal Model: Brevity is valued but it is not always possible to model complex reading processes in under a minute. You may consider using a reciprocal model: engaging students in sharing an evidence and interpretation and how they came up with it. You will most likely need to explicitly elicit the HOW from students. They will be more likely to share the what. It is valuable for them to share both.

Finding Evidence

Individuals

- Reread "Superbug MRSA Worries Doctors, Athletes."
- Identify evidence for **how MRSA infections occur**.
- Underline or highlight the evidence you find. Mark each **I** for infection.
- Make notes in your MRSA evidence and interpretation notetaker.

Pairs or small groups

- Take turns sharing the evidence you found and the interpretations you made.
- Add new evidence to your MRSA evidence and interpretation notetaker.
- **Stellar idea:** Select one piece of evidence and one interpretation that you or your partner can share with the class. Mark where it is in the texts with a star so you can find it and direct your peers to it.

Whole class

- Share stellar ideas (one piece of evidence and one interpretation).
  - Explain where it is in the text set.
  - Explain **how you and your partner knew it was evidence** about MRSA infection.
  - Explain the reading strategy you used to identify it.
- Listen and respond to your peers ideas. Use science talk stems.
- Add new evidence and interpretations to your MRSA evidence and interpretation notetaker.
- Which reading strategies helped identify and interpret evidence in the text?
- What additions or revisions can we make on the reading strategies list poster?

Repeat above steps for "Kansas City Teen Gets MRSA from Attempted Lip Piercing, Almost Dies," and "How long do microbes like bacteria and viruses live on surfaces in the home at normal room temperatures?"

Will Brown 9/15/2014 4:21 PM

Comment [19]: Teacher Notes:

Balance of content and Process: The immediate content goal here is to get lots of evidence/interpretations shared. The mid-range content goal is to vet the evidence/interpretations so that they end up well grounded in the texts and scientific principles. The process goal is for students to share how they identified ideas and evidence from the articles, and how they came up with an interpretation.

Product and process go hand in hand: Eliciting multiple interpretations of proffered evidence, including dissenting viewpoints AND focusing on the why and how, helps get to the bottom of what ideas from the text may be evidence for the question at hand as well as how they are evidence for it, and how they inform responding to the question.

Support for thinking about "evidence": This is a great time for students to engage in metacognitive conversations around knowledge-building: what counts as evidence? Eliciting these ideas about what counts as evidence and why is a great way to ground the E/I note taker that students will be returning to throughout the module and as they read additional texts. These are ongoing supports for the model-building and revision students will do throughout the rest of the module.

Posters: You might revisit any of the persistent poster but will likely have new ideas for the MRSA E/I and for the reading strategies list.

MRSA Infection

Identifying the Components and Their Roles

To understand a phenomenon, scientists ask what are all the components (players) involved, what are the cause-and-effect relationships among them, and what are the mechanisms. To help themselves with the sense-making, scientist write their ideas using words, numbers, and visuals to represent the components, causes, effects, and mechanisms. For the MRSA investigation we'll use words and visuals to represent and communicate how MRSA infects people as we make sense of it.

Individual think-write

Locate: your MRSA evidence and interpretation notetaker and your cause-effect-mechanism-explanation chart on page 12. Review the evidence and interpretations you noted. Respond to the three prompts in the space below and, if needed, on the next page.

- What components or players need to be in the model? How do I know?
- What relationships between them need to be represented? How do I know?
- What kinds of visuals (pictures, figures, symbols, charts, diagrams, and SmartArt) might help?

Identifying the Components and Their Roles

Pair discussion

- Take turns sharing your ideas for one minute each.
- Add notes about your partner's ideas onto your own response.
- **Stellar idea:** Select one component or one relationship that you or your partner can share with the class. Mark it with a star. Be ready to explain how you identified it and how you might represent it with words or visuals.

Whole class discussion

- Share stellar ideas.
- Listen to your peers' ideas. Add peers' ideas onto your own response.
- Use science talk stems. Ask a question or respond to the ideas that your peers share.
- What additions or revisions can we make on the scientific model construction strategy list poster?

Will Brown 9/15/2014 4:22 PM

Comment [20]: Teacher Notes:

Formative Assessment: Note which components and relationships student identify and which they do not. Also note what kinds of visual representations are shared. Consider if enough have been shared or if any highly useful visual representations have been overlooked.

Responsive Instruction: If a major component is missing from the whole class discussion, you might ask students if any had considered [such and such]. As much as possible, draw it out from students. Also, you might refer students back to visual representations of models already encountered in the course or in the homeostasis module to uncover more visual representations.

Persistent Poster: The scientific model construction strategy list poster was started in the Homeostasis Investigation. So, the focus here is what additions or refinements can be made to it. May need to ask student to re-read the poster and then consider if there are additions or revision to make. This poster is revisited multiple time in this investigation.

MRSA Infection

Piecing Together the MRSA Infection Puzzle

A scientific model is an idea or set of ideas that explains a phenomenon: the components (players), the causes, the effects, the mechanisms. Piecing together the parts into a coherent scientific explanation (or model) takes creativity, deep thinking and perseverance. This is why people enjoy science – the joy of figuring stuff out. For now, our focus is on explaining:

How does MRSA infect people?

Teacher Model

- Locate: your MRSA evidence and interpretation notetaker, the scientific models criteria list poster and the scientific model construction strategy list poster.
- Listen and make notes below about the teacher's model construction process.

Willard Brown 9/9/2014 1:17 PM

Comment [21]: Teacher notes:

More about how than about what: Focus the teacher model* on **Model* Construction rather than on showing a constructed model.** Show the thinking you do in piecing together one part of the MRSA infection model.

* Multiple different meanings of the word model here ☹

Whole class discussion

- What did you notice about your teacher's thought processes as he/she began to construct a model?
- What additions or revisions can we make on the scientific models criteria list poster and the scientific model construction strategy list poster?

Will Brown 9/15/2014 4:24 PM

Comment [22]: Teacher Notes:

Persistent Poster: The Scientific models criteria list poster was started in the Reading Models Investigation. So, the focus here with both of the scientific models and model construction is, "have we learned today about these." It is efficient to ask students to re-read the poster and then consider if there are additions or revisions to make. This poster is revisited multiple times in this investigation.

Small groups

- Discuss
  - What does your model need to explain?
  - What scientific model construction strategy may help?
  - What criterion do you need to pay extra attention to?
- Review your MRSA evidence and interpretation notetaker and visuals.
- Create a scientific model that explains how MRSA infection occurs.
  - Use words and visuals to make your model as clear as possible.
  - Try to account for as much of the evidence from the texts as you can.
  - Check to make sure that your model makes sense with what you know about MRSA, bacteria, infection, and antibiotics.

Piecing Together the MRSA Infection Puzzle

These two blank pages are available for drafting your science model.

MRSA Infection

Peer Review and Consensus Building

Peer review and consensus building are essential to science knowledge building. Peer review provides assurance that someone who knows what they're doing has double-checked new claims and findings. In consensus building, ideas are examined from multiple perspectives. In peer review and consensus building we ask:

- Does the model help us explain the phenomenon?
- Does our model help us address our investigation/inquiry questions?
- Does the model (explanation) account for all of the available evidence?
- Can we use the model to predict what will happen if we manipulate the phenomena?
- Does the model agree with our understandings about how the world works and other science models?

Individual and small group model analysis

Prepare by analyzing your process and progress with your own model. Write your notes in **Box 1** on the peer review and consensus building notetaker on page 22, then discuss with your group. Use **science talk stems** in your discussion.

- **Significance:** What ideas did you think about and what questions did you grapple with as you constructed your model? What was the puzzlement?
- **Purpose:** Why did you include what you did in your model? What does your model help to explain, predict, or describe?
- **Reliability and justification:**
  - What aspects of the phenomena or evidence does your model account for? What is your evidence and reasoning for your explanation?
  - What have not accounted for yet or what are you unsure about in your model?
- **Future research:** What questions do you have about the phenomena or explanatory model at this point in the investigation?

Willard Brown 9/15/2014 4:32 PM

Comment [23]: Teacher Note:

Normalize discourse for expressing skepticism, questioning, disagreement, and argument: Recommend discussion* of what peer review involves, especially how we hold each other accountable for grounding our models in evidence and science principles AND why it is/could be useful to have peer review in science. Recommend revisiting class norms to make sure they work for peer review and consensus-building. Recommend reviewing talk stems that could be used in peer review.

* You might lead into the discussion of peer review with a discussion of a quote that gets at science epistemology, such as *"...I can live with doubt and uncertainty and not knowing. I think it's much more interesting to live not knowing than to have answers which might be wrong."* Richard P Feynman, "The Pleasure of Finding Things Out"

Pairing groups for peer review: You may want to group students by the kinds of models that you see emerging from the small groups. Pairing groups with very different models could be one useful way to spark conversations about the different forms models can take. Pairing groups with very similar models may support students in noticing what is "new" in their peer's models. Either way, it may be helpful to glance over the emergent models, do a formative assessment of the components, relationships, and mechanisms that are present and absent, as a way to pair the student groups for peer review.

Peer Review and Consensus Building

Presenting and reviewing

Presenters: Provide your model to your peers and give them some time to read it over before you present. Some points to address in your presentations are:

- **Significance**: The big question for us was _____. What was hard to explain was _____.
- **Purpose**: We built our model to try to explain _____. We think it helps explain, predict or describe _____ because _____.
- **Reliability and justification**: We are very confident about _____ parts of our model because _____. We are still unsure about_____ parts of our model because _____.
- **Future research:** We still have questions about _____.

Reviewers: Listen, read and make notes in **Box 2** on the peer review and consensus building notetaker about:

- What is clear and what is unclear.
- What is misrepresented, mistaken or missing (such as evidence that is unaccounted for).
- What does not belong in the model (things for which there are no evidence)?
- The questions you wonder about.
- Ideas for refinement.

Developing a response

Listeners take a few minutes to discuss their peers' model and develop a response.

- What is well explained and accounted for in the model? Why?
- What is clear in the model? Why?
- What is unclear or misrepresented in the model? Why?
- What is missing from the model? Why?
- What does not belong in the model? Why?

Prepare 2-4 substantive responses to your peers' model. Write these in **Box 3** on the peer review and consensus building notetaker. Use **science talk stems** in your feedback.

Sharing Feedback

- Groups take turn sharing and discussing their response to their peers' model.
- Each group makes notes of the feedback they receive from the peers in **Box 4** of the peer review and consensus building notetaker.

MRSA Infection
Peer Review and Consensus Building Notetaker

Our Model

1. My notes for the presentation	4. My notes from peers' feedback

Peers' Model

2. My notes about peers' model	3. My response to peers' presentation

MRSA Infection

Reflection and Revision

Will Brown 9/15/2014 4:33 PM

Comment [24]: Teacher Note:

Making learning visible: The goal for this reflection and revision is to help students concretize their learning and notice the knowledge they are building. It supports both ongoing engagement and knowledge building.

The goal for revisiting scientific models and E/I posters is to make public the learning about science epistemology & practices (with respect to scientific models) and the content (MRSA, antibiotic resistance, and evolution). This is an opportunity to 'level the playing field' before moving into the next part of the investigation.

Small group discussion

Discuss how you will respond to the feedback you received.

- What did you see or hear from other groups' models that you liked?
- How will you modify your model, based on the classroom discussion?

Use different colored sticky notes provided by your teacher to label parts of your models that you:

- Are very confident about and want to keep.
- Would like to add to your model.
- Still have questions about.

Now make the revisions (upgrades!) to your model.

Individual think-write

Respond to three of the following five prompts in the space below.

- What is one part of your MRSA infection model that you are proud of? Why?
- What are you learning about cause, effect, mechanism and explanation in science?
- What are you learning about science models and/or how to construct science models?
- What are you learning about bacteria, antibiotics and infection?
- What are you learning about MRSA, antibiotic resistance, and evolution?

Whole class discussion

- Share a response to either prompt.
- What additions or revisions can we make on the scientific models criteria list poster and the scientific model construction strategy list poster?
- What additions or revisions can we make on the evidence interpretation posters for MRSA, antibiotic resistance, and evolution?

Transmission and Spread of MRSA

Our Ideas About Contagious Diseases and Epidemics

Individual think-write

- What do you know, think, possibly remember, predict or wonder about the following terms?

contagious disease	epidemic
scope	scale

Pair discussion

- Take turns sharing your ideas for one minute each.
- Add partner's ideas to your brainstorm.
- **Stellar idea:** Select one idea that you or your partner can share with the class. Mark it with a star.

Whole class discussion

- Share the stellar idea you or your partner has about contagious diseases and/or epidemics.
- Listen closely. Add peers' ideas to your brainstorm.
- Use science talk stems. Respond to your peers' stellar ideas.

Transmission and Spread of MRSA

MRSA Scope and Scale

Individual think-write: preview

- Locate your science reading stems.
- Locate the next three texts (MRSA Reader pages R8-10).
  - "Antibiotic Resistance"
  - "Comparison of Estimated Death in U.S. in 2005"
  - "MRSA skyrockets in Washington"
- Take three minutes to look over the three texts and respond to the prompts below.
  - What might be challenging or interesting about reading these texts?
  - How are they alike and how are they different?
  - What kinds of texts are they? How do you know?
  - What predictions can you make about the kind of science information each may contain and how it might inform our investigation of MRSA?
  - What might you need to do to get as much as you can from reading these texts?

Pair discussion

- Take turns sharing your ideas for one minute each.
- Add notes about your partner's ideas onto your own response.
- Select one response that you or your partner can share with the class. Mark it with a star.

Whole class discussion

- Share your response or your partner's response.
- Add peers' ideas onto your own response.

Reading and making thinking visible

- **Think aloud:** Partners take turns thinking aloud with the text, "Antibiotic Resistance." One partner thinks aloud and the other partner makes notes in the margin about their partner's thoughts.

OR

- **Talk to the text:** Individually talk to the text on "Antibiotic Resistance." Pairs take turns sharing their talk to the text comments.
- Use the science reading stems to help you share your reading process and work together to make sense of the text.

Pair discussion

After reading, discuss and respond to the prompts.

- **Reading process:** What science reading processes were important for your reading?
- **Inquiry:** What are you noticing or wondering now about MRSA, antibiotic resistance or evolution? What is interesting? What is important?
- **Stellar ideas**
  - Select a science reading process to share with the class. Mark it with a star.
  - Also, select one new idea or question about MRSA, antibiotic resistance, or evolution to share with the class. Mark them on your text with a star.

Whole class discussion

Share stellar ideas about reading process.

- What did you notice about your partner's (or your own) reading processes with this text?
- What reading challenges did you or your partner encounter and how did you respond to the reading challenge?
- What visuals or models did you or your partner form as you read? How did they help your understanding?
- What additions or revisions can we make on the reading strategies list poster?

Share stellar ideas about MRSA, antibiotic resistance, and evolution.

- What questions, connections, or ah-ha's do you have from your reading?
- What ideas and questions can we add to the evidence interpretation posters for MRSA, antibiotic resistance, and evolution?
- What new words can we add to our word wall?

Repeat above steps with the "Comparison of Estimated Deaths in U.S. in 2005" (R9) and "MRSA skyrockets in Washington" (R10).

Transmission and Spread of MRSA

Finding and Interpreting Evidence

Making sense of natural phenomena is messy work. You are always trying to make the best explanation you can with the information that is available. It can be hard to figure out what information helps explain what is going and harder still to figure out how it all ties together logically. For now, the focus is on finding and interpreting evidence that relates to these inquiry questions:

How widely has MRSA spread?
How is MRSA transmitted and spread?

Individual think-write

- Locate your MRSA evidence and interpretation notetaker. You may need additional pages now.
- Locate the MRSA Reader pages R1-10 (the first six texts).
- Review or re-read the texts and notetakers to identify evidence for **how MRSA is transmitted** and **how MRSA spread widely**.
- Underline or highlight the evidence you find. Mark each **T** for transmission or **S** for spread.
- Make notes in your evidence and interpretation notetaker.

Pairs or small group discussion

- Discuss how you know what counts as evidence about MRSA transmission and spread.
- Discuss how the evidence might link together – the cause and effect relationships.
- Add new evidence/interpretations to your MRSA evidence and interpretation notetaker.
- **Stellar idea:** Select one evidence and one interpretation that you or your partner can share with the class. What reading process did you use to identify it? Mark where it is in the texts with a star so you can find it and direct your peers to it.

