## UNIT TITLE:

<table>
<thead>
<tr>
<th>Teachers</th>
<th>Grade Levels</th>
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UNIT OVERVIEW

Description

*What is the nature of the problem students will tackle in this unit?*

Meaningfulness for Students

*Why do you think students will find the problem in this unit meaningful?*
UNIT OVERVIEW (cont’d)

<table>
<thead>
<tr>
<th>Relevant Missouri Show-Me Knowledge Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Although several of the Missouri Show-Me Knowledge Standards could relate to the content in this unit, which knowledge standards will you integrate into the activities and projects of this unit?</td>
</tr>
</tbody>
</table>

**COMMUNICATION ARTS**

<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>4</td>
<td>writing formally (such as reports, narratives, essays) and informally (such as outlines, notes)</td>
</tr>
<tr>
<td>6</td>
<td>participating in formal and informal presentations and discussions of issues and ideas</td>
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**MATHEMATICS**

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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>3</td>
<td>data analysis, probability and statistics</td>
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</table>

**SCIENCE**

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<table>
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<tr>
<th></th>
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<tbody>
<tr>
<td>7</td>
<td>processes of scientific inquiry (such as formulating and testing hypotheses)</td>
</tr>
<tr>
<td>8</td>
<td>impact of science, technology and human activity on resources and the environment</td>
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</tbody>
</table>

**SOCIAL STUDIES**

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<table>
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<tbody>
<tr>
<td>6</td>
<td>relationships of the individual and groups to institutions and cultural traditions</td>
</tr>
<tr>
<td>7</td>
<td>processes of scientific inquiry (such as formulating and testing hypotheses)</td>
</tr>
</tbody>
</table>

**OTHERS**


UNIT OVERVIEW (cont’d)

Goals and Objectives

Based on the Missouri Show-Me Performance Standards, what are the goals of the unit and what objectives will help students meet those goals throughout the three phases of the unit?

1. Working as a researcher exploring engineering systems, the student will gather, organize, analyze, and apply information ideas.

OBJECTIVES

- conduct research to answer questions and evaluate information and ideas
- use technological tools and other resources to locate, select, and organize information
- organize data, information and ideas into useful forms (including charts, graphs, outlines) for analysis or presentation

2. While analyzing potential problems and solutions, the student will communicate effectively within and beyond the classroom.

OBJECTIVES

- plan and make written, oral and visual presentations for a variety of purposes and audiences
- exchange information, questions and ideas while recognizing the perspectives of others
- use technological tools to exchange information and ideas

3. Using the tools of inquiry to develop a highway improvement plan, the student will recognize and solve problems.

OBJECTIVES

- identify problems and define their scope and elements
- examine problems and propose solutions from multiple perspectives
- assess costs, benefits and other consequences of proposed solutions
Goals and Objectives (cont’d)

While considering the interdependence of community and state needs, the student will use critical thinking to defend decisions.

OBJECTIVES

- explain reasoning and identify information used to support decisions
- reason inductively from facts and deductively from general premises

As an engineer working with other engineers, the student will be a responsible group member and demonstrate positive leadership skills.

OBJECTIVES

- develop, monitor, and revise plans of action to meet deadlines and accomplish goals
- work with others to complete tasks that require a coordinated effort

Expert Contacts

What experts in fields related to this unit will contribute to the design, development, and implementation of this unit with students?

