Learning Design
While Meeting Local Community Needs

EPICS®
Real Designs for Real People

Design
Prepare
Grow
Explore
Succeed
Serve

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Director, EPICS Programs
Purdue University

www.EPICSk12.org
www.purdue.edu/epics
Motivation: Education & Society

- **Education**
  - Prepare future leaders in the global economy with quality experiences
  - Sustain projects in an affordable and sustainable manner
  - Connect societal needs with engineering

- **Society**
  - Opportunities for impact with REAL projects that can be used by real people
  - Long-term partnerships to address needs of the underserved
<table>
<thead>
<tr>
<th>Purdue University</th>
<th>University</th>
<th>EPICS K-12</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Headquarters</td>
<td>EPICS University Consortium</td>
<td>EPICS K12</td>
</tr>
<tr>
<td>• Academic Program</td>
<td>• 24 Universities</td>
<td>• 100+ High Schools</td>
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<tr>
<td>• Multidisciplinary, Engineering-Centered Design Course</td>
<td>• U.S., Canada</td>
<td>• 14 U.S. States</td>
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<tr>
<td>• Community-based</td>
<td>• Colombia, Ireland, Korea, India</td>
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<tr>
<td>• Local and Global</td>
<td>20 Years</td>
<td>IEEE-EPICS</td>
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<tr>
<td>20 Years</td>
<td>NAE Gordon Prize</td>
<td>• 50+ projects</td>
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<td>• Latin America</td>
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<td>Signature Program</td>
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## EPICS Programs

### EPICS Curriculum Provides

<table>
<thead>
<tr>
<th></th>
<th>Service-Learning</th>
<th>Design Education</th>
<th>Project Management</th>
<th>Community Partnerships</th>
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</thead>
</table>

- **Disciplinary Knowledge from Departments**
- **Projects and Problems from Local Community**
- **Institutional Curriculum and Culture**

**Adapted to Local Institutional Culture**
Activity 1

- Get in groups of about 4
- Introduce yourselves and wait for further instructions
Service Experiences

• Generate a list of service projects, volunteer opportunities and/or community service-learning experiences that students engage in.
  – In-school or extra-curricular
  – Do NOT have to involve engineering, list all sorts of service opportunities for students
We define (community) service learning as a type of experiential education in which students participate in service in the community and reflect on their involvement in such a way as to gain further understanding of course content and of the discipline and its relationship to social needs and an enhanced sense of civic responsibility.

- Hatcher and Bringle, 1997
Characteristics of Service-Learning or Community-Engaged Learning

- **Service** – students participate in service for the underserved in a community.
- **Academically-based** – reinforces or connects with the subject material of the academic course.
- **Reciprocity** – Mutual needs, mutual learning.
- **Reflection (Analysis, metacognition)** – Students reflect (analyze) on their experience and learning.
# Service vs Learning

<table>
<thead>
<tr>
<th></th>
<th>Learning goals are primary; service outcomes are secondary</th>
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<tbody>
<tr>
<td>service-LEARNING</td>
<td>Learning goals are primary; service outcomes are secondary</td>
</tr>
<tr>
<td>SERVICE-learning</td>
<td>Service outcomes are primary; learning goals are secondary</td>
</tr>
<tr>
<td>service learning</td>
<td>Service and learning goals are separate</td>
</tr>
<tr>
<td>SERVICE-LEARNING</td>
<td>Service and learning goals have equal weight; each enhances the other for all participants</td>
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</tbody>
</table>
New Context for Learning

A similar phenomenon occurs when students are able to marshal a body of knowledge to solve problems presented in class but fail even to see a problem, much less the relevance of what has been learned, in a different setting. The new situation does not provide the cues associated with what has been learned; the “key words” from the classroom are not present in the wider environment. A service-learning student will have more ways to access this understanding. – Eyler and Giles

Learners of all ages are more motivated when they can see the usefulness of what they are learning and when they can use that information to do something that has an impact on others – especially in their local community – Bransford et al., How People Learn
Activity

• Which of the service experiences on your list included Engineering in some way?
  – Categorize them by

<table>
<thead>
<tr>
<th>Related to STEM</th>
<th>Not related to STEM</th>
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</table>
Examples

STEM-based Service-Learning high schools
Design-Based, Service-Learning

Learning by Doing

Teachers as Facilitators

Real Design
Real People
Real Impact

EPICS®
Human-Centered Design

- Interactions with Stakeholders
- Prototypes/communications at all stages
Stand-alone Engineering Class