Whole class discussion

- Share stellar ideas (one piece of evidence and one interpretation).
  - Explain where it is in the text set.
  - Explain how you and your partner(s) knew it was evidence about MRSA transmission or spread.
  - Explain the reading strategy you used to identify it.
- Listen and respond to your peers ideas. Use science talk stems.
- Add new evidence/interpretations to your MRSA evidence and interpretation notetaker.
- What additions or revisions can we make on the reading strategies list poster?

Willard Brown 9/15/2014 4:35 PM

Comment [25]: Teacher Notes:

Reading Strategy Review: Consider asking students to review the Reading Strategies list and identify what reading strategies that they have used in identifying evidence in the Homeostasis and MRSA investigations. A quick share-out could help level the playing field before the task begins.

Scope and Scale: Text 4-6 provide evidence about how widespread MRSA is.
Mechanism: Texts 1-3 provide evidence for the mechanism of transmission and spread.

Re-reading with a new purpose: Frame the new purpose for the re-reading. In our first read of texts 1-3, we were just getting into the investigation. Now we have a new lens for considering the those texts: what can learn about how widely MRSA spread and HOW MRSA is transmitted and spread. When we revisit/re-read a text with new questions in mind, we can potentially learn a lot more because our thinking will be different.

Scaffold Stamina & Confidence Development: Consider chunking this task into 2 or 3 rounds of reading, note-making and talking with the first round requiring less stamina and the later rounds requiring more. For instance, focus on just text 4. Go through the Individual think write, pair, or small group discussion and whole group discussion only using text. Repeat with texts 5 &6. Finally repeat with texts 1-3.

Transmission and Spread of MRSA

Identifying the Components and Their Roles

Individual think-write

Locate your MRSA evidence and interpretation notetaker and your MRSA infection model. Review the evidence and interpretations you noted. Review your MRSA infection model. Use all of these to answer the prompts below:

- How do transmission and spread relate to MRSA infection?
- What parts of the MRSA infection model need to be [in] a model for MRSA transmission and spread?
- What other components need to be in a model for MRSA transmission and spread? How do you know?
- What relationships between them need to be represented? How do you know?
- What kinds of visuals (pictures, figures, symbols, charts, diagrams, and SmartArt) might help?

Pair discussion

- Take turns sharing your ideas for one minute each.
- Add notes about your partner's ideas onto your own response.
- **Stellar idea:** Select one idea that you or your partner can share with the class. Mark it with a star.

Whole class discussion

- Share stellar ideas.
- Listen to your peers' ideas. Add peers' ideas onto your own response.
- Use science talk stems. Ask a question or respond to the ideas that your peers share.

Will Brown 9/15/2014 4:37 PM

Comment [26]: Teacher Notes:

Supporting (new) model building:

Given that students will consider infection, spread, scope/scale, and the evolutionary components of the MRSA phenomenon, one decision you may want to make is whether to have students continue to add details and/or elaborate on a SINGLE model or build 3 SEPARATE models.

The infection mode may have components that are relevant for spread and transmission. You may want to return to the infection model that students built prior to this as a starting-off point: what did this model help us understand about MRSA? What new ideas do we now know that need to be accounted for?

Building out 3 separate models may afford the opportunity for students to examine more closely the components, relationships, and mechanisms underlying each of the three "pieces" of the MRSA phenomenon.

Fine Tuning Support: Students may undervalue reviewing their notes, so It may help to structure the task further. For example, give a distinct amount time for each of the three steps: (1) Review the evidence and interpretations you noted*; (2) Review your MRSA infection model. (3) Use all of these to answer the prompts below…

*If this is a beginning a new class period, then more time is needed for this step. If not, then less.

Will Brown 9/15/2014 4:37 PM

Comment [27]: Teacher Notes

Reminder – formative assessment: Identify ideas that will enrich the whole class discussion and ask students to be ready to share them. Also, cultivate less frequently heard students to do the sharing out. And be on the lookout for missing components or misconstrued components.

Strategic probing: Be ready to probe for them in the whole group discussion. "Did any one consider …. Go look at text *x* paragraph *y*. Could ____ be a necessary component? Why or why not?

Reminder – balance process and content.

Transmission and Spread of MRSA

MRSA Transmission and Spread Model

We have done the work of identifying the infection's components and their roles. Now we're ready to tie this information together to form a scientific model that answers the questions:

How widely has MRSA spread?
How is MRSA transmitted and spread?

Small group discussion

- Locate your MRSA evidence and interpretation notetaker, scientific model criteria list, and scientific model construction strategy list.
- Discuss with your group:
  - What does your model need to explain?
  - What scientific model construction strategy may help?
  - What criterion do you need to pay extra attention to?
- Review your MRSA evidence and interpretation notetaker and visuals for transmission and spread.
- Work with your group to create a scientific model that explains how MRSA transmission and spread occur.
  - Use words and visuals to make your model as clear as possible.
  - Try to account for as much of the evidence from the texts as you can.
  - Try to make your model consistent with other ideas we have about how MRSA works. Show how MRSA infection fits into this new MRSA model.
- The next two blank pages are available for drafting your science model.

Transmission and Spread of MRSA
Peer Review and Consensus Building

Use the peer review and consensus building protocol on pages 20-21 and the notetaker below.

Our Model

1. My notes for the presentation	4. My notes from peers' feedback

Peers' Model

2. My notes about peers' model	3. My response to peers' presentation

Transmission and Spread of MRSA
Reflection and Revision

Small group discussion

Discuss how you will respond to the feedback you received.
- What did you see or hear from other groups' models that you liked?
- How will you modify your model, based on the classroom discussion?

Use different colored sticky notes provided by your teacher to label parts of your models that you:
- Are very confident about and want to keep.
- Would like to add to your model.
- Still have questions about.

Revise: Make the revisions (upgrades!) to your model.

Individual think-write

Respond to three of the following five prompts.
- What is one part of your MRSA infection model that you are proud of? Why?
- What are you learning about cause, effect, mechanism, and explanation in science?
- What are you learning about science models and/or constructing science models?
- What are you learning about bacteria, antibiotics, and infection?
- What are you learning about MRSA, antibiotic resistance, and evolution?

Whole class discussion

- Share a response to either prompt.
- What additions or revisions can we make on the scientific models criteria list poster and the scientific model construction strategy list poster?
- What additions or revisions can we make on the evidence interpretation posters for MRSA, antibiotic resistance, and evolution?

Evolution of SA to MRSA

Our first ideas about the origin of MRSA

Individual think-write

Respond to the following prompts.

- What do you know, think, possibly remember, guess or wonder about what caused Staphylococcus aureus (SA) become methicillin-resistant Staphylococcus aureus (MRSA)?
- Why might it be important to know how SA became MRSA?

Willard Brown 9/15/2014 4:39 PM

Comment [28]: Teacher note:

Relevant information: Texts 1-6 vary in the amount and explicitness of information relevant to this question. The relevant information is more explicit in texts 1-3 than in 4-6. If students are stuck, it might be helpful to point them back to texts 1-3.

Purpose: The goal of the Think-Write is activating/sharing of schema as a beginning point for an investigation. Elicit many voices and many ideas. Great opportunity for formative assessment about student schema and disposition toward evolution.

Pair discussion

- Take turns sharing your ideas for one minute each.
- Add notes about your partner's ideas onto your own response.
- **Stellar idea**: Select one idea that you or your partner can share with the class. Mark it with a star.

Whole class discussion

- Share stellar ideas.
- Listen closely. Add great ideas from your peers to your own response.
- Use science talk stems. Respond to your peers' stellar ideas.

Evolution of SA to MRSA

Change over Time

Science reading is inquiry. When we read science text, we form and revise models that explain the phenomena we are reading about. When we read about a new science topic, it may feel like a muddle. There are many new ideas. We have many questions. The ideas are not organized in our minds. Then we dig in. We muster our prior knowledge. We try to make connections and answer our questions. We read more, think more, write more and talk more to create a model out of the muddle. The focus of this reading inquiry is to uncover more reading processes that helps us move from the muddle to the model and to figure out how these processes work for us.

Individual think-write: preview

- Locate: your science reading stems.
- Locate the next five texts (MRSA Reader pages R11-18).
  - "MRSA History"
  - "Superbug, Super-fast Evolution"
  - "Resistance to the antibiotic Vancomycin"
  - "Battling Bacterial Evolution: The Work of Carl Bergstrom"
  - "Modification by Natural Selection"
- Take four minutes to look over the five texts.
  - What might be challenging or interesting about reading these texts?
  - How are they alike and how are they different?
  - What kinds of texts are they? How do you know?
  - What predictions can you make about the kind of science information each may contain and how it might inform our investigation of MRSA?
  - What might you need to do to get as much as possible from reading these texts?

Willard Brown 9/15/2014 4:39 PM

Comment [29]: Teacher Note:

Balancing the learning focus: The introduction foregrounds the literacy learning. You might add words to foreground that we are all the while deepening the investigation of MRSA, antibiotic resistance, and evolution.

Building Genre knowledge: Previewing a variety of text types really foregrounds the variation in text types and the challenges they each present.

Pair discussion

- Take turns sharing your ideas for one minute each.
- Add notes about your partner's ideas onto your own response.

Whole class discussion

- Share your response or your partner's response.
- Add peers' ideas onto your own response.

Teacher model

- Locate "MRSA History" in your Reader.
- Listen and make notes about the teacher's reading process.

Willard Brown 9/9/2014 4:30 PM

Comment [30]: Teacher Notes:

Reminder – pre-plan you teacher model: The text offers multiple opportunities to think about the causal relationship between antibiotic usage and the rise of resistant bacteria strains. So, the literacy focus could be 'margin modeling' – constructing visual representation of scientific models/processes in the margin to help make sense of the text. This is a kind of Talking to the Text – making a visual rather than a comment. So for this teacher model you would need to both Think Aloud and Talk to the Text.

Science Talk Stems: The science reading and talking stems can be support both the teacher modeling and also the individual reading work. The "**Modeling**" and "**Visualizing**" reading stems could be especially helpful.

Whole class discussion

- What did you notice about how your teacher read the science text?
- What are some science reading processes that you noticed?
- What additions or revisions can we make on the reading strategies list poster?

Change over Time

Reading and making thinking visible

- **Think aloud:** Partners take turns thinking aloud with the text, "MRSA History." One partner thinks aloud and the other partner makes notes in the margin about their partner's thoughts.

OR

- **Talk to the text:** Individually talk to the text on "MRSA History." Pairs take turns sharing their talk to the text comments.
- Use the science reading stems to help you share your reading process and work together to make sense of the text.

Pair discussion

After reading discuss and respond to the prompts.

- **Reading process:** What science reading processes were important for your reading?
- **Inquiry:** What are you noticing or wondering now about MRSA, antibiotic resistance or evolution? What is interesting? What is important?
- **Stellar ideas**
  - Select a science reading process to share with the class. Mark it with a star.
  - Also, select one new idea or question about MRSA, antibiotic resistance, or evolution to share with the class. Mark them on your text with a star.

Whole class discussion

Share stellar ideas about reading process.

- What did you notice about your reading process with this text? What reading challenges did you or your partner encounter and how did you respond to the reading challenge? For texts with visuals: How did you read the visual(s)? What modeling did you do as you read?
- What additions or revisions can we make on the reading strategies list poster?

Share stellar ideas about MRSA, antibiotic resistance, and evolution.

- What questions, connections, or ah-ha's do you have from your reading?
- What ideas and questions can we add to the evidence interpretation posters for MRSA, antibiotic resistance, and evolution?
- Add new words to our word wall.

Repeat above steps with the next four texts: "Superbug, Super-fast Evolution" (R13-14), "Resistance to the antibiotic Vancomycin" (R15), "Battling Bacterial Evolution: The Work of Carl Bergstrom" (R16-17), and "Modification by Natural Selection" (R18).

Will Brown 9/15/2014 4:50 PM

Comment [31]: Teacher Notes:

Focus: This is the part of the investigation that features the role of evolution in MRSA most prominently. During Pairs discussions, look for ideas and students to share about evolution and the role of evolution in MRSA (how it helps us make sense of MRSA). Also, give evolution extra attention in the whole class discussions.

Will Brown 9/15/2014 4:52 PM

Comment [32]: Teacher Note:

Set literacy learning focus for each text: Each of these text offer different reading opportunities and challenges. For example, 'Superbug' has a lot of words with multiple meanings, 'Resistance' is a graph and has potential for connections to the previous text. Use text and task analysis to see the processes and schema you use in reading these texts as a basis for identifying literacy goals for each text.

Frame the reading work: Use an inquiry question: "what can we learn about reading graphs from reading 'Resistance …'?" or a teacher model to frame the reading work for each text.

Keep it fresh: The point here is to prevent reading from becoming "just another task." Identifying both literacy and inquiry goals can keep the important work of knowledge-building upfront for the students so that they can persevere in working through and making sense of difficult texts.

Evolution of SA to MRSA

Identifying and Connecting Evidence for How SA became MRSA

Whole class

- Locate your MRSA evidence and interpretation notetaker. You may need additional pages now.
- Form groups of four and count of by ones and twos in each group.

Individual think-write

- **Ones**: Review or re-read each odd numbered text and the notetaker to identify evidence for how SA became MRSA.
- **Twos**: Review or re-read each even numbered text and the notetaker to identify evidence for how SA became MRSA.
- Underline or highlight the evidence you find. Mark each **E** for evolution.
- Make notes in your evidence and interpretation notetaker.

Small group discussion

- Share the evidence you found for how SA became MRSA.
- Discuss why each counts as evidence for how SA became MRSA.
- Discuss how the evidence might link together. What are the cause and effect relationships?
- Add new evidence and interpretations to your MRSA evidence and interpretation notetaker.
- **Stellar idea:** Select one evidence and one interpretation that you or your partner can share with the class. What reading process did you use to find and identify it? Mark where it is in the texts with a star so you can find it and direct your peers to it.

Whole class discussion

- Share stellar ideas (one piece of evidence and one interpretation).
  - Explain where it is in the text set.
  - Explain how you and your partner(s) knew it was evidence about how SA became MRSA.
  - Explain the reading strategy you used to find and identify it.
- Listen and respond to your peers ideas. Use science talk stems.
- Add new evidence/interpretations to your MRSA evidence and interpretation notetaker.
- What additions or revisions can we make on the reading strategies list poster?

Willard Brown 9/5/2014 2:57 PM

Comment [33]: Teacher notes:

Scaffolding Stamina: It may be helpful to further divvy up this jigsaw into four roles and four sets of texts. Important that everyone has texts that address how SA became MRSA or relate to it. The goal for this scaffold is equity and engagement rather than convenience.

Evolution of SA to MRSA

Scientific Model of How SA Became MRSA

Small group discussion

Locate and review: MRSA evidence and interpretation notetaker, models for MRSA infection, transmission and spread, the scientific model criteria list, and the scientific model construction strategy list.

- Discuss with your group:
  - What does your model need to explain?
  - How can the model for how SA became MRSA build off of the models for MRSA infection, transmission, and spread?
  - What scientific model construction strategy may help?
  - What criterion do you need to pay extra attention to?
  - What components and relationships belong in the model? What words and visuals could depict them?
- Work with your group to create a scientific model that explains how SA became MRSA.
  - Use words and visuals to make your model as clear as possible.
  - Try to account for as much of the evidence from the texts as you can.
  - Try to make your model consistent with other ideas we have about how MRSA works. Show how MRSA infection, transmission and spread fit into this new MRSA model.
- The next two blank pages are available for drafting your science model.

Scientific Model of How SA Became MRSA

Scientific Model of How SA Became MRSA

Evolution of SA to MRSA

Peer Review and Consensus Building

Use the peer review and consensus building protocol on pages 20-21 and the notetaker below.

Our Model

1. My notes for the presentation	4. My notes from peers' feedback

Peers' Model

2. My notes about peers' model	3. My response to peers' presentation

Will Brown 9/15/2014 4:53 PM

Comment [34]: Teacher Notes:

Raise the bar: This is the final peer review in the investigation (although the science seminar is a kind of peer review). Call on students to dig down, support, and hold each other accountable for scientific thinking and discourse. Revisit purpose of peer review and scientific argument – to get to the bottom of things. Revisit talk stems that may help. Invite students to read the science talk stems and locate stems that might be useful. Revisit Criteria for Scientific Models to identify what standards they are holding each other to.