1
2
3
4
5
UNIT OVERVIEW (cont’d)

<table>
<thead>
<tr>
<th>Pre-Assessment</th>
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</thead>
<tbody>
<tr>
<td><em>What knowledge and skills do you think are important for students to have in order to complete the projects in this unit successfully?</em></td>
</tr>
</tbody>
</table>

*How will you identify students’ prior knowledge and misconceptions about the problem?*
### Critical Question

*What is the critical question that students will respond to throughout Phase 1 of the unit?*

### Objectives

*Considering the goals of this unit, what are the objectives for students during this phase of the unit? You might consider the performance and knowledge skills required for students to complete the project in Phase 1 with little or no teacher support.*

1. use technological tools and other resources to locate, select, and organize information
2. make oral and visual presentations for a variety of purposes and audiences
3. identify problems and define their scope and elements
4. explain reasoning and identify information used to support decisions
5. work with others to complete tasks that require a coordinated effort

### Problem-Solving Model

*What part of the model for design problem solving best illustrates the problem solving that will occur in the work groups during Phase 1? You can use the PBL Design Graphic to answer these questions.*

In Phase 1, students are not only gathering information to determine the relationship between the problem space and their community but also think about how to better meet the needs of people in their community.

*How does the problem solving process in this phase of the unit relate to the way experts in related fields solve problems?*

The students, like real-world engineers, are characterizing the study area, defining issues related to interstate improvement in the study area, and determining the purpose and need for the improvement study.

### Phase 1 Project Criteria

*What project will students work collaboratively to complete during Phase 1 that relates to the critical question of this phase of the unit?*

After gathering relevant, accurate, and clear facts and statistics about the problem in their community, the group will determine why the problem is important to their community. Their knowledge and ideas for the future of the problem will be shared in their project for this phase.
What criteria will you expect students to complete when they work on the project collaboratively? Consider the objectives you identified for students’ learning during Phase 1.

1. locate relevant, accurate, and clear facts from different sources that help your group explain why this problem is important to your community
2. talk in your group about whether or not your group thinks the problem as it is today, can meet the needs of people in your community
3. talk in your group about what your group thinks should happen to better meet the needs of people in your community
4. develop a plan for how to convince others why the problem needs improvement in order to better meet the needs of people in your community
5. present the plan to other workgroups in your classroom and improve your presentation before sharing it with students from other communities

Formative and Summative Assessment

How will you assess students’ learning in regards to the objectives at the end of Phase 1?

see Phase 3 Group Scoring Guide for assessment of group products based on Bereiter’s Scheme of Knowledge (levels 1-3)

Facilitating Activities

What activities do you think are important in Phase 1 to help your students meet the objectives of this phase of the unit and to successfully complete the project?

1
2
3

Initial Inquiry Questions

What kind of questions do you anticipate students posing at the beginning of Phase 1 that will guide them in answering the critical question in this phase of the unit?


Important Implementation Dates

What aspects of the activities in Phase 1 need to be scheduled or arranged ahead of time?

1
Resources and Tools

What resources and/or tools within your classroom, in your building, or in your community are necessary to help students during Phase 1?
PHASE 2

Critical Question

What is the critical question that students will respond to throughout Phase 2 of the unit?

How can we use our expertise in an area related to the problem to better understand the problem and develop a feasible solution?

Objectives

Considering the goals of this unit, what are the objectives for students during this phase of the unit? You might consider the performance and knowledge skills required for students to complete the project in Phase 2 with little or no teacher support.

1. conduct research to answer questions and evaluate information and ideas
2. exchange information, questions and ideas while recognizing the perspectives of others
3. examine problems and proposed solutions from multiple perspectives
4. reason inductively from facts and deductively from general premises
5. develop, monitor, and revise plans of action to meet deadlines and accomplish goals

Problem-Solving Model

What part of the model for design problem solving best illustrates the problem solving that will occur in the work groups during Phase 2?

Box 2, “negotiate the design inquiry boundaries”
Box 3, “articulate a shared vision of the future system”

In Phase 2, students will acquire expertise in an area related to the problem space, including problem solving strategies and conceptual knowledge. This will help them know where change could be effected in the system and help the revise their original vision for the problem.

How does the problem solving process in this phase of the unit relate to the way experts in related fields solve problems?

In general, engineers draw upon their prior experiences and knowledge and relate these to the unique characteristics of a current design problem. At this phase engineers would be assessing a range of strategies developed from engineering and related expertise areas based on purpose or need.
Phase 2 Project Criteria

What project will students work collaboratively to complete during Phase 2 that relates to the critical question of this phase of the unit?