Flexible Program Model

Embedded in a Core Class

After School Program
EPICS Program Examples

Education:
- K-12 Schools
- Museums
- Adult learning programs
- After school programs

Access and Abilities:
- Adaptive services
- Assistive technology
- Adaptive Services
- Programs for Adults with Disabilities

Human Services:
- Homeless prevention
- Habitat for Humanity
- Family and Children agencies
- Neighborhood revitalization
- Local Government

Environment:
- Environmental Organizations
- Neighborhood associations,
- Parks and recreation
Xavier College Prep, Arizona

- All Girls, Catholic School
- Multiple Engineering Courses

School As Partner Projects:

- Building a **Telescope Stand** for Science Teacher in the School that is accessible to all students
- **Re-design of the lunch line** system for efficiency of purchases
- **Phoenix Renews Project**- helping design and build community spaces in the Phoenix Area
Rio Salado Habitat

Xavier College Prep

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Redesign of the traffic pattern for the school lunch room
Sammamish HS, Bellevue WA

Partner: Assistive Technology Specialist

Create an accessibility devise for pre-school special needs students
Partner: MidAmerica Service Dog Clients

- Create accessibility equipment to interact with service dogs.
Nazareth Academy
Creating Educational Games
Nazareth Academy, LaGrange IL
Computerized Food Pantry Project

Students worked with all food pantries in rural Huron County to design a computerized systems for tracking food items, customer information and coordinate operations.
High Tech High, San Diego, CA
High Tech High, CA
Working with the Cerebral Palsy Association
School Energy Analysis
• Educated school on energy conservation
• Created signs and video

Green Roof Project
• Elective course to learn about impact
• Designed and built portable green roof carts for school presentations
Pacific Ridge, California
Chantilly HS, VA
Salpointe HS, AZ

Salpointe HS Tucson AZ

Ben’s Bells Project (BBPP)
January 30th, 2014
Salpointe Catholic High School

EPICS®
Salpointe HS Tucson AZ
Agawam High School, MA
Leo Club
Specialized dog bowls for non-profit organization
Make Lions Club Eye Mobile handicap accessible
Design of school IDs
Nanotechnology Through Marine Aquaculture
Madeira School, VA
Rancho Solano HS, AZ

Worm Farm
McCUTCHEON HIGH SCHOOL, IN

McCUTCHEON HIGH SCHOOL, LAFAYETTE, INDIANA

EPICS®
Students at Foxcroft created a working model of this 200 year old water powered mill from Aldie Virginia to help meet 4th grade social studies standards.
Foxcroft School, VA
Educational Resources for Elementary School Children
Foxcroft School, VA
Activity

• What is a STEM-based service-learning project that could be done in your own school or program?
  – Who would the community partner be?
  – What would the students do?
  – What would they learn about STEM?
High School
EPICS®
Demographics

<table>
<thead>
<tr>
<th></th>
<th>National Female</th>
<th>EPICS Female</th>
<th>Minority</th>
<th>EPICS Minority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Females</td>
<td>19</td>
<td>50·6</td>
<td>15</td>
<td>52</td>
</tr>
<tr>
<td>Minority Populations</td>
<td>Nat’l Ave</td>
<td>Nat’l Ave</td>
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</table>
EPICS K12:  
Motivation to Pursue a STEM Major

- Extremely Favorable: 15%
- Really Favorable: 19%
- Favorable: 37%
- Extremely Unfavorable: 8%
- Unfavorable: 21%

~30% started with no interest in engineering or computing  
~1/2 change to strong interest
EPICS 1st Year Learning Community

- **Female:** 54% Female
- **Male:** 46% Male
- **120 Students**

**Why Students Chose the EPICS LC**

- Experience & Community
- Experience
- Learning Community
- Community & Service
- Particular Learning Community

- **Female**
- **Male**
Elizabeth Ketcik
Engineering Education 2011
Design Engineer, Filtran Inc.
• A producer of automatic transmission auto filters for major automobile manufacturers.

EPICS gave me valuable experience working in multidisciplinary groups. In my current job, I collaborate with many people who have different backgrounds on each project. EPICS taught me to work well with my teammates and customers.
Global Leaders
Engaged Professionals
(locally and globally)
Changing the Conversation
and the World

College
and
Universities

Pre-university
Starting Ideas

• Projects within your own school
  – Sustainability
  – Education – younger students
  – Special Education partnerships

• Have students identify projects
  – Introduction to EPICS K12
  – Students do needs assessments, produce rough prototypes and reports
Reflection, Metacognition, Analysis,...