Staff 9/16/2014 1:42 PM

Formatted Table

Evolution of SA to MRSA
Reflection and Revision

Small group discussion

Discuss how you will respond to the feedback you received.
- What did you see or hear from other groups' models that you liked?
- How will you modify your model, based on the classroom discussion?

Use different colored sticky notes provided by your teacher to label parts of your models that you:
- Are very confident about and want to keep.
- Would like to add to your model.
- Still have questions about.

Revise: Make the revisions (upgrades!) to your model.

Individual think-write

Respond to three of the following five prompts.
- What is one part of your MRSA infection model that you are proud of? Why?
- What are you learning about cause, effect, mechanism, and explanation in science?
- What are you learning about science models and/or constructing science models?
- What are you learning about bacteria, antibiotics and infection?
- What are you learning about MRSA, antibiotic resistance, and evolution?

Whole class discussion

- Share a response to either prompt.
- What additions or revisions can we make on the scientific models criteria list poster and the scientific model construction strategy list poster?
- What additions or revisions can we make on the evidence interpretation posters for MRSA, antibiotic resistance, and evolution?

Managing the Public Health Challenge of MRSA

Scientific Models and Solutions

Natural phenomena offer both opportunities and challenges. Scientists draw on scientific models to design solutions to these challenges.

Individual think-write

Respond to either of the following two prompts.

- Describe a real-world challenge presented by natural phenomena. What are some solutions scientists have designed (or are trying to design) to address these challenges? What scientific models or explanations might scientist have drawn on to design these solutions?
- What are some real-world challenges presented by MRSA infection, transmission, spread and evolution? What is (might be) the impact of MRSA on you and your community? How significant are the challenges MRSA presents? Why?

Pair discussion

- Take turns sharing your ideas for one minute each.
- Add notes about your partner's ideas onto your own response.

Whole class discussion

- Share your response or your partner's response.
- Listen and respond to your peers' ideas. Use science talk stems.
- Add peers' ideas onto your own response.

Managing the Public Health Challenge of MRSA

Solutions for MRSA Infection, Transmission, Spread, and Evolution

Individual think-write: preview

- Locate your science reading stems
- Locate the next two texts (MRSA Reader pages R19-22)
  - "Wash your hands"
  - "The success of evolutionary engineering"
- Take three minutes to look over the texts, considering these questions:
  - What might be challenging or interesting about reading these texts?
  - What kinds of texts are they? How do you know?
  - What do you predict about the reliability of the information in these texts? How do you know?
  - What predictions can you make about the kind of science information each may contain and how it might inform our investigation of MRSA?

Pair discussion

- Take turns sharing your ideas for one minute each.
- Add notes about your partner's ideas onto your own response.

Whole class discussion

- Share your response or your partner's response.
- Listen and respond to your peers' ideas. Use science talk stems.
- Add peers' ideas onto your own response.

Mon-lin Ko 9/15/2014 4:53 PM

Comment [35]: Teacher Notes:

Preparing to make recommendations:

As students head into this final section of the module, they have already begun to see that there are many facets of MRSA: the infection, transmission, spread, and evolution. The goal for managing the public health challenge is to understand HOW different interventions work on these different aspects of MRSA.

One way to prepare for this is to anticipate the fit between the solutions that are discussed in the texts, and brainstorm the ones that students may come up with, and think about how that impacts the infection, transmission, spread and evolution. It is easy to overlook the evolutionary aspect of the phenomenon (or perhaps avoid it altogether because it's so hard to deal with!). Push students to examine the influence any given proposed solution might have and really workout all the reasoning for HOW and IN WHAT WAYS it would impact MRSA.

Teacher model

- Locate: "Wash your hands."
- Listen and make notes about the teacher's reading process.

Willard Brown 9/15/2014 4:54 PM
Comment [36]: Teacher Notes:

Scientific Reasoning: Model how you make connection to the MRSA models and make inferences about potential points of intervention and potential solutions.

Whole class discussion

- What did you notice about how your teacher read the science text?
- What are some science reading processes that you noticed?
- What additions or revisions can we make on the reading strategies list poster?

Solutions for MRSA Infection, Transmission, Spread, and Evolution

Reading and making thinking visible

- **Think aloud:** Partners take turns thinking aloud with the text, "Wash your hands." One partner thinks aloud and the other partner makes notes in the margin about their partner's thoughts.

OR

- **Talk to the text:** Individually talk to the text on "Wash your hands." Pairs take turns sharing their talk to the text comments.
- Use the science reading stems to help you share your reading process. Work together to make sense of the text and predict potential solutions for MRSA infection, transmission, spread, and evolution.

Pair discussion

After reading, discuss and respond to the prompts.

- **Reading process:** What science reading processes were important for your reading?
- **Inquiry:** What are you noticing or wondering now about MRSA, antibiotic resistance, or evolution? What is interesting? What is important?
- **Stellar ideas**
  - Select a science reading process to share with the class. Mark it with a star.
  - Also, select one potential solution for MRSA infection, transmission, spread, and evolution. Mark them on your text with a star.

Whole class discussion

Share stellar ideas about reading process

- What did you notice about your reading process with this text? What reading challenges did you or your partner encounter and how did you respond to the reading challenge? What modeling did you do as you read?
- What additions or revisions can we make on the reading strategies list poster?

Share stellar ideas about MRSA, antibiotic resistance, and evolution.

- What questions, connections, or ah-ha's do you have from your reading?
- What ideas and questions can we add to the evidence interpretation posters for MRSA, antibiotic resistance, and evolution?
- Add new words to our word wall.

Repeat above steps with "The success of evolutionary engineering."

Managing the Public Health Challenge of MRSA

Think Scientifically, Act Locally

You have read about MRSA. You have talked about MRSA. You have made models of MRSA infection, transmission, spread, and evolution. You've identified the challenges MRSA presents. Now it is time to apply that knowledge to predict a course of action to limit the impact of MRSA.

Teacher model and individual think-write

- Locate: MRSA evidence and interpretation posters, MRSA evidence and interpretation notetakers, and MRSA models for infection, transmission and spread, and evolution.
- Review your MRSA posters, notetakers, and models to identify **problems** in your community related to:
  - MRSA infection
  - MRSA transmission and spread
  - MRSA evolution (the evolution of antibiotic resistance in MRSA)
- What is the problem and how is it related to MRSA?

Willard Brown 9/15/2014 4:55 PM

Comment [37]: Teacher Note:

Teacher Model: Offer a Think-Aloud model (example). Include reviewing notetakers, and identifying a possible problem. For example:

- Washing hands is a proven way to reduce the spread of MRSA because …
- But washing hands before lunch at school is impossible because….
- The consequences of limited hand washing are …
- This is important to students, staff and faculty because ….

Small group discussion

- Take turns sharing your ideas for one minute each.
- Add notes about your partner's ideas onto your own response.

Whole class discussion

- Share your response or your partner's response.
- Add peers' ideas onto your own response.

Teacher model and individual think-write

- Locate: MRSA evidence and interpretation posters, MRSA evidence and interpretation notetakers, and MRSA models for infection, transmission and spread, and evolution.
- Select two of the problems in your community related to MRSA.
- Review your MRSA posters, notetakers and models to identify possible points in the models for intervention or possible solutions.
- What course of action could limit (possibly limit) the impact of:
    - MRSA infection
    - MRSA transmission and spread
    - MRSA evolution (the evolution of antibiotic resistance in MRSA)
- Who (in your community) would have to act to make a difference?

Willard Brown 9/15/2014 4:59 PM

Comment [38]: Teacher Notes:

Teacher Model: Prepare and share a Think-Aloud model of identifying possible points for intervention or possible solutions for a problem that your class identified.

- Draw on the Student Models for infection, spread/transmission, and evolution as a basis for your think-aloud modeling
- Use talk stems to make your thinking overt: 'One point in the model that might work for an intervention is … because ….' ; 'One course of action that might help with the hand washing problem is … because …'

Small group discussion

- Take turns sharing your ideas for one minute each.
- Add notes about your partner's ideas onto your own response.
- Prepare to share about one problem and course of action.

Whole class discussion

- Share your response or your partner's response.
- Add peers' ideas onto your own response.

Small group discussion

- Select one problem in your community related to MRSA and at least one course of action or solution for the problem for your group.

Teacher model and small group work

- Write a compelling scientific **recommendation** for the course of action your team determined.
  - Decide who will be the audience for the recommendation.
  - Describe the course of action.
  - Explain how and why the course of action could limit the impact of **MRSA infections**, **transmission and spread**, AND **evolution**. Ground your explanation in your scientific models for MRSA infections, transmission and spread, and evolution.
  - Make sure that the recommendation gets to the root of the problem.
  - Reflect on your own learning (think about what was hard for you to understand, or what was most important to your understanding) to help you decide what information the audience needs to know to understand the recommendation.
  - Address any misconceptions that might interfere with the audience's understanding.

Willard Brown 9/15/2014 5:00 PM

Comment [39]: Teacher Notes:

Teacher Model: Prepare and share a Think-Aloud model of making a compelling course of action for a problem in your community related to MRSA and the potential solution. Focus is on the process of doing the task instead of on the product of the task. Use talk stems to make your thinking explicit, such as.

- We recommend that …
- If the recommendation is enacted then …
- If the recommendation is not enacted then …
- The course of action is effective because …
- It is important to understand that …
- You may think … but in fact …. Therefore …

Our Scientific Recommendation (Drafts)

Small group analysis of own recommendation

Prepare for the science seminar by analyzing your process and progress with your group's recommendation. Use **science talk stems** in your discussion. Make notes in science seminar notetaker.

- **Purpose:** What problem does your course of action address? Why did you include what you did in your recommendation?
- **Significance**: What would be the potential impact if your recommendation is carried out? How does it get at the root of the problem?
- **Reliability and justification:**
  - What aspects of the phenomena or evidence does your course of action take into account?
  - What have not been accounted for yet, or what are you unsure about in your course of action?
- **Future research:** What questions do you have about the phenomena or explanatory model that relate to your recommended course of action?

Presenting and reviewing

Presenters: Provide your recommendation to your peers and give them some time to read it over before you present. Some points to address in your presentations are:

- **Purpose**: Our course of action is designed to deal with _____.
- **Significance**: We think that it will _____ because _____.
- **Reliability and justification**: We are very confident about _____ parts of our course of action because _____. We are still unsure about _____ parts of our course of action because _____.
- **Future research:** We still have questions about _____.

Reviewers: Listen, read and make notes on the science seminar notetaker about:

- What is clear and what is unclear.
- What is misrepresented, mistaken or missing (such as evidence that is unaccounted for).
- What does not belong in the course of action.
- The questions you wonder about.
- Ideas for refinement.

Willard Brown 9/15/2014 5:02 PM
Comment [40]: Teacher Notes:

Organizing the seminar – possible approaches:
Altogether: Whole class, one group at a time, everyone gives feedback to everyone. *Features: a grand way to end the learning experience.*
Breakout sessions: Each group presents once to two other groups. *Features: faster, smaller audiences.*
Carousel: One group member stays with poster and presents* multiple times. Rest of group visits other groups' posters, listens to presenter, and gives feedback. (* or the speaker can be switched after each round). *Features: Faster than one at a time. Allows for multiple opportunities to present and give feedback.*

Developing a response

Listeners take a few minutes to discuss their peers' recommendations and develop a response.

- What problem is the course of action intended to solve?
- Is the course of action intended likely to solve it? Why or why not?
- Does the course of action get to the root of the problem?
- What is well explained and accounted for in the recommendation? Why?
- What is clear in the recommendation? Why?
- What is unclear or misrepresented in the recommendation? Why?
- What is missing from the recommendation? Why?
- What does not belong in the recommendation? Why?

Prepare 2-4 substantive responses to your peers' recommendations. Write these in the science seminar notetaker. Use **science talk stems** in your feedback.

Sharing feedback

Groups take turn sharing and discussing their response to their peers' recommendations.
Each group makes notes of the feedback they receive on the science seminar notetaker.

Managing the Public Health Challenge of MRSA
Science Seminar Notetaker

My Group's MRSA Recommendation

My notes for the presentation	My notes from peers' feedback

Peers' MRSA Recommendations

My notes about peers' recommendation	My response to peers' presentation

My notes about peers' recommendation	My response to peers' presentation

Peers' MRSA Recommendations

My notes about peers' recommendation	My response to peers' presentation

My notes about peers' recommendation	My response to peers' presentation

My notes about peers' recommendation	My response to peers' presentation

You may need to make additional pages.

Managing the Public Health Challenge of MRSA
Building Consensus

Individual

- Which courses of action might be the most effective at addressing the MRSA epidemic? Which gets at the root of the problem? Why do you think so?

Whole class discussion

- Which courses of action might be the most effective at addressing the MRSA epidemic? Which gets at the root of the problem? Why do you think so?

Managing the Public Health Challenge of MRSA
MRSA Inquiry Reflection

Individual

Respond to each of the following prompts.

- What have you learned that you may find useful in the future?

- What do you want to learn more about?

Small group discussion

- Take turns sharing your ideas for one minute each.

Whole class discussion

- Share your response.

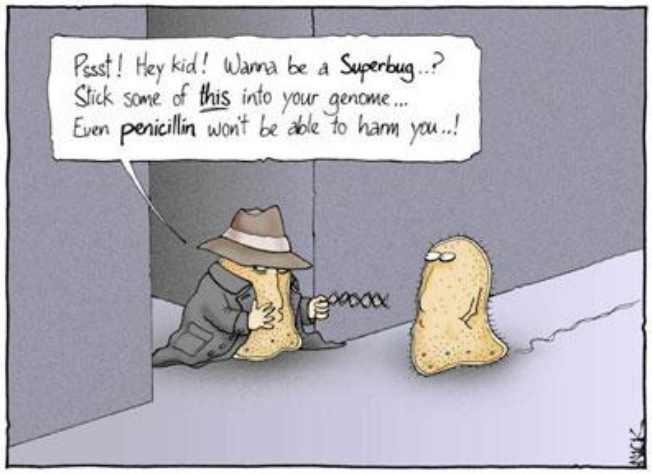
PROJECT READi

Name _____ Date _____

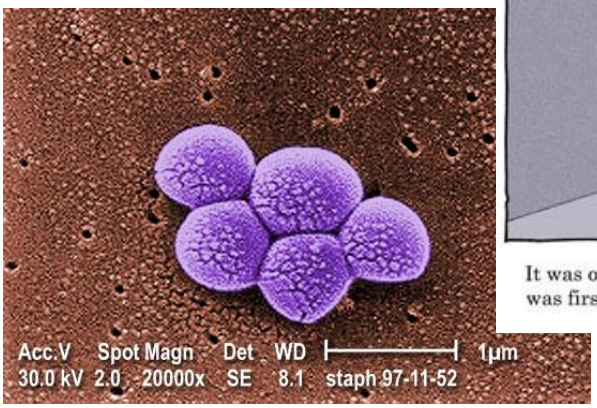
Teacher _____

MRSA

Reader



It was on a short-cut through the hospital kitchens that Albert was first approached by a member of the Antibiotic Resistance.



The intended use of these materials is in tandem with ongoing professional development focused on supporting reading as scientific practice. This work is funded by the Reading for Understanding Initiative of the Institute for Education Sciences, U.S. Department of Education, through Grant R305F100007 to University of Illinois at Chicago. The opinions expressed are those of the authors and do not represent views of the Institute or the U.S. Department of Education.

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PROJECT READi

Name _____ Date _____
Teacher _____

MRSA Reader
Table of Contents

'Superbug' MRSA Worries Doctors, Athletes

Jan. 13, 2005

Ricky Lannetti was once the picture of health – a big, strong college football player.

In the fall of 2003, he had led his team to a big victory, catching more passes than anyone and securing a spot in the national semifinals. But sometime after that game he caught something else.

"They didn't know what they had. They were as confused as I was," his mother, Teresa, told ABC News. "They had five different antibiotics in him, but they finally said, 'We can't handle it.'" On Dec. 6, 2003, one week after his last game, Lannetti died.