After gathering and analyzing relevant, accurate, and clear facts and statistics about an area related to the problem space, the group will determine how the area of expertise applies to development of a feasible solution to the problem space problem that impacts multiple communities.

What criteria will you expect students to complete when they work on the project collaboratively? Consider the objectives you identified for students’ learning during Phase 2.

1. locate relevant, accurate, and clear facts from different sources that help you understand your expert area related to the problem space

2. talk in your expert area group about how your expert area affects the way we will solve the problem and how it affects the feasibility of the problem solution path.

3. develop a plan for how to accurately communicate the following to students in your group: (1) the main ideas about the expert area and (2) how you think your expert area will help us solve the problem space problem better

4. develop your plan for communicating to students in your group

5. talk in your group about how the areas of expertise are related and how the expert areas will help you solve the problem space problem better

Formative and Summative Assessment

How will you assess students’ learning in regards to the objectives at the end of Phase 2?

see Phase 2 Group Scoring Guide for assessment of group products based on Bereiter’s Scheme of Knowledge (levels 3-5)

Facilitating Activities

What activities do you think are important in Phase 2 to help your students meet the objectives of this phase of the unit and to successfully complete the project?
case study analyses of similar projects for students to apply developing expertise and see interdependencies of expert areas

Areas of Expertise

What areas of expertise are important to the problem that students will investigate in groups?

1. design 6. human environment (e.g., air, noise, recreation areas, visual aesthetics)
2. socioeconomics 7. financing
3. /engineering (e.g., safety) 8. construction
4. public affairs (e.g., informed consent) 9.
5. natural environment (e.g., wetlands, habitat, species) 10.

Important Implementation Dates

What aspects of the activities in Phase 2 need to be scheduled or arranged ahead of time?

1
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4
Resources and Tools

What resources and/or tools within your classroom, in your building, or in your community are necessary to help students during Phase 2?
### Critical Question

*What is the critical question that students will respond to throughout Phase 3 of the unit?*

How can we use the knowledge and skills from Phase 1 and Phase 2 to develop a feasible solution to the problem?

### Objectives

*Considering the goals of this unit, what are the objectives for students during this phase of the unit? You might consider the performance and knowledge skills required for students to complete the project in Phase 3 with little or no teacher support.*

1. Organize data, information and ideas into useful forms (including charts, graphs, outlines) for analysis or presentation
2. Use technological tools to exchange information and ideas
3. Assess costs, benefits and other consequences of proposed solutions
4. Explain reasoning and identify information used to support decisions
5. Work with others to complete tasks that require a coordinated effort

### Problem-Solving Model

*What part of the model for design problem solving best illustrates the problem solving that will occur in the work groups during Phase 3?*

Box 4, “outlining the specifications of the future system”
Box 5, “develop and test model of the future system”

In Phase 3, students will work in their group to propose a solution to the problem that incorporates a plan of action for their community and multiple communities. They will apply the expert areas and assess their solution to determine feasibility.

*How does the problem solving process in this phase of the unit relate to the way experts in related fields solve problems?*
The students determine a preferred solution to the problem and draft a document that lists their solution path. The solution path document should include a feasibility statement, why it will work, and an implementation plan, how it will work and an evaluative process, how we will know it worked. Then, the students will seek public feedback from experts on the feasibility of their solution path.

Phase 3 Project Criteria

What project will students work collaboratively to complete during Phase 3 that relates to the critical question of this phase of the unit?

After gathering relevant, accurate, and clear facts and statistics about the problem space in their community, the group will determine why problem is important to their community.

Their knowledge and ideas for the future of the problem will be shared with other groups outside their classroom. It is a critical aspect of this unit that students present to an authentic community-based audience at the end of the unit. A consequential task of this nature defines the meaningful and authentic nature of a PBL unit.