- What types of reflection?
- Learning objectives for the reflection?
  - Connections with discipline or career
  - Academic
  - Community
  - Larger social issues
  - Students themselves
Activity

- Individually, list what will be learned from the activity related to the subject matter or disciplinary skills from the service?
- What are the larger systems or social issues that are contributing to the need the service is addressing?
Partnerships are Key

Connect Schools with corporate, business, higher education, and professional societies to provide:

– Mentors
– Expertise
– Advisors
– Other Support
Current Hubs

Phoenix/Tucson
- U of A and ASU Support
- Intel Sponsorship

San Jose/Bay Area
- Youth Community Service of Palo Alto
- Google, SanDisk Sponsorship

Chicago
- Motorola Solutions Foundation Sponsorship

Broward County Florida
- Broward County Public Schools STEM Coordinators
- Motorola Solutions Foundation Sponsorship

Central Indiana
Contact Information:

EPICS K-12 Team

Charese Williams
Jean Trusedell, NBCT
Dr. Bill Oakes, Director

Headquarters e-mail: epics.high@purdue.edu
Phone: (765) 494-7938
Web pages: www.epicsk12.org
https://engineering.purdue.edu/EPICSHS
3.10 EP Using the prototype as a discussion tool

**Essential Question:** How can I use the redesigned prototype as an interview tool to be able to determine a specific need for a special needs stakeholder in the community? How do I figure out what we’ve missed?

**Standards**

**NGSS HS. Engineering Design**

Students who demonstrate understanding can:

**HS-ETS1-1.** Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

**ETS1.b: Developing Possible Solutions** When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.

**ELA/Literacy – SL.11-12.1c** - Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher led) with diverse partners on *grade 8 topics, texts, and issues*, building on others’ ideas and expressing their own clearly. Pose questions that connect the ideas of several speakers and respond to others’ questions and comments with relevant evidence, observations, and ideas.

**ELA/Literacy – SL.11-12.1d.** Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher led) with diverse partners on *grade 8 topics, texts, and issues*, building on others’ ideas and expressing their own clearly. Acknowledge new information expressed by others, and, when warranted, qualify or justify their own views in light of the evidence presented.

**Materials**

- 3.10 Student Sheets
- Student notebooks
- 3D Prototype
- Student debrief slips

**Activities**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Name of the Activity</th>
<th>Photocopies</th>
<th>Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Preparation for Class - 1.3 and 1.8-Teacher Toolbox. Assigning Team rolls - 1.13 Teacher Toolbox- Roles and Responsibilities.</td>
<td>Student page</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Standards Statement (Option: Unpacking the standards Teacher toolbox 1.12- Unpacking the standards)</td>
<td>3.14 Student Sheet</td>
<td>PowerPoint Presentation 3.10 Student Sheet</td>
</tr>
<tr>
<td>3</td>
<td>Interviews of community members using the prototype as a discussion tool.</td>
<td></td>
<td>PowerPoint Presentation 3.10 Student Sheet 3.10 interview sheet</td>
</tr>
<tr>
<td>4</td>
<td>Reflection and Formative Assessment</td>
<td>Student debrief slips</td>
<td>PowerPoint Presentation Notebook Formative Assessment Sheet</td>
</tr>
</tbody>
</table>
Overview
The students have created multiple prototype to represent that need and in this activity, the students will discuss their prototypes then go back to their identified stakeholder and present the different prototype to get feedback from the community member to determine if this will indeed meet their needs.

Major Concepts
- Communication with stakeholders
- Speaking and listening skills
- Building Self-Efficacy through cooperative learning strategies.
- Notebook and team building.

Objectives
Students will:
- Identification of possible needs in the community based on feedback from the interview with the prototype.
- Identify situations that impact the standard of living in the community by using the prototype as a communication tool.
- Identify underrepresented members of the community who have needs.
- Continue to build notebook reflection and teaming skills.

Lesson Preparation

Preparation
- **Lesson Preparation**: For specific directions on preparing lesson materials, see 1.3 and 1.8 documents in the Teacher Toolbox.
- **Instructional Resource**: Make sure that you have the *PowerPoint presentation* ready for class viewing.