There's still a lot of mystery surrounding how Lannetti, 21, got sick in the first place and why his illness progressed so quickly. But one thing is clear: He had an infection caused by a bacteria generally found on the skin or in the nose, called MRSA, or methycillin resistant *staphylococcus aureus*.

MRSA is the kind of germ doctors have worried about for years: some call it a "superbug," a germ the usual antibiotics won't kill.

Worse, it can cause trouble quickly. What starts as a skin infection, can become a deadly pneumonia or blood or bone infection in a matter of days if not treated correctly.

Delicate Choices

Up until recently, doctors hadn't seen MRSA in healthy young people outside the hospital, said Dr. Robert Daum of University of Chicago Hospitals. "MRSA is a denizen of the hospital," he said. "It lives here."

But now, 65 percent of the staphylococcus infections coming into his emergency room in otherwise healthy kids are MRSA, he said. To him, that rate of growth is alarmingly fast – a cause for concern.

MRSA is resistant to anywhere from 15 to 30 different antibiotics. That means when it's detected, a doctor has only a very small number of compounds at hand that are able to kill it.

Daum said he has seen some patients with MRSA that are worse off for having seen a doctor that could not recognize it. The patients were treated with regular antibiotics – and that gave the germ more time to do damage in the body.

"We've seen a lot of kids that come in here that needed intensive care and in fact have died that have started off by being out in the community, where they get an old treatment and then come in here having failed it," he said.

Evolving Quickly

Most MRSA infections begin with a cut or a bruise, which is why some of the worst outbreaks have happened to football teams.

"I think you'd be hard-pressed right now to find a college athletic department that has not seen it in some shape or form with some of their athletes," said Ron Courson, the athletic trainer for the University of Georgia football team. Eight players on his team had MRSA infections this season.

A communal locker room, with many people in one area, can help bacteria spread, he said. "You may have athletes sharing equipment such as passing a towel from one person to the next person on the sideline."

Even the NFL has had its share of problems: players such as Kenyatta Walker of the Tampa Bay Buccanneers and Junior Seau and Charles Rodgers of the Miami Dolphins reportedly have been hospitalized with serious MRSA infections.

Daum's biggest concern is that as MRSA continues to evolve, it will become resistant to even more antibiotics.

"Bacteria are unlike us humans. We have a generation time of about 25 years. They have a generation time of 20 minutes," he said. "They can adapt pretty fast."

Daum said he is seeing a strain in the Midwest that is so severe, it has caused deaths even when the right antibiotic is used.

Source: http://abcnews.go.com/Health/Primetime/story?id=410908&page=1&singlePage=true

Kansas City Teen Gets MRSA From Attempted Lip Piercing, Almost Dies

Kansas City Teen Gets MRSA From Attempted Lip Piercing, Almost Dies

Published May 12, 2008 / FoxNews.com

A Kansas City-area teenager who tried to pierce his lip with a needle from a first-aid kit ended up with a staph infection that almost killed him.

Zeke Wheeler of Blue Springs is recovering at Children's Mercy Hospital after several surgeries on his knees and hips to remove the drug-resistant infection called Methicillin-resistant Staphylococcus aureus infection. Now the 15-year-old high school freshman faces heart surgery, more hospitalization and a long course of antibiotics.

The boy's father — John Wheeler — said Wednesday that the boy was at home ill with flu and bronchitis on April 8 and tried to pierce his lower lip. A week later the boy felt feverish and went to an emergency room, where he was diagnosed with a viral infection.

Not until he was at Children's Mercy was he found to have MRSA. Dr. Robyn Livingston, director of Infection Control at Children's Mercy Hospital, told KCTV-5, "If MRSA gets into the blood stream, you're talking about infection on the heart, pneumonia, into the bone that may require surgical intervention." Every part of Wheeler's body is now affected, Livingston added. He's had six blood transfusions, and three knee and two hip surgeries.

Dr. Joseph Rahimian, an infectious disease specialist at St. Vincent's Hospital in New York City, said he treats about 15 cases of MRSA each week. "It's a bacteria we're seeing more and more frequently in communities and hospitals," Rahimian said. "It could be because of the increased use of antibiotics." Rahimian said he thinks Wheeler will recover, although the teenager might have some chronic consequences. "I guess there is a lesson in this," Rahimian said. "If you are getting a piercing, it should be done with someone who knows what they are doing, and it should be done with a clean, sterilized needle with someone who knows where the major vessels are to avoid injecting into an artery or vein."

— The Associated Press contributed to this report

Source: http://www.foxnews.com/story/0,2933,354696,00.html#ixzz1m0Zzjt9b

How long do microbes like bacteria and viruses live on surfaces in the home at normal room temperatures?

How long do microbes like bacteria and viruses live on surfaces in the home at normal room temperatures?

Posted 08.22.2002 at 11:43 AM 2 Comments

Art Dekenipp
Alvin, Texas

The answer is probably not what you want to hear: Microbes can live on household surfaces for hundreds of years. The good news, however, is that most don't. Some well-known viruses, like HIV, live only a few seconds.

Microbes, of course, are everywhere. Each square centimeter of skin alone harbors about 100,000 bacteria. And a single sneeze can spray droplets infested with bacteria and viruses as far as 3 feet. The microbial life span depends on many factors, says Philip Tierno, director of microbiology and diagnostic immunology at the New York University School of Medicine. Because viruses must invade cells of a living host to reproduce, their life spans outside are generally shorter than that of bacteria, which reproduce on their own. Although viruses can survive outside a host on household surfaces, their ability to duplicate themselves is compromised-shortening the virus's life span.

Humidity also makes a difference; no bacteria or virus can live on dry surfaces with a humidity of less than 10 percent. Any sort of nutrients-food particles, skin cells, blood, mucus-helps microbes thrive, which is why your kitchen sponge is a breeding ground.

Bacteria called mesophiles, such as the tuberculosis-causing Mycobacterium tuberculosis, survive best at room temperature and are likely to thrive longer than cold-loving psychrophiles or heat-loving thermophiles. According to Tierno, at room temperature and normal humidity, Escherichia coli (E. coli), a bacteria found in ground beef that causes food poisoning, can live for a few hours to a day. The calicivirus, the culprit of the stomach flu, lives for days or weeks, while HIV dies nearly instantly upon exposure to sunlight. Other microbes form exoskeleton-like spores as a defense mechanism, like the bacteria *Staphylococcus aureus*, which is responsible for toxic shock syndrome, food poisoning, and wound infections. In this way, they can withstand temperature and humidity extremes. Tierno says this bacterial spore can survive for weeks on dry clothing using sloughed skin cells for food. The Bacillus anthracis, the anthrax bacteria, can also form spores and survive tens to hundreds of years.

Worried that your home is a hospitable habitat? Tierno says simple hand washing can greatly reduce your risk of picking up germs. Using a disinfectant on high-traffic surfaces-doorknobs, kitchen counters, and sinks-also helps eliminate unwanted household guests.

Edited by Bob Sillery
Research by Reed Albergotti and Emily Bergeron

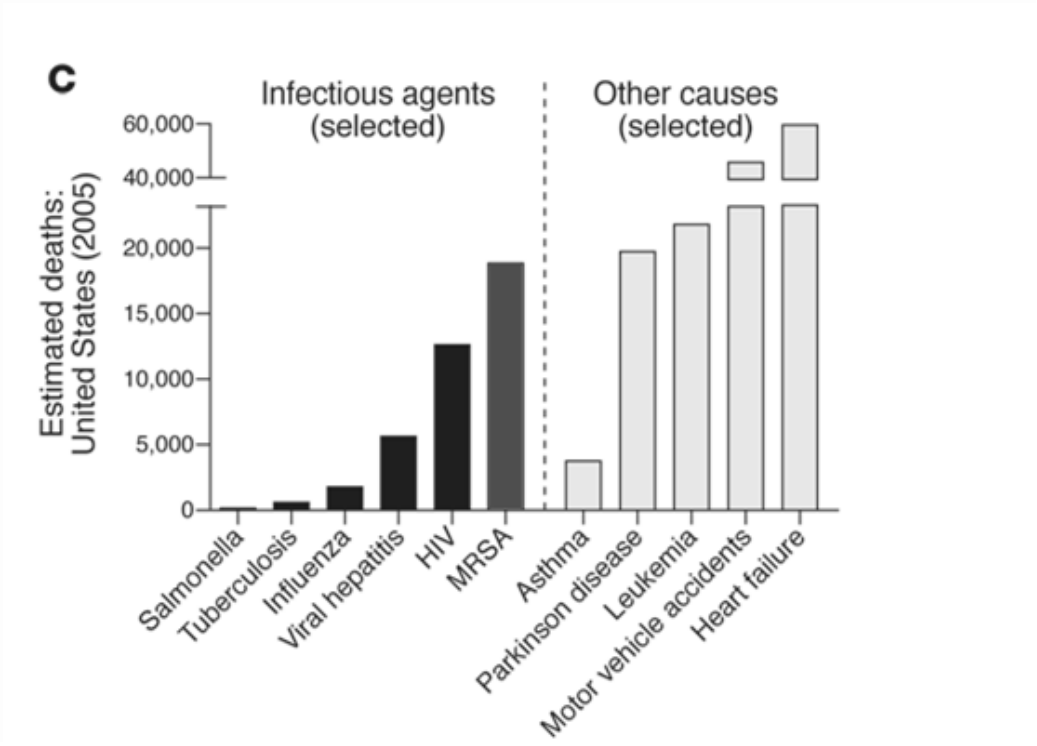
Source: http://www.popsci.com/scitech/article/2002-08/how-long-do-microbes-bacteria-and-viruses-live-surfaces-home-normal-room-tem

Antibiotic / Antimicrobial Resistance

Antibiotics and similar drugs, together called antimicrobial agents, have been used for the last 70 years to treat patients who have infectious diseases. Since the 1940s, these drugs have greatly reduced illness and death from infectious diseases. Antibiotic use has been beneficial and, when prescribed and taken correctly, their value in patient care is enormous. However, these drugs have been used so widely and for so long that the infectious organisms the antibiotics are designed to kill have adapted to them, making the drugs less effective. People infected with antimicrobial-resistant organisms are more likely to have longer, more expensive hospital stays, and may be more likely to die as a result of the infection.

Source: http://www.cdc.gov/drugresistance/index.html

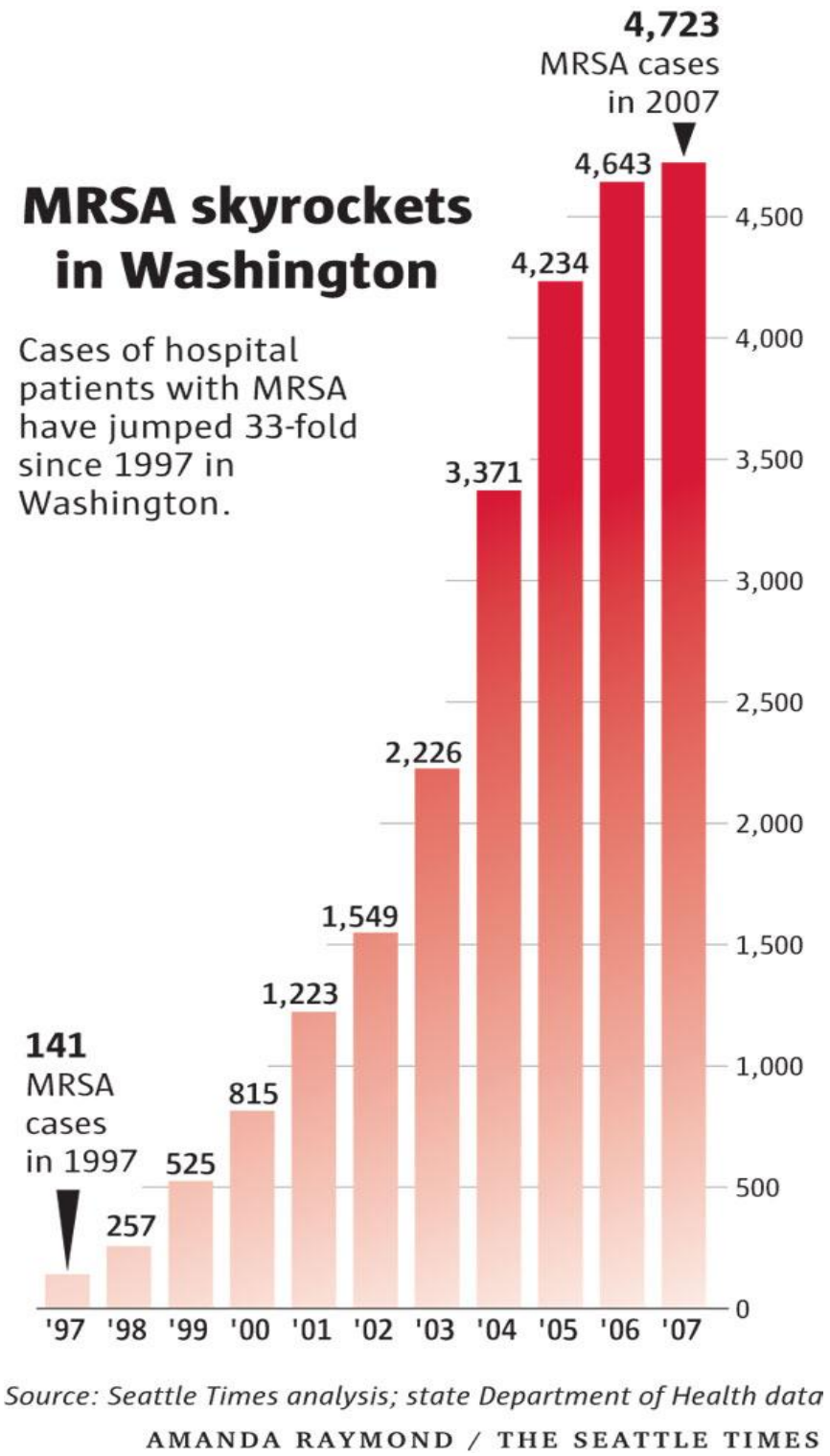
Comparison of Estimated Deaths in U.S. in 2005



(**C**) Comparison of estimated deaths in the United States in 2005 due to individual infectious agents or other causes. Data are CDC estimates from National Vital Statistics Reports (12) and Klevens et al. (11). Deaths associated with MRSA infection are based on the estimated number of in-hospital deaths rather than attributable mortality, whereas data for all other causes of mortality are based on US Standard Certificate of Death. Note also that mortality due to MSSA is not included, and thus estimated mortality associated with all *S. aureus* infections is not shown.

Source: http://www.jci.org/articles/view/38226, Frank R. DeLeo, Henry F. Chambers, *J. Clin. Invest.* 2009; 119(9):2464

MRSA skyrockets in Washington



Source: http://seattletimes.com/flatpages/specialreports/mrsagraph.html

MRSA History

Late 1880s
Scottish surgeon Alexander Ogston identifies a bacterium, *Staphylococcus aureus*.

1928
British scientist Alexander Fleming discovers the first antibiotic, penicillin.

1941
Penicillin becomes available in the United States and England. The first penicillin-resistant Staphylococcus aureus is reported a short time later.

Late 1940s
One-quarter of *Staphylococcus aureus* bacteria in hospitals are penicillin-resistant.

1958
Vancomycin, still considered an antibiotic of last resort, is introduced.

1959
The antibiotic methicillin is introduced.

1961
Doctors find the first cases of methicillin-resistant *Staphylococcus aureus* (MRSA).

1960-1967
Infrequent hospital outbreaks of MRSA in Western Europe and Australia.

1968
First hospital outbreak of MRSA in the United States at the Boston City Hospital, Massachusetts.

1968–mid 1990s
Percent of *Staphylococcus aureus* infections in hospitalized patients that were caused by MRSA increased slowly but steadily.

1982
Large outbreak of MRSA infections among intravenous drug users in Detroit, Michigan.

Late 1980s–1990s
Outbreaks of MRSA noted in Australia among Aboriginal populations with no exposure to hospitals.

1998–2008: The CA-MRSA Epidemic Decade
While rates of HA-MRSA (Hospital Acquired) infection remained stable, rates of CA-MRSA (Community Acquired) increased.

Mid-1990s
Scattered reports of CA-MRSA infections in children in the United States.