What criteria will you expect students to complete when they work on the project collaboratively? Consider the objectives you identified for students’ learning during Phase 3.

1. write a description of the problem, including facts and statistics, of the current condition as well as a prediction for its future

2. develop a hypothesis, or a statement describing how your group thinks an engineer or related expert should develop to better meet the needs of the people in the community

3. outline a procedure, or a logically-defined plan of action, about how your group’s idea would be implemented

4. talk in your group about how to “test the feasibility” of your solution and plan; determine whether your solution could feasibly be implemented.

5. using the results of your feasibility test, predict the success of your solution and plan and identify short-term and long-term problems that might occur because of your solution and plan of action

Formative and Summative Assessment

How will you assess students’ learning in regards to the objectives at the end of Phase 3?
see Phase 3 Group Scoring Guide for assessment of group products based on Bereiter’s Scheme of Knowledge (levels 4-6)

### Facilitating Activities

*What activities do you think are important in Phase 3 to help your students meet the objectives of this phase of the unit and to successfully complete the project?*

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5. 

### Solution Generation

*How will you motivate students to develop solutions to the problem that incorporates state and local community needs from Phase 1 and the different areas of expertise from Phase 2?*

### Important Implementation Dates

*What aspects of the activities in Phase 3 need to be scheduled or arranged ahead of time?*

1. 
2. 
3. 

### Resources and Tools

*What resources and/or tools within your classroom, in your building, or in your community are necessary to help students during Phase 3?*

1. 
2. 
3. 
4.
<table>
<thead>
<tr>
<th>LEARNING</th>
<th>ACCOMPLISHING</th>
<th>EXCELling</th>
<th>EXCEPTIONAL</th>
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<tbody>
<tr>
<td>Working with the teacher, the students found and used at least two resources.</td>
<td>With some teacher help, the students found and used at least two resources and identified if the information gathered was relevant.</td>
<td>The students found and used information from different types of resources, determined if the information was relevant, and judged the relevancy of information.</td>
<td>The students independently found and used information from different types of resources, identified if the information was relevant, and judged the relevancy of information.</td>
</tr>
<tr>
<td>The students and teacher worked together to identify and use facts and statistics to support their ideas.</td>
<td>With some teacher assistance, the students determined facts and statistics to support their ideas and identified if the information was relevant.</td>
<td>The students could combine information, make connections between information, and identify the relevance of the information.</td>
<td>The students independently combined information, made connections between facts and statistics, and identified the relevance of the information.</td>
</tr>
<tr>
<td>The students used minimal eye contact, needed few reminders about distracting body movements, yet needed some reminders to speak so all could understand the message.</td>
<td>The students attempted some eye contact, stood straight and relaxed, and used good volume and were easy to understand.</td>
<td>The students made eye contact with many audience members, used several appropriate gestures and facial expressions, and used expressions that added to the understanding of the message.</td>
<td>The student made eye contact with all audience members, used many appropriate gestures and facial expressions that added to the understanding of the message.</td>
</tr>
<tr>
<td>With teacher help, the students listened to one others’ ideas and shared in the responsibility for completing work.</td>
<td>With encouragement, the students listened to one others’ ideas, tried to compromise with each group.</td>
<td>The students listened to one others’ ideas, encouraged all group members to compromise, and motivated all group members to compromise, and worked as a team.</td>
<td>The student listened to others’ ideas, motivated all group members to compromise, and worked as a team.</td>
</tr>
<tr>
<td>Setting up the problem</td>
<td>As they described a vision for the future of the problem space, the students identified and explained constraints in the system including some that are related to the future of interstate.</td>
<td>As they described a specific vision for the future of the problem in their community, the students identified and explained constraints in the system that are prioritized.</td>
<td>As they described a specific vision for the future of the problem in their community, the students identified, explained, and prioritized constraints in the system.</td>
</tr>
</tbody>
</table>