Procedure

**Activity 1: Preparation for the Class**

**Multimedia Presentation**: This lesson will have a multimedia presentation that will help to get the students thinking about the lesson and walking them through the information. Download the presentation in the folder.

**Preparing the notebooks**- see document 1.3 in the Teacher Toolbox for specific instructions concerning notebooking.

**Line of Learning**. Have the students reflect on the following question.

3.10 Reflecting on multiple prototype:

**Question**: How do you think the stakeholder is going to react to the different designed prototypes and how will this meeting give more information in the design process?

**Team Roles and Responsibilities**- For more detailed information about team roles; use 1.13 Teacher Toolbox Team Roles and Responsibilities.

**Activity 2: Unpacking the Standards**

**Class Explanation**: The students have been compiling information the needs of the stakeholders within the community and have created a prototype of a project that is going to be used as a catalyst for more dialogue with potential stakeholders, it is essential that the students have exemplary listening skills. The standards that are used in this lesson revolve around the Common Core ELA Speaking and Listening along with analyzing local challenges and identifying specific needs for underrepresented members of the community.
Note to Teacher: Look above to see the standards that will be addressed through this lesson. The students need to understand the focus of the lesson, so an examination of the standards is a way of addressing this lesson essential.

**Here is a possible Standard Statement which incorporates the standards used in this lesson:**

> Students will experience how speaking and listening skills is an important way of gathering important information to evaluate a solution to an engineering problem by creating multiple prototypes and listening to feedback from the stakeholders.

Optional Lesson Component: As an additional component for this lesson, you may use Teacher toolbox 1.12 - Unpacking the standards in a Student Centered Classroom. This gives procedures to help your students create their own standards statement.

**Activity 3: Group discussion of multiple prototypes**

Introduction: You have gone through the process of redesigning your prototype and have had much more information available than when you created your first prototype. You will now need to evaluate the multiple prototypes that you have created as a team and determine which ones you would like to present to your stakeholders to get further feedback. You may decide that there are parts of each of the prototype that are of value to the final design and would like the parts to be evaluated by the stakeholder. You as the designer will need to make these decisions.

Instructions:
Essential Question: What information am I getting about the potential service-learning project through multiple prototypes?

In Groups: Examine each of the multiple prototypes that you have developed a team.
- Which of these or possibly all, do you want to present to the stakeholder?
- What specifications from the prototype do you want to analyze through this interview process?

Discuss your Interview plan
- Which of the prototypes you will want to discuss with your stakeholders?
- What information do you hope to gather about the specifications for your project?
- When and where are you going to meet?
- Who is going to go with you?
- What is the description of your prototype?

Interviewing stakeholders with the prototype

Interview advocates within the community with the prototype:
- **Set up a time to interview**- Be sure to be sensitive to the time constraints of your potential project partner. Remember they are helping you understand issues that they know only too well.
- **Students will explain their prototype to the stakeholder to explain its parts. They may also use the sketches from previous lessons as a tool.**
  - Students will interview partners and gather information using the prototype as a visual tool.
  - Students will use their student sheet in their notebook as a guide.
  - Students will use the description they have created in their notebook to help them relay the information about the prototype to the stakeholder.
  - Students will record the stakeholder’s impression of the prototype in the student notebook.
Group Assignment: Compiling stakeholder reflection of the prototype interview data

- After all in your group have interviewed their partner and gotten feedback with the prototypes, reconvene as a group and create a narrative explaining the stakeholder’s impression of the design and how you are going to implement the new information in the design.
- Discuss your findings with other members of your team and create a team document for your group related to the prototype with the following information to be sure to address:
  - accessibility
  - Leisure activities
  - Use of media in the home and community.
  - Any other information that relates to your project and the needs and information that you have gathered through this interview process.
- Each member of the team will be responsible for the narrative so it would be advisable to divide the work load and work together compile the information. Students must examine document 3.10 Reflection: Use of the prototype rubric for guidance on a quality reflective piece that gives vital information to the needs assessment for your community.

Note to Teacher: Circulate among the teams as they review the information and synthesize the information into usable data. You will be able to help the students see potential needs by looking at the information from an adult experience level and to see potential projects and how best to use the information from the interviews about the prototypes.