1999
First reports of healthy, young children dying of severe MRSA infections.

2002
Doctors find in the United States a strain of Staphylococcus aureus highly resistant to vancomycin.

2005
CA-MRSA risk factors identified to date include: athletes, military recruits, incarcerated people, emergency room patients, urban children, HIV patients, men who have sex with men, indigenous populations.

Today
Over 95% of *Staphylococcus aureus* worldwide is penicillin-resistant and 60% is methicillin-resistant.

Source: Adapted from http://mrsa-research-center.bsd.uchicago.edu/timeline.html
http://articles.latimes.com/2006/feb/26/science/sci-staph26/3

Superbug, Super-fast Evolution

April 2008

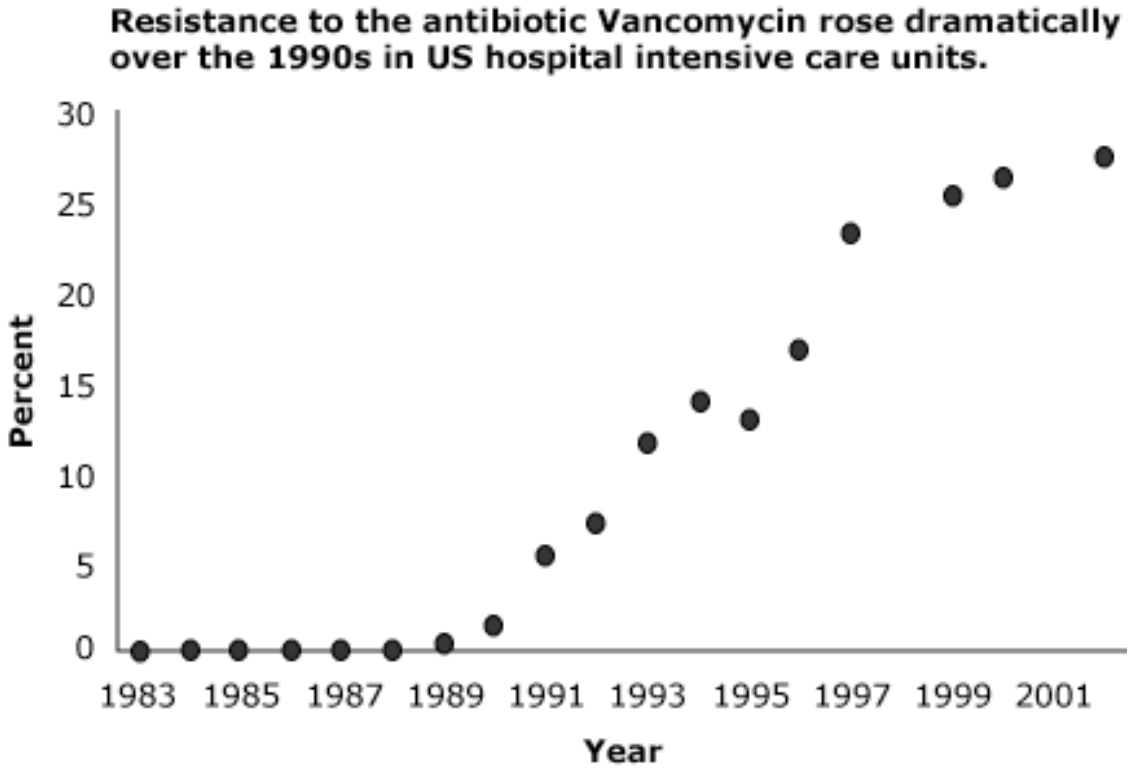
Fascination with tiny microbes bearing long, difficult-to-pronounce names is often reserved for biology classrooms — unless of course the bug in question threatens human health. MRSA (methicillin-resistant *Staphylococcus aureus*) now contributes to more US deaths than does HIV, and as its threat level has risen, so has the attention lavished on it by the media. At this point, almost any move the bug makes is likely to show up in your local paper. Last month saw reporting on studies of hospital screening for MRSA (which came up with conflicting results), stories on MRSA outbreaks (involving both real and false alarms), and media flurries over the finding that humans and their pets can share the infection with one another. Why is this bug so frightening? The answer is an evolutionary one.

Where's the evolution?

MRSA is resistant not only to the antibiotic methicillin, but also to whole other suites of our drugs, making it very difficult to treat and, occasionally, deadly. Modern strains of MRSA did not, however, show up out of the blue. In the early 1940s, when penicillin was first used to treat bacterial infections, penicillin-resistant strains of *S. aureus* were unknown — but by the 1950s, they were common in hospitals. Methicillin was introduced in 1961 to treat these resistant strains, and within one year, doctors had encountered methicillin-resistant *S. aureus.* Today, we have strains of MRSA that simultaneously resist a laundry list of different antibiotics, including vancomycin — often considered our last line of antibacterial defense.

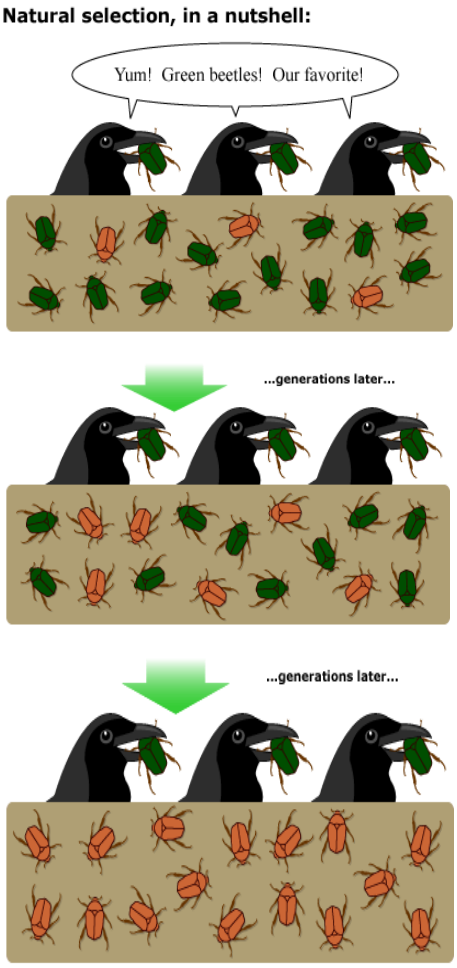
How did *S. aureus* morph from a minor skin infection to a terror? When the media report on MRSA and other drug resistant pathogens, they often say that such pathogens have recently "emerged" — that they've "developed" resistance or "learned" to evade our drugs. In fact, it's more accurate to say that these bugs have evolved resistance. It's particularly ironic that newspapers might shy away from describing bacterial evolution as such because, when it comes to evolution, bacteria have most of the rest of us beat.

Resistance to the antibiotic Vancomycin



Battling Bacterial Evolution: The Work of Carl Bergstrom

Dr. Carl Bergstrom manages evolution. From his laboratory at the University of Washington, Carl figures out how to control the evolutionary future of microbe populations, nudging them towards particular destinies and away from others. His laboratory does not look like a traditional biology lab; rather than test tubes or microscopes or Petri dishes, the rooms are full of computers, whiteboards, books, and coffee machines.



Green beetles have been selected against, and brown beetles have flourished.

Hooked on natural selection

Carl had always been interested in biology but got hooked on evolution after encountering Darwin's basic idea of natural selection. The concept is simple, but incredibly powerful…
Natural selection is simply the logical result of four features of living systems:

- **variation** - individuals in a population vary from one another
- **inheritance** - parents pass on their traits to their offspring genetically
- **selection** - some variants reproduce more than others
- **time** - successful variations accumulate over many generations

Natural Selection and Antibiotic Resistance

Natural selection can operate in any population, but Carl focuses much of his work on bacterial populations that impact public health… Carl's work tackles the very real problem of the evolution of antibiotic resistance by bacterial populations in hospitals.

Antibiotics, such as penicillin, are drugs that kill or prevent the growth of bacteria. When antibiotics were first discovered, they seemed to represent a miracle cure for human diseases like pneumonia, typhoid, bubonic plague, and gonorrhea. However, almost immediately after the introduction of antibiotics, bacteria began to up the stakes — resistant strains of bacteria soon evolved that could grow even in the presence of a particular antibiotic, rendering our drugs ineffective in battling these resistant infections.

How exactly does antibiotic resistance evolve? How have such small and simple organisms managed to repeatedly outpace our drugs? The process is quite simply evolution by natural selection.

Bacteria are great evolvers for many reasons. For example, their short generation times and large population sizes boost the rate at which they can evolve.

Modification by Natural Selection

Modification by Natural Selection

Darwin proposed that the environment may affect individual organisms in a population in different ways because individuals in a species are not identical. Some organisms have traits that make them better able to cope with their environment. Organisms that have a greater number of these favorable traits tend to leave more offspring than organisms with fewer beneficial traits. Darwin called the different degrees of successful reproduction among organisms in a population natural selection.

If a trait both increases the reproductive success of an organism *and* is inherited, then that trait will tend to be passed on to many offspring. A population of organisms **adapt** to their environment as their proportion of genes for favorable traits increases. The resulting change in the genetic makeup of a population is evolution. In an evolving population, a single organism's genetic contribution to the next generation is termed **fitness.** Thus, an individual with high fitness is well adapted to its environment and reproduces more successfully than an individual with low fitness.

Bear in mind that natural selection is not an active process. Organisms do not purposefully acquire traits that they need, although it may seem that this is true. The environment "selects" the traits that will increase in a population. The kinds of traits that are favorable depend on the demands of the environment. An organism may be able to run fast, or it may be strong or have coloring that acts as camouflage from predators. Traits that are favorable for some organisms in some environments are not necessarily favorable for all organisms or all environments. For example, the large body size of large mammals such as the elephant would not be beneficial to a species of flying birds if size prevented flight. A favorable trait is said to give the organism that has it an **adaptive advantage.**

Selection conditions change as the demands of the environment change. For example, a significant change in climate or available food can cause rapid evolutionary change as populations adapt to the change. If the environmental change is too extreme, however, populations cannot adapt quickly enough and they become extinct.

Excerpted from MODERN BIOLOGY, page 287.

Wash your hands

Wash your hands

Human skin — even in the most healthy of us — is teeming with bacteria. Most of those bacteria only cause disease under special circumstances. But everyone also carries potentially dangerous germs from time to time, such as staph, strep, and the intestinal bacteria that cause food poisoning and diarrhea. Sad to say, health care personnel — including your doctors and nurses — are particularly likely to carry the most troublesome bacteria, especially on their hands. And although viruses don't set up shop on the skin the way bacteria do, the viruses that cause diarrhea and respiratory infections — from the sniffles to the flu — can hang around on the hands long enough to spread from person to person.

If your skin is covered with so many bacteria, why don't they make you sick more often? Although the skin is a hospitable resting place for bacteria, it is also a tough barrier that prevents hostile bugs from reaching the body's vulnerable internal tissues. Ironically, perhaps, some of the traditional methods of removing bacteria from the skin can disrupt the skin's own defenses. Scrubbing can produce tiny abrasions that allow bacteria to sneak into your tissues. Detergents and even plain water can remove the skin's oils, which have important antibacterial properties.

Good handwashing, then, involves two potentially conflicting goals, removing microbes while still keeping your skin healthy.

Preached but not practiced

Handwashing is good advice — but do Americans follow it?

Often, we don't. When investigators surveyed public restrooms around the country, they found that only 83% of people washed up after using the toilet. Do posted reminders to "Please Wash Your Hands" help? When researchers tested this simple strategy, they found that handwashing improved in women but not in men.

The gender gap applies to hospitals, too. In one study, female physicians washed their hands after 88% of patient contacts, but male doctors washed after just 54%.

Does it work?

Yes. Just 30 seconds of simple handwashing with soap and water reduces the bacterial count on health care workers' hands by 58%. And there is an even better way: Alcohol-based handrubs reduce counts by 83%.

What's best?

Soap and water is the time-honored technique, and it does work. In fact, it's still the best way to remove visible soilage and particulate material. But as the public has become concerned about the risk of infection, soaps with antibacterial additives have gradually taken over 45% of the market. It's understandable, but it's not helpful; antibacterial soap is no better than ordinary soap, and the additives actually increase the risk of allergic reactions and other side effects.

Plain soap will do the job — and so will plain water. Tap water is excellent, and cool or lukewarm temperatures serve as well as hot water. If soap and water are not available, antibacterial wipes can help. Although they are not as effective, they will reduce bacterial counts. Washing with soap and water is the best way to remove dirt, but waterless, alcohol-based handrubs are even better at killing germs. Handrubbing is faster and more convenient than handwashing, and it's also easier on the skin. Hospitals are switching to handrubs because they kill more bacteria and viruses and they are used more regularly.

When and how

How should you wash? Wet your hands with water, then apply the soap to your palms. Rub your hands together briskly for at least 15 seconds before rinsing.

Wash your hands before each trip to the dining room and after each trip to the bathroom. Wash after handling diapers and animals. Wash before and after you handle food. Wash after you take out the trash, work in the yard, clean the house, repair the car, or do other messy chores. Wash before and after sex. Wash after you come in contact with anyone who is sick. If you follow reasonable guidelines you'll be washing often, but you won't become obsessive or compulsive. Be careful, not fearful.

August 2006 Update
Source: http://www.health.harvard.edu/fhg/updates/update0806d.shtml

The success of evolutionary engineering

Responding to the pervasive reach of evolution in medicine, scientists have developed an impressive series of innovative methods to slow the pace of evolution. The following examples show that successful methods often slow evolution for clearly evolutionary reasons and that these approaches may be generalizable to other systems.

Drug overkill and HIV triple drug therapy. The evolutionary biology hidden in this strategy is simple: a strong, multi-drug overdose leaves no viruses able to reproduce, and so there is no genetically based variation in fitness among the infecting viruses in this overwhelming drug environment. Without fitness variation, there is no evolutionary fuel, and evolution halts.

Direct observational therapy. Tuberculosis (TB) infects 1/3 of the world's population and is difficult to treat because it requires 6 months of medication to cure. Partial treatment has resulted in the evolution of multi-drug resistance. Direct observational therapy has been used to improve patient compliance during the whole treatment regimen, reducing evolution of resistance by ensuring a drug dose long enough and severe enough to completely eradicate the infection from each person.

Withholding the most powerful drugs. The antibiotic vancomycin has been called the "drug of last resort," because it is used only when other, less powerful antibiotics fail. Withholding the most powerful drugs lengthens their effective life span because overall selection pressure exerted by these drugs is reduced, slowing the pace of evolution.

Screening for resistance. Screening infections for sensitivity to particular antibiotics before treatment allows for a narrow=range antibiotic to be used instead of a broad-spectrum antibiotic. Reduced use of a broad-spectrum antibiotic slows evolution of resistance as in the mechanisms above. Similarly, farmers are advised to check their fields after pesticide treatment and then change the chemical used in the next spraying if many resistant individuals are discovered. Screening for pest susceptibility reduces use of chemicals for which resistance has begun to evolve.

Table 3. The success of evolutionary engineering: mechanisms that reduce evolution can and do work on all three parts of the evolutionary engine.

Mechanisms that work to slow evolution	
Method of slowing evolution	Example
Reduce variation in a fitness-related trait	
Drug overkill with multiple drugs	• Triple-drug therapy for AIDS • Pesticide pyramiding
Ensure full dosage	• Direct observation therapy of tuberculosis
Reduce appearance of resistance mutations	• Engineer RT gene of HIV-1
Reduce pest population size	• Integrated pest management of resistant mutants • Nondrug sanitary practices
Reduce directional selection	
Vary selection over time	• Herbicide rotation • Vary choice of antibiotics, pesticides or antiretrovirals
Use nonchemical means of control	• Integrated pest management
Limit exposure of pests to selection	• Withhold powerful drugs, e.g., restricted Vancomycin use
Avoid broad-spectrum antibiotics	• Test for drug or pesticide susceptibility before treatment of infections or fields
Reduce heritability of a fitness-related trait	
Dilute resistance alleles	• Refuge planting

Adapted from www.sciencemag.org SCIENCE VOL 293 7 SEPTEMBER 2001

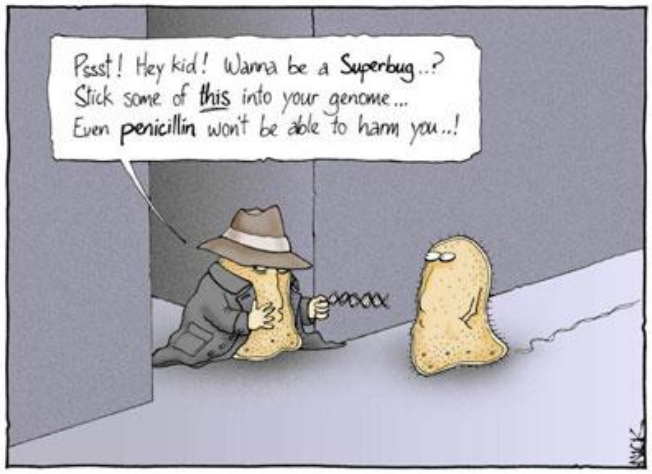
PROJECT READi

Name _____ Date _____

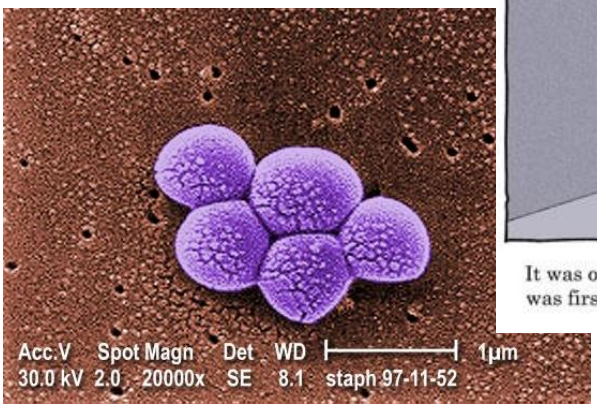
Teacher _____

MRSA

Investigation, Part I



It was on a short-cut through the hospital kitchens that Albert was first approached by a member of the Antibiotic Resistance.



The intended use of these materials is in tandem with ongoing professional development focused on supporting reading as scientific practice. This work is funded by the Reading for Understanding Initiative of the Institute for Education Sciences, U.S. Department of Education, through Grant R305F100007 to University of Illinois at Chicago. The opinions expressed are those of the authors and do not represent views of the Institute or the U.S. Department of Education.

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MRSA Investigation

MRSA is a serious threat to the public. Scientists have studied this deadly infection for many years because it is an important public health issue. MRSA is also a significant scientific puzzle, because many of the treatments used to cure MRSA infections work less well now than they did forty, twenty, ten, or even five years ago.

One goal for the MRSA investigation is to make sense of the MRSA phenomena through creating explanatory scientific models for how it emerges and spreads.
A second goal for our investigation into MRSA is to determine the best measures (or courses of action) to manage the public health challenge presented by the infection, and to share what we have learned with our community.

Our third goal is to uncover powerful practices for reading science texts for the purpose of construction and critique of scientific models – in essence reading, talking, listening, and writing scientifically.

This MRSA investigation has four phases:

- MRSA infection
- Transmission and spread of MRSA
- Evolution of SA to MRSA
- Managing the public health challenge of MRSA

Each phase includes texts to read and make sense of, group and class discussion, and construction and critique of science explanatory models or science recommendations.

MRSA Infection
Beginning With What We Know, Think, and Wonder

Individual think-write

What do you know, think, possibly remember, guess at or wonder about **any two** of the following terms?

bacteria	infection	antibiotic
antibiotic resistance	MRSA	evolution

Pair discussion

- Take turns sharing your ideas for one minute each.
- Add partner's ideas to your chart.
- **Stellar idea**: Select one idea that you or your partner can share with the class. Mark it with a star.

Whole class sharing of our initial thoughts

- Share stellar ideas.
- Listen closely.
- Use science talk stems.
- Add peers' ideas to your chart.

MRSA Infection
MRSA in the News

Reading as inquiry: In the MRSA investigation, our reading supports development of science-reading savvy and building science knowledge. Whenever we read, we'll make our thinking visible so we can consider together how we read science and learn from each other. After we read we'll discuss how we read the text and work through any challenges the text presents. We will record the science reading process that we use on our class science reading strategies list, updating it as we read different texts. We will also discuss what we are noticing and thinking about **MRSA**, **antibiotic resistance** and **evolution**. We will use evidence and interpretation notetakers and posters to keep track of our ideas each time we read.

Individual think-write: preview

- Locate the reading strategy list, and the texts "Superbug MRSA Worries Doctors, Athletes," and "Kansas City Teen Gets MRSA from Attempted Lip Piercing, Almost Dies" (MRSA Reader pages R1-5).
- Take two minutes to look over the two texts and respond to the prompts below.
  - What might be challenging about reading these two articles?
  - What might be interesting about reading these two articles?
  - What kind of sources are these?
  - What kind of science information might they contain about MRSA?
  - What might you do to get as much as possible from the reading this article?

Pair discussion

- Take turns sharing your ideas for one minute each.
- Add notes about your partner's ideas onto your own response.
- **Stellar idea**: Select one response that you or your partner can share with the class. Mark it with a star.

Whole class discussion

- Share stellar ideas.
- Listen closely and respond to your peers ideas.
- Use science talk stems.
- Add peers' best ideas onto your own response.

MRSA in the News

Teacher model

- Locate your science reading stems.
- Locate "Kansas City Teen," and "Superbug MRSA Worries Doctors, Athletes," (R1-5).
- Listen and make notes below about the teacher's reading process.

Whole class discussion

- What did you notice about how your teacher read the science text?
- What are some science reading processes that you noticed?
- Which were new or particularly useful for this text?
- What additions or revisions can we make on the reading strategies list poster?

MRSA in the News

Reading and making thinking visible

- **Think aloud:** Partners take turns thinking aloud by paragraph for the first section. One partner thinks aloud while the other partner makes notes in the margin of the text about their partner's thoughts. Help each other make sense of the text.

OR

- **Talk to the text:** Individually talk to the text on the first section. Pairs take turns sharing their talk to the text comments. Help each other make sense of the text.
- Use the science reading stems to help you share your reading process.

Pair discussion

After reading discuss and respond to the prompts.

- **Words:** What new words or word-uses did you encounter? How did you make sense of their meaning?
- **Confusions or clarifications**: What parts of the text were unclear? Where do you have questions? Work together to clarify confusing parts of the text and to answer questions that you have.
- **Reading process:** What other science reading processes were important for your reading?
- **Inquiry:** What are you noticing or wondering now about MRSA, antibiotic resistance or evolution? What is interesting? What is important?
- **Stellar ideas:** Select a new word, a confusion or clarification, or a reading process AND one idea or question about MRSA, antibiotic resistance or evolution that you or your partner can share with the class. Mark them on your text with a star.

Whole class discussion

- Share a new word, confusion or clarification, or a reading process.
- Which reading strategies helped make sense of the text?
- What additions or revisions can we make on the reading strategies list poster?
- Share new ideas about MRSA, antibiotic resistance and evolution.
- What ideas and questions can we add to the evidence interpretation posters for MRSA, antibiotic resistance and evolution?
- What new words can we add to our word wall?

Repeat above steps for remaining sections of "Superbug MRSA Worries Doctors, Athletes" and for "Kansas City Teen Gets MRSA from Attempted Lip Piercing, Almost Dies."

MRSA Infection
Living and Learning

Individual think-write

Respond to either of the following two prompts.

- What is a word, that for you, the meaning has changed over time? How did it change and why? A response might be like: *I used to think that ____ meant but now I know that it means ____ because ____.*

- Have you experienced learning a new word and then suddenly noticing that word appearing everywhere? What was the word? When did you learn it? Where do you then recall noticing it? How do you account for the phenomena?

Pair discussion

- Take turns sharing your ideas for one minute each.
- Add notes about your partner's ideas onto your own response.
- **Stellar idea**: Select one response that you or your partner can share with the class. Mark it with a star.

Whole class discussion

- Share stellar ideas about word learning.
- Listen closely.
- Use science talk stems.
- Add great ideas from your peers to your own response.

MRSA Infection
MRSA in Our Homes

Individual think-write: preview

- Locate your science reading stems.
- Locate: "How long do microbes like bacteria and viruses live on surfaces in the home at normal room temperatures?" (pages R6-7)
- Take two minutes to look over the text and respond to the prompts below.
    - What might be challenging about reading this article?
    - What might be interesting about reading this article?
    - What kind of text is this? How do you know?
    - What predictions can you make about the kind of science information it may contain and how it might inform our investigation of MRSA?
    - What might you do to get as much as you can from reading this article?

Pair discussion

- Take turns sharing your ideas for one minute each.
- Add notes about your partner's ideas onto your own response.
- **Stellar idea**: Select one response that you or your partner can share with the class. Mark it with a star.

Whole class discussion

- Share stellar ideas.
- Listen closely and respond to your peers ideas.
- Use science talk stems.
- Add peers' best ideas onto your own response.

MRSA in Our Homes

Survival words: There are many words, terms and symbols that are used only in science, or that have particular meanings in science texts. Developing your own savvy for dealing with new words while reading – predicting which new words will be the most valuable to focus on learning and having strategies for learning in them while reading – is invaluable for science reading and science knowledge-building.

Teacher model

- Listen and make notes below about the teacher's reading process.
- The text for the teacher model is not a source of information for MRSA investigation.

Methanotrophic bacteria occupy benthic microbial mats in shallow marine hydrocarbon seeps, Coal Oil Point, California

Microbial mats composed of giant sulfur bacteria are observed throughout the benthos along continental margins. These communities serve to oxidize dissolved sulfides to sulfate, and are typically associated with the recent exposure of sulfide-rich sediments. Such mats are also ubiquitous in areas of hydrocarbon seepage, where they are thought to consume sulfide generated in underlying sediment. Despite the high abundance of dissolved methane in hydrocarbon seeps, few studies have considered the importance of methanotrophy in mat communities.

Source: Ding, H., and D. L. Valentine (2008), Methanotrophic bacteria occupy benthic microbial mats in shallow marine hydrocarbon seeps, Coal Oil Point, California, J. Geophys. Res., 113, G01015, doi: 10.1029/2007JG000537.

Whole class discussion

- What did you notice about how your teacher handled new words while reading?

MRSA in Our Homes

Individual reading

Note new words.

- Locate: "How long do microbes like bacteria and viruses live on surfaces in the home at normal room temperatures?" (pages R6-7)
- Underline words in the text that are **new to you** or are **familiar but used in unfamiliar ways.**
- Circle any of these words that you predict that you will need to understand in order to understand the main ideas of the text. These are your **survival words** for this text.

Pair discussion

Take turns sharing your own survival words and your reading processes.

- **Survival words:** Discuss why you picked the word:
    - Is it an unfamiliar word or a familiar word used in an unfamiliar way?
    - What clues in the text suggest that it will be important to clarify the word's meaning to understand the main ideas of the text?
- **Stellar idea:** Select one survival word that you or your partner can share with the class. Mark it with a star. Be ready to explain why you picked it and why you decided that it was an important word for this text.

Whole class discussion

- Share survival words and reasons for picking them.
- Help clarify the meaning of your peers' survival words if you already know them.
- If you uncover new survival words circle them in the text, or if you learn what they mean *in this text* make a note on the text.
- Which reading strategies helped in deciding which words are worth understanding?
- What additions or revisions can we make on the reading strategies list poster?

MRSA in Our Homes

Reading and making thinking visible

- **Think aloud:** Partners take turns thinking aloud by paragraph with "How long do microbes like bacteria and viruses live on surfaces in the home at normal room temperatures?" One partner thinks aloud and the other partner makes notes in the margin about their partner's thoughts.

OR

- **Talk to the text:** Individually talk to the text on "How long do microbes like bacteria and viruses live on surfaces in the home at normal room temperatures?" Pairs take turns sharing their talk to the text comments paragraph by paragraph.
- Help each other figure out what the survival words mean in this text.

Pair discussion

- **Reading process:** What science reading processes were important for your reading?
- **Inquiry:** What are you noticing or wondering now about MRSA, antibiotic resistance or evolution? What is interesting? What is important?
- **Stellar ideas**
    - Select one survival word or science reading process that you or your partner can share with the class. Mark it with a star. Be ready to tell what you or your partner did, where in the reading/text you did it and how it helped.
    - Also, select one new idea or question about MRSA, antibiotic resistance, or evolution that you or your partner can share with the class. Mark them on your text with a star.

Whole class discussion

- Share how we clarified survival words and what they mean in this text.
- Help each other figure out the meanings of any remaining survival words.
- Which reading strategies helped in deciding which words are worth understanding?
- What additions or revisions can we make on the reading strategies list poster?
- Share new ideas about MRSA, antibiotic resistance and evolution.
- What ideas and questions can we add to the evidence interpretation posters for MRSA, antibiotic resistance and evolution?
- What new words can we add to our word wall?

MRSA Infection
Cause, Effect, Mechanism, and Explanation

Individual

What do you know, think, possibly remember, predict or wonder about the following terms?

cause	effect
mechanism	**explanation**

Pair discussion initial thoughts

- Take turns sharing your ideas for one minute each.
- Add partner's ideas to your own chart.
- **Stellar idea**: Select one idea that you or your partner can share with the class. Mark it with a star.

Whole class sharing

- Share your stellar idea.
- Listen closely to your classmates' ideas.
- Use science talk stems.
- Add peers' ideas to your chart.

MRSA Infection
Finding Evidence

The most important goal of science is developing explanations (or models) of how natural phenomena work. For the MRSA investigation, you and your classmates do the work of forming explanations for how MRSA works. For now the focus is finding evidence that might relate to the inquiry question:

How does MRSA infect people?

Teacher model

- Make or locate: A MRSA evidence and interpretation notetaker
- Locate: "Superbug MRSA Worries Doctors, Athletes," "Kansas City Teen Gets MRSA from Attempted Lip Piercing, Almost Dies," and "How long do microbes like bacteria and viruses live on surfaces in the home at normal room temperatures?" in the MRSA Reader, pages R1-7.
- Listen and make notes below about the teacher's reading process.

Source	Evidence	Interpretation

Whole class discussion

- What did you notice about how your teacher identified evidence and formed interpretations?

Finding Evidence

Individuals

- Reread "Superbug MRSA Worries Doctors, Athletes."
- Identify evidence for **how MRSA infections occur**.
- Underline or highlight the evidence you find. Mark each **I** for infection.
- Make notes in your MRSA evidence and interpretation notetaker.

Pairs or small groups

- Take turns sharing the evidence you found and the interpretations you made.
- Add new evidence to your MRSA evidence and interpretation notetaker.
- **Stellar idea:** Select one piece of evidence and one interpretation that you or your partner can share with the class. Mark where it is in the texts with a star so you can find it and direct your peers to it.

Whole class

- Share stellar ideas (one piece of evidence and one interpretation).
    - Explain where it is in the text set.
    - Explain **how you and your partner knew it was evidence** about MRSA infection.
    - Explain the reading strategy you used to identify it.
- Listen and respond to your peers ideas. Use science talk stems.
- Add new evidence and interpretations to your MRSA evidence and interpretation notetaker.
- Which reading strategies helped identify and interpret evidence in the text?
- What additions or revisions can we make on the reading strategies list poster?

Repeat above steps for "Kansas City Teen Gets MRSA from Attempted Lip Piercing, Almost Dies," and "How long do microbes like bacteria and viruses live on surfaces in the home at normal room temperatures?"

MRSA Infection
Identifying the Components and Their Roles

To understand a phenomenon, scientists ask what are all the components (players) involved, what are the cause-and-effect relationships among them, and what are the mechanisms. To help themselves with the sense-making, scientist write their ideas using words, numbers, and visuals to represent the components, causes, effects, and mechanisms. For the MRSA investigation we'll use words and visuals to represent and communicate how MRSA infects people as we make sense of it.

Individual think-write

Locate: your MRSA evidence and interpretation notetaker and your cause-effect-mechanism-explanation chart on page 12. Review the evidence and interpretations you noted. Respond to the three prompts in the space below and, if needed, on the next page.

- What components or players need to be in the model? How do I know?
- What relationships between them need to be represented? How do I know?
- What kinds of visuals (pictures, figures, symbols, charts, diagrams, and SmartArt) might help?

Identifying the Components and Their Roles

Pair discussion

- Take turns sharing your ideas for one minute each.
- Add notes about your partner's ideas onto your own response.
- **Stellar idea:** Select one component or one relationship that you or your partner can share with the class. Mark it with a star. Be ready to explain how you identified it and how you might represent it with words or visuals.

Whole class discussion

- Share stellar ideas.
- Listen to your peers' ideas. Add peers' ideas onto your own response.
- Use science talk stems. Ask a question or respond to the ideas that your peers share.
- What additions or revisions can we make on the scientific model construction strategy list poster?

MRSA Infection
Piecing Together the MRSA Infection Puzzle

A scientific model is an idea or set of ideas that explains a phenomenon: the components (players), the causes, the effects, the mechanisms. Piecing together the parts into a coherent scientific explanation (or model) takes creativity, deep thinking and perseverance. This is why people enjoy science – the joy of figuring stuff out. For now, our focus is on explaining:

How does MRSA infect people?

Teacher Model

- Locate: your MRSA evidence and interpretation notetaker, the scientific models criteria list poster and the scientific model construction strategy list poster.
- Listen and make notes below about the teacher's model construction process.

Whole class discussion

- What did you notice about your teacher's thought processes as he/she began to construct a model?
- What additions or revisions can we make on the scientific models criteria list poster and the scientific model construction strategy list poster?

Small groups

- Discuss
    - What does your model need to explain?
    - What scientific model construction strategy may help?
    - What criterion do you need to pay extra attention to?
- Review your MRSA evidence and interpretation notetaker and visuals.
- Create a scientific model that explains how MRSA infection occurs.
    - Use words and visuals to make your model as clear as possible.
    - Try to account for as much of the evidence from the texts as you can.
    - Check to make sure that your model makes sense with what you know about MRSA, bacteria, infection, and antibiotics.

Piecing Together the MRSA Infection Puzzle

These two blank pages are available for drafting your science model.

Piecing Together the MRSA Infection Puzzle

MRSA Infection
Peer Review and Consensus Building

Peer review and consensus building are essential to science knowledge building. Peer review provides assurance that someone who knows what they're doing has double-checked new claims and findings. In consensus building, ideas are examined from multiple perspectives. In peer review and consensus building we ask:

- Does the model help us explain the phenomenon?
- Does our model help us address our investigation/inquiry questions?
- Does the model (explanation) account for all of the available evidence?
- Can we use the model to predict what will happen if we manipulate the phenomena?
- Does the model agree with our understandings about how the world works and other science models?

Individual and small group model analysis

Prepare by analyzing your process and progress with your own model. Write your notes in **Box 1** on the peer review and consensus building notetaker on page 22, then discuss with your group. Use **science talk stems** in your discussion.

- **Significance:** What ideas did you think about and what questions did you grapple with as you constructed your model? What was the puzzlement?
- **Purpose:** Why did you include what you did in your model? What does your model help to explain, predict, or describe?
- **Reliability and justification:**
  - What aspects of the phenomena or evidence does your model account for? What is your evidence and reasoning for your explanation?
  - What have not accounted for yet or what are you unsure about in your model?
- **Future research:** What questions do you have about the phenomena or explanatory model at this point in the investigation?

Peer Review and Consensus Building

Presenting and reviewing

Presenters: Provide your model to your peers and give them some time to read it over before you present. Some points to address in your presentations are:

- **Significance**: The big question for us was _____. What was hard to explain was _____.
- **Purpose**: We built our model to try to explain _____. We think it helps explain, predict or describe _____ because _____.
- **Reliability and justification**: We are very confident about _____ parts of our model because _____. We are still unsure about_____ parts of our model because _____.
- **Future research:** We still have questions about _____.

Reviewers: Listen, read and make notes in **Box 2** on the peer review and consensus building notetaker about:

- What is clear and what is unclear.
- What is misrepresented, mistaken or missing (such as evidence that is unaccounted for).
- What does not belong in the model (things for which there are no evidence)?
- The questions you wonder about.
- Ideas for refinement.

Developing a response

Listeners take a few minutes to discuss their peers' model and develop a response.

- What is well explained and accounted for in the model? Why?
- What is clear in the model? Why?
- What is unclear or misrepresented in the model? Why?
- What is missing from the model? Why?
- What does not belong in the model? Why?

Prepare 2-4 substantive responses to your peers' model. Write these in **Box 3** on the peer review and consensus building notetaker. Use **science talk stems** in your feedback.

Sharing Feedback

- Groups take turn sharing and discussing their response to their peers' model.
- Each group makes notes of the feedback they receive from the peers in **Box 4** of the peer review and consensus building notetaker.

MRSA Infection

Peer Review and Consensus Building Notetaker

Our Model

1. My notes for the presentation	4. My notes from peers' feedback

Peers' Model

2. My notes about peers' model	3. My response to peers' presentation

MRSA Infection
Reflection and Revision

Small group discussion

Discuss how you will respond to the feedback you received.

- What did you see or hear from other groups' models that you liked?
- How will you modify your model, based on the classroom discussion?

Use different colored sticky notes provided by your teacher to label parts of your models that you:

- Are very confident about and want to keep.
- Would like to add to your model.
- Still have questions about.

Now make the revisions (upgrades!) to your model.

Individual think-write

Respond to three of the following five prompts in the space below.

- What is one part of your MRSA infection model that you are proud of? Why?
- What are you learning about cause, effect, mechanism and explanation in science?
- What are you learning about science models and/or how to construct science models?
- What are you learning about bacteria, antibiotics and infection?
- What are you learning about MRSA, antibiotic resistance, and evolution?

Whole class discussion

- Share a response to either prompt.
- What additions or revisions can we make on the scientific models criteria list poster and the scientific model construction strategy list poster?
- What additions or revisions can we make on the evidence interpretation posters for MRSA, antibiotic resistance, and evolution?

Transmission and Spread of MRSA

Our Ideas About Contagious Diseases and Epidemics

Individual think-write

- What do you know, think, possibly remember, predict or wonder about the following terms?

contagious disease	epidemic
scope	scale

Pair discussion

- Take turns sharing your ideas for one minute each.
- Add partner's ideas to your brainstorm.
- **Stellar idea:** Select one idea that you or your partner can share with the class. Mark it with a star.

Whole class discussion

- Share the stellar idea you or your partner has about contagious diseases and/or epidemics.
- Listen closely. Add peers' ideas to your brainstorm.
- Use science talk stems. Respond to your peers' stellar ideas.

Transmission and Spread of MRSA
MRSA Scope and Scale

Individual think-write: preview

- Locate your science reading stems.
- Locate the next three texts (MRSA Reader pages R8-10).
    - "Antibiotic Resistance"
    - "Comparison of Estimated Death in U.S. in 2005"
    - "MRSA skyrockets in Washington"
- Take three minutes to look over the three texts and respond to the prompts below.
    - What might be challenging or interesting about reading these texts?
    - How are they alike and how are they different?
    - What kinds of texts are they? How do you know?
    - What predictions can you make about the kind of science information each may contain and how it might inform our investigation of MRSA?
    - What might you need to do to get as much as you can from reading these texts?

Pair discussion

- Take turns sharing your ideas for one minute each.
- Add notes about your partner's ideas onto your own response.
- Select one response that you or your partner can share with the class. Mark it with a star.

Whole class discussion

- Share your response or your partner's response.
- Add peers' ideas onto your own response.

MRSA Scope and Scale

Reading and making thinking visible

- **Think aloud:** Partners take turns thinking aloud with the text, "Antibiotic Resistance." One partner thinks aloud and the other partner makes notes in the margin about their partner's thoughts.

OR

- **Talk to the text:** Individually talk to the text on "Antibiotic Resistance." Pairs take turns sharing their talk to the text comments.
- Use the science reading stems to help you share your reading process and work together to make sense of the text.

Pair discussion

After reading, discuss and respond to the prompts.

- **Reading process:** What science reading processes were important for your reading?
- **Inquiry:** What are you noticing or wondering now about MRSA, antibiotic resistance or evolution? What is interesting? What is important?
- **Stellar ideas**
    - Select a science reading process to share with the class. Mark it with a star.
    - Also, select one new idea or question about MRSA, antibiotic resistance, or evolution to share with the class. Mark them on your text with a star.

Whole class discussion

Share stellar ideas about reading process.

- What did you notice about your partner's (or your own) reading processes with this text?
- What reading challenges did you or your partner encounter and how did you respond to the reading challenge?
- What visuals or models did you or your partner form as you read? How did they help your understanding?
- What additions or revisions can we make on the reading strategies list poster?

Share stellar ideas about MRSA, antibiotic resistance, and evolution.

- What questions, connections, or ah-ha's do you have from your reading?
- What ideas and questions can we add to the evidence interpretation posters for MRSA, antibiotic resistance, and evolution?
- What new words can we add to our word wall?

Repeat above steps with the "Comparison of Estimated Deaths in U.S. in 2005" (R9) and "MRSA skyrockets in Washington" (R10).

Transmission and Spread of MRSA
Finding and Interpreting Evidence

Making sense of natural phenomena is messy work. You are always trying to make the best explanation you can with the information that is available. It can be hard to figure out what information helps explain what is going and harder still to figure out how it all ties together logically. For now, the focus is on finding and interpreting evidence that relates to these inquiry questions:

How widely has MRSA spread?
How is MRSA transmitted and spread?

Individual think-write

- Locate your MRSA evidence and interpretation notetaker. You may need additional pages now.
- Locate the MRSA Reader pages R1-10 (the first six texts).
- Review or re-read the texts and notetakers to identify evidence for **how MRSA is transmitted** and **how MRSA spread widely**.
- Underline or highlight the evidence you find. Mark each **T** for transmission or **S** for spread.
- Make notes in your evidence and interpretation notetaker.

Pairs or small group discussion

- Discuss how you know what counts as evidence about MRSA transmission and spread.
- Discuss how the evidence might link together – the cause and effect relationships.
- Add new evidence/interpretations to your MRSA evidence and interpretation notetaker.
- **Stellar idea:** Select one evidence and one interpretation that you or your partner can share with the class. What reading process did you use to identify it? Mark where it is in the texts with a star so you can find it and direct your peers to it.

Whole class discussion

- Share stellar ideas (one piece of evidence and one interpretation).
    - Explain where it is in the text set.
    - Explain how you and your partner(s) knew it was evidence about MRSA transmission or spread.
    - Explain the reading strategy you used to identify it.
- Listen and respond to your peers ideas. Use science talk stems.
- Add new evidence/interpretations to your MRSA evidence and interpretation notetaker.
- What additions or revisions can we make on the reading strategies list poster?

Transmission and Spread of MRSA
Identifying the Components and Their Roles

Individual think-write

Locate your MRSA evidence and interpretation notetaker and your MRSA infection model. Review the evidence and interpretations you noted. Review your MRSA infection model. Use all of these to answer the prompts below:

- How do transmission and spread relate to MRSA infection?
- What parts of the MRSA infection model need to be a model for MRSA transmission and spread?
- What other components need to be in a model for MRSA transmission and spread? How do you know?
- What relationships between them need to be represented? How do you know?
- What kinds of visuals (pictures, figures, symbols, charts, diagrams, and SmartArt) might help?

Pair discussion

- Take turns sharing your ideas for one minute each.
- Add notes about your partner's ideas onto your own response.
- **Stellar idea:** Select one idea that you or your partner can share with the class. Mark it with a star.

Whole class discussion

- Share stellar ideas.
- Listen to your peers' ideas. Add peers' ideas onto your own response.
- Use science talk stems. Ask a question or respond to the ideas that your peers share.

Transmission and Spread of MRSA
MRSA Transmission and Spread Model

We have done the work of identifying the infection's components and their roles. Now we're ready to tie this information together to form a scientific model that answers the questions:

How widely has MRSA spread?
How is MRSA transmitted and spread?

Small group discussion

- Locate your MRSA evidence and interpretation notetaker, scientific model criteria list, and scientific model construction strategy list.
- Discuss with your group:
    - What does your model need to explain?
    - What scientific model construction strategy may help?
    - What criterion do you need to pay extra attention to?
- Review your MRSA evidence and interpretation notetaker and visuals for transmission and spread.
- Work with your group to create a scientific model that explains how MRSA transmission and spread occur.
    - Use words and visuals to make your model as clear as possible.
    - Try to account for as much of the evidence from the texts as you can.
    - Try to make your model consistent with other ideas we have about how MRSA works. Show how MRSA infection fits into this new MRSA model.
- The next two blank pages are available for drafting your science model.

MRSA Transmission and Spread Model

MRSA Transmission and Spread Model

Transmission and Spread of MRSA
Peer Review and Consensus Building

Use the peer review and consensus building protocol on pages 20-21 and the notetaker below.

Our Model

1. My notes for the presentation	4. My notes from peers' feedback

Peers' Model

2. My notes about peers' model	3. My response to peers' presentation

Transmission and Spread of MRSA
Reflection and Revision

Small group discussion

Discuss how you will respond to the feedback you received.

- What did you see or hear from other groups' models that you liked?
- How will you modify your model, based on the classroom discussion?

Use different colored sticky notes provided by your teacher to label parts of your models that you:

- Are very confident about and want to keep.
- Would like to add to your model.
- Still have questions about.

Revise: Make the revisions (upgrades!) to your model.

Individual think-write

Respond to three of the following five prompts.

- What is one part of your MRSA infection model that you are proud of? Why?
- What are you learning about cause, effect, mechanism, and explanation in science?
- What are you learning about science models and/or constructing science models?
- What are you learning about bacteria, antibiotics, and infection?
- What are you learning about MRSA, antibiotic resistance, and evolution?

Whole class discussion

- Share a response to either prompt.
- What additions or revisions can we make on the scientific models criteria list poster and the scientific model construction strategy list poster?
- What additions or revisions can we make on the evidence interpretation posters for MRSA, antibiotic resistance, and evolution?

PROJECT READi

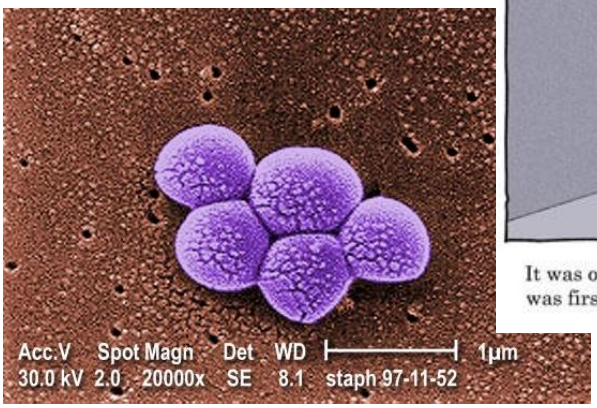
Name _____ Date _____

Teacher _____

MRSA

Investigation, Part II

It was on a short-cut through the hospital kitchens that Albert was first approached by a member of the Antibiotic Resistance.



The intended use of these materials is in tandem with ongoing professional development focused on supporting reading as scientific practice. This work is funded by the Reading for Understanding Initiative of the Institute for Education Sciences, U.S. Department of Education, through Grant R305F100007 to University of Illinois at Chicago. The opinions expressed are those of the authors and do not represent views of the Institute or the U.S. Department of Education.

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Evolution of SA to MRSA

Our first ideas about the origin of MRSA

Individual think-write

Respond to the following prompts.

- What do you know, think, possibly remember, guess or wonder about what caused Staphylococcus aureus (SA) become methicillin-resistant Staphylococcus aureus (MRSA)?
- Why might it be important to know how SA became MRSA?

Pair discussion

- Take turns sharing your ideas for one minute each.
- Add notes about your partner's ideas onto your own response.
- **Stellar idea**: Select one idea that you or your partner can share with the class. Mark it with a star.

Whole class discussion

- Share stellar ideas.
- Listen closely. Add great ideas from your peers to your own response.
- Use science talk stems. Respond to your peers' stellar ideas.

Evolution of SA to MRSA
Change over Time

Science reading is inquiry. When we read science text, we form and revise models that explain the phenomena we are reading about. When we read about a new science topic, it may feel like a muddle. There are many new ideas. We have many questions. The ideas are not organized in our minds. Then we dig in. We muster our prior knowledge. We try to make connections and answer our questions. We read more, think more, write more and talk more to create a model out of the muddle. The focus of this reading inquiry is to uncover more reading processes that helps us move from the muddle to the model and to figure out how these processes work for us.

Individual think-write: preview

- Locate: your science reading stems.
- Locate the next five texts (MRSA Reader pages R11-18).
    - "MRSA History"
    - "Superbug, Super-fast Evolution"
    - "Resistance to the antibiotic Vancomycin"
    - "Battling Bacterial Evolution: The Work of Carl Bergstrom"
    - "Modification by Natural Selection"
- Take four minutes to look over the five texts.
    - What might be challenging or interesting about reading these texts?
    - How are they alike and how are they different?
    - What kinds of texts are they? How do you know?
    - What predictions can you make about the kind of science information each may contain and how it might inform our investigation of MRSA?
    - What might you need to do to get as much as possible from reading these texts?

Pair discussion

- Take turns sharing your ideas for one minute each.
- Add notes about your partner's ideas onto your own response.

Whole class discussion

- Share your response or your partner's response.
- Add peers' ideas onto your own response.

Change over Time

Teacher model

- Locate "MRSA History" in your Reader.
- Listen and make notes about the teacher's reading process.

Whole class discussion

- What did you notice about how your teacher read the science text?
- What are some science reading processes that you noticed?
- What additions or revisions can we make on the reading strategies list poster?

Change over Time

Reading and making thinking visible

- **Think aloud:** Partners take turns thinking aloud with the text, "MRSA History." One partner thinks aloud and the other partner makes notes in the margin about their partner's thoughts.

OR

- **Talk to the text:** Individually talk to the text on "MRSA History." Pairs take turns sharing their talk to the text comments.
- Use the science reading stems to help you share your reading process and work together to make sense of the text.

Pair discussion

After reading discuss and respond to the prompts.

- **Reading process:** What science reading processes were important for your reading?
- **Inquiry:** What are you noticing or wondering now about MRSA, antibiotic resistance or evolution? What is interesting? What is important?
- **Stellar ideas**
    - Select a science reading process to share with the class. Mark it with a star.
    - Also, select one new idea or question about MRSA, antibiotic resistance, or evolution to share with the class. Mark them on your text with a star.

Whole class discussion

Share stellar ideas about reading process.

- What did you notice about your reading process with this text? What reading challenges did you or your partner encounter and how did you respond to the reading challenge? For texts with visuals: How did you read the visual(s)? What modeling did you do as you read?
- What additions or revisions can we make on the reading strategies list poster?

Share stellar ideas about MRSA, antibiotic resistance, and evolution.

- What questions, connections, or ah-ha's do you have from your reading?
- What ideas and questions can we add to the evidence interpretation posters for MRSA, antibiotic resistance, and evolution?
- Add new words to our word wall.

Repeat above steps with the next four texts: "Superbug, Super-fast Evolution" (R13-14), "Resistance to the antibiotic Vancomycin" (R15), "Battling Bacterial Evolution: The Work of Carl Bergstrom" (R16-17), and "Modification by Natural Selection" (R18).

Evolution of SA to MRSA

Identifying and Connecting Evidence for How SA became MRSA

Whole class

- Locate your MRSA evidence and interpretation notetaker. You may need additional pages now.
- Form groups of four and count of by ones and twos in each group.

Individual think-write

- **Ones**: Review or re-read each odd numbered text and the notetaker to identify evidence for how SA became MRSA.
- **Twos**: Review or re-read each even numbered text and the notetaker to identify evidence for how SA became MRSA.
- Underline or highlight the evidence you find. Mark each **E** for evolution.
- Make notes in your evidence and interpretation notetaker.

Small group discussion

- Share the evidence you found for how SA became MRSA.
- Discuss why each counts as evidence for how SA became MRSA.
- Discuss how the evidence might link together. What are the cause and effect relationships?
- Add new evidence and interpretations to your MRSA evidence and interpretation notetaker.
- **Stellar idea:** Select one evidence and one interpretation that you or your partner can share with the class. What reading process did you use to find and identify it? Mark where it is in the texts with a star so you can find it and direct your peers to it.

Whole class discussion

- Share stellar ideas (one piece of evidence and one interpretation).
    - Explain where it is in the text set.
    - Explain how you and your partner(s) knew it was evidence about how SA became MRSA.
    - Explain the reading strategy you used to find and identify it.
- Listen and respond to your peers ideas. Use science talk stems.
- Add new evidence/interpretations to your MRSA evidence and interpretation notetaker.
- What additions or revisions can we make on the reading strategies list poster?

Evolution of SA to MRSA
Scientific Model of How SA Became MRSA

Small group discussion

Locate and review: MRSA evidence and interpretation notetaker, models for MRSA infection, transmission and spread, the scientific model criteria list, and the scientific model construction strategy list.

- Discuss with your group:
  - What does your model need to explain?
  - How can the model for how SA became MRSA build off of the models for MRSA infection, transmission, and spread?
  - What scientific model construction strategy may help?
  - What criterion do you need to pay extra attention to?
  - What components and relationships belong in the model? What words and visuals could depict them?
- Work with your group to create a scientific model that explains how SA became MRSA.
  - Use words and visuals to make your model as clear as possible.
  - Try to account for as much of the evidence from the texts as you can.
  - Try to make your model consistent with other ideas we have about how MRSA works. Show how MRSA infection, transmission and spread fit into this new MRSA model.
- The next two blank pages are available for drafting your science model.

Scientific Model of How SA Became MRSA

Scientific Model of How SA Became MRSA

Evolution of SA to MRSA
Peer Review and Consensus Building

Use the peer review and consensus building protocol on pages 20-21 and the notetaker below.

Our Model

1. My notes for the presentation	4. My notes from peers' feedback

Peers' Model

2. My notes about peers' model	3. My response to peers' presentation

Evolution of SA to MRSA
Reflection and Revision

Small group discussion

Discuss how you will respond to the feedback you received.

- What did you see or hear from other groups' models that you liked?
- How will you modify your model, based on the classroom discussion?

Use different colored sticky notes provided by your teacher to label parts of your models that you:

- Are very confident about and want to keep.
- Would like to add to your model.
- Still have questions about.

Revise: Make the revisions (upgrades!) to your model.

Individual think-write

Respond to three of the following five prompts.

- What is one part of your MRSA infection model that you are proud of? Why?
- What are you learning about cause, effect, mechanism, and explanation in science?
- What are you learning about science models and/or constructing science models?
- What are you learning about bacteria, antibiotics and infection?
- What are you learning about MRSA, antibiotic resistance, and evolution?

Whole class discussion

- Share a response to either prompt.
- What additions or revisions can we make on the scientific models criteria list poster and the scientific model construction strategy list poster?
- What additions or revisions can we make on the evidence interpretation posters for MRSA, antibiotic resistance, and evolution?

Managing the Public Health Challenge of MRSA
Scientific Models and Solutions

Natural phenomena offer both opportunities and challenges. Scientists draw on scientific models to design solutions to these challenges.

Individual think-write

Respond to either of the following two prompts.

- Describe a real-world challenge presented by natural phenomena. What are some solutions scientists have designed (or are trying to design) to address these challenges? What scientific models or explanations might scientist have drawn on to design these solutions?
- What are some real-world challenges presented by MRSA infection, transmission, spread and evolution? What is (might be) the impact of MRSA on you and your community? How significant are the challenges MRSA presents? Why?

Pair discussion

- Take turns sharing your ideas for one minute each.
- Add notes about your partner's ideas onto your own response.

Whole class discussion

- Share your response or your partner's response.
- Listen and respond to your peers' ideas. Use science talk stems.
- Add peers' ideas onto your own response.

Managing the Public Health Challenge of MRSA

Solutions for MRSA Infection, Transmission, Spread, and Evolution

Individual think-write: preview

- Locate your science reading stems
- Locate the next two texts (MRSA Reader pages R19-22)
    - "Wash your hands"
    - "The success of evolutionary engineering"
- Take three minutes to look over the texts, considering these questions:
    - What might be challenging or interesting about reading these texts?
    - What kinds of texts are they? How do you know?
    - What do you predict about the reliability of the information in these texts? How do you know?
    - What predictions can you make about the kind of science information each may contain and how it might inform our investigation of MRSA?

Pair discussion

- Take turns sharing your ideas for one minute each.
- Add notes about your partner's ideas onto your own response.

Whole class discussion

- Share your response or your partner's response.
- Listen and respond to your peers' ideas. Use science talk stems.
- Add peers' ideas onto your own response.

Teacher model

- Locate: "Wash your hands."
- Listen and make notes about the teacher's reading process.

Whole class discussion

- What did you notice about how your teacher read the science text?
- What are some science reading processes that you noticed?
- What additions or revisions can we make on the reading strategies list poster?

Solutions for MRSA Infection, Transmission, Spread, and Evolution

Reading and making thinking visible

- **Think aloud:** Partners take turns thinking aloud with the text, "Wash your hands." One partner thinks aloud and the other partner makes notes in the margin about their partner's thoughts.

OR

- **Talk to the text:** Individually talk to the text on "Wash your hands." Pairs take turns sharing their talk to the text comments.
- Use the science reading stems to help you share your reading process. Work together to make sense of the text and predict potential solutions for MRSA infection, transmission, spread, and evolution.

Pair discussion

After reading, discuss and respond to the prompts.

- **Reading process:** What science reading processes were important for your reading?
- **Inquiry:** What are you noticing or wondering now about MRSA, antibiotic resistance, or evolution? What is interesting? What is important?
- **Stellar ideas**
    - Select a science reading process to share with the class. Mark it with a star.
    - Also, select one potential solution for MRSA infection, transmission, spread, and evolution. Mark them on your text with a star.

Whole class discussion

Share stellar ideas about reading process

- What did you notice about your reading process with this text? What reading challenges did you or your partner encounter and how did you respond to the reading challenge? What modeling did you do as you read?
- What additions or revisions can we make on the reading strategies list poster?

Share stellar ideas about MRSA, antibiotic resistance, and evolution.

- What questions, connections, or ah-ha's do you have from your reading?
- What ideas and questions can we add to the evidence interpretation posters for MRSA, antibiotic resistance, and evolution?
- Add new words to our word wall.

Repeat above steps with "The success of evolutionary engineering."

Managing the Public Health Challenge of MRSA
Think Scientifically, Act Locally

You have read about MRSA. You have talked about MRSA. You have made models of MRSA infection, transmission, spread, and evolution. You've identified the challenges MRSA presents. Now it is time to apply that knowledge to predict a course of action to limit the impact of MRSA.

Teacher model and individual think-write

- Locate: MRSA evidence and interpretation posters, MRSA evidence and interpretation notetakers, and MRSA models for infection, transmission and spread, and evolution.
- Review your MRSA posters, notetakers, and models to identify **problems** in your community related to:
    - MRSA infection
    - MRSA transmission and spread
    - MRSA evolution (the evolution of antibiotic resistance in MRSA)
- What is the problem and how is it related to MRSA?

Small group discussion

- Take turns sharing your ideas for one minute each.
- Add notes about your partner's ideas onto your own response.

Whole class discussion

- Share your response or your partner's response.
- Add peers' ideas onto your own response.

Think Scientifically, Act Locally

Teacher model and individual think-write

- Locate: MRSA evidence and interpretation posters, MRSA evidence and interpretation notetakers, and MRSA models for infection, transmission and spread, and evolution.
- Select two of the problems in your community related to MRSA.
- Review your MRSA posters, notetakers and models to identify possible points in the models for intervention or possible solutions.
- What course of action could limit (possibly limit) the impact of:
    - MRSA infection
    - MRSA transmission and spread
    - MRSA evolution (the evolution of antibiotic resistance in MRSA)
- Who (in your community) would have to act to make a difference?

Small group discussion

- Take turns sharing your ideas for one minute each.
- Add notes about your partner's ideas onto your own response.
- Prepare to share about one problem and course of action.

Whole class discussion

- Share your response or your partner's response.
- Add peers' ideas onto your own response.

Think Scientifically, Act Locally

Small group discussion

- Select one problem in your community related to MRSA and at least one course of action or solution for the problem for your group.

Teacher model and small group work

- Write a compelling scientific **recommendation** for the course of action your team determined.
    - Decide who will be the audience for the recommendation.
    - Describe the course of action.
    - Explain how and why the course of action could limit the impact of **MRSA infections, transmission and spread**, AND **evolution**. Ground your explanation in your scientific models for MRSA infections, transmission and spread, and evolution.
    - Make sure that the recommendation gets to the root of the problem.
    - Reflect on your own learning (think about what was hard for you to understand, or what was most important to your understanding) to help you decide what information the audience needs to know to understand the recommendation.
    - Address any misconceptions that might interfere with the audience's understanding.

Our Scientific Recommendation (Drafts)

Think Scientifically Act Locally

Managing the Public Health Challenge of MRSA
MRSA Recommendation Science Seminar

Small group analysis of own recommendation

Prepare for the science seminar by analyzing your process and progress with your group's recommendation. Use **science talk stems** in your discussion. Make notes in science seminar notetaker.

- **Purpose:** What problem does your course of action address? Why did you include what you did in your recommendation?
- **Significance**: What would be the potential impact if your recommendation is carried out? How does it get at the root of the problem?
- **Reliability and justification:**
  - What aspects of the phenomena or evidence does your course of action take into account?
  - What have not been accounted for yet, or what are you unsure about in your course of action?
- **Future research:** What questions do you have about the phenomena or explanatory model that relate to your recommended course of action?

Presenting and reviewing

Presenters: Provide your recommendation to your peers and give them some time to read it over before you present. Some points to address in your presentations are:

- **Purpose**: Our course of action is designed to deal with _____.
- **Significance**: We think that it will _____ because _____.
- **Reliability and justification**: We are very confident about _____ parts of our course of action because _____. We are still unsure about _____ parts of our course of action because _____.
- **Future research:** We still have questions about _____.

Reviewers: Listen, read and make notes on the science seminar notetaker about:

- What is clear and what is unclear.
- What is misrepresented, mistaken or missing (such as evidence that is unaccounted for).
- What does not belong in the course of action.
- The questions you wonder about.
- Ideas for refinement.

Developing a response

Listeners take a few minutes to discuss their peers' recommendations and develop a response.

- What problem is the course of action intended to solve?
- Is the course of action intended likely to solve it? Why or why not?
- Does the course of action get to the root of the problem?
- What is well explained and accounted for in the recommendation? Why?
- What is clear in the recommendation? Why?
- What is unclear or misrepresented in the recommendation? Why?
- What is missing from the recommendation? Why?
- What does not belong in the recommendation? Why?

Prepare 2-4 substantive responses to your peers' recommendations. Write these in the science seminar notetaker. Use **science talk stems** in your feedback.

Sharing feedback

Groups take turn sharing and discussing their response to their peers' recommendations. Each group makes notes of the feedback they receive on the science seminar notetaker.

Managing the Public Health Challenge of MRSA
Science Seminar Notetaker

My Group's MRSA Recommendation

My notes for the presentation	My notes from peers' feedback

Peers' MRSA Recommendations

My notes about peers' recommendation	My response to peers' presentation

My notes about peers' recommendation	My response to peers' presentation

Science Seminar Notetaker

Peers' MRSA Recommendations

My notes about peers' recommendation	My response to peers' presentation

My notes about peers' recommendation	My response to peers' presentation

My notes about peers' recommendation	My response to peers' presentation

You may need to make additional pages.

Managing the Public Health Challenge of MRSA
Building Consensus

Individual

- Which courses of action might be the most effective at addressing the MRSA epidemic? Which gets at the root of the problem? Why do you think so?

Whole class discussion

- Which courses of action might be the most effective at addressing the MRSA epidemic? Which gets at the root of the problem? Why do you think so?

Managing the Public Health Challenge of MRSA
MRSA Inquiry Reflection

Individual

Respond to each of the following prompts.

- What have you learned that you may find useful in the future?

- What do you want to learn more about?

Small group discussion

- Take turns sharing your ideas for one minute each.

Whole class discussion

- Share your response.

Source	Evidence	Interpretation

Source	Evidence	Interpretation

Source	Evidence	Interpretation

Source	Evidence	Interpretation

Source	Evidence	Interpretation

Source	Evidence	Interpretation

Source	Evidence	Interpretation

Source	Evidence	Interpretation