Activity 5: Wrap-Up: Reflection and Formative Assessment

1) Back to the Standards:
   Go back to the original class document about the standards.
   Ask the students did they:
   - Use the prototype as a tool to gather more information about the needs within the community?
   - Did this investigation and the use of the prototype give a glimpse into the gaps of services for the special needs members of the community?
   - Use speaking and listening skills to be able to synthesize the information from the interview using the prototype into a reflective document?

2) Formative Assessment and student reflection: Last 5 minutes of class
   - Pass out the exit slips. This will give you an idea of what they have learned in the lesson.
   - Make sure that they students have their notebooks open with their sheets taped in their books.
Notebook check:
As the students are filling out the slips, walk around the room and check to make sure that the student have the following information in their notebook:

✓ Completed the 3.10 student sheet.
✓ Completed the group reflection of the stakeholder’s impression of the prototypes.
✓ Have the students turn in the exit slip.

3) Teacher Reflection: Look at the student’s debriefing slips, the reflective document about the needs of the underrepresented members of the community and the student notebook. Have the students accomplished the objectives for the lessons?

Questions:
✓ Have the students expressed an understanding of the needs of the underserved members of the community and use the prototype as a discussion tool?
✓ How are the students reflecting in their notebook?
✓ Are the students able to work effectively and efficiently in their groups?
✓ Are there any interventions that may need to happen to improve these skills?
✓ Are the students showing self-efficacy when reflecting on their own learning in the class

Resources:
- University of South Florida- Center for Urban Transportation Research- Developing a Community Profile- http://www.cutr.usf.edu
- Oakes, W., Zoltowski, C., (2013). Presentation for Online Teacher Training, EPICS Program, Purdue University.
Overview: In focus of this unit is for the students to walk through the EPICS Engineering Design Cycle with the students completing a design that will impact their community. They will identify needs within the community, develop the specifications for that project, develop a conceptual design which will be refined into a detailed design and will deliver the project to the stakeholder.
# Year Long Curriculum Module 1 - Project Identification Phase

**Project Identification Phase Overview Statement:** The goal of this phase is to identify a specific, compelling need to be addressed by the project.

When a team is in this phase of the design process, they will determine the exact problem to be solved by the project. This means the following criteria must be determined:

- The tasks to be accomplished – these are called **project objectives**.
- The reasons for the project – these are called **motivations**.
- What results, documents, or objects that will be produce at the end of the project - these are called **outcomes and deliverables**.
- How long they want to spend on the project – this is called **duration**.

Who is the representative for the community organization that is helping with the project – this person is the **community partner contact**.

## Lesson Overview and Essential Question

<table>
<thead>
<tr>
<th>Lesson</th>
<th>Overview and Essential Question</th>
<th>Major Concepts</th>
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</thead>
<tbody>
<tr>
<td><strong>1.1 Introduction to Service-Learning</strong>&lt;br&gt;Standards&lt;br&gt;ELA- WHST.9-12.7</td>
<td><strong>Essential Question:</strong> What does Service-Learning mean to me?</td>
<td><strong>Major Concepts</strong>&lt;br&gt;- History of Service-Learning&lt;br&gt;- Components of Service-Learning&lt;br&gt;- Notebook and team building</td>
</tr>
<tr>
<td><strong>1.2 Code of Conduct</strong>&lt;br&gt;Standards&lt;br&gt;NGSS HS-ETS1-3.&lt;br&gt;ELA- SL.11-12.1d- SL.11-12.3-</td>
<td><strong>Essential Question:</strong> What are specific actions and code of conduct that is essential for a productive team and a successful project?</td>
<td><strong>Major Concepts</strong>&lt;br&gt;- Code of cooperation&lt;br&gt;- Foundations of Teaming and cooperation&lt;br&gt;- Notebook and team building</td>
</tr>
<tr>
<td><strong>1.3 Teaming Skills</strong>&lt;br&gt;Standards&lt;br&gt;NGSS HS-ETS1-3.&lt;br&gt;ELA- SL.11-12.1d- SL.11-12.3-</td>
<td><strong>Essential Question:</strong> What are the teaming skills that we will need to accomplish the projected service-learning project?</td>
<td><strong>Major Concepts</strong>&lt;br&gt;- Analyze a major global concern such as cancer with quantitative criteria&lt;br&gt;- Building Self-Efficacy through cooperative learning strategies.&lt;br&gt;- Application of Engineering to solve a real world problem.&lt;br&gt;- Use of skills, interests and talents to serve the community.&lt;br&gt;- Notebook and team building</td>
</tr>
<tr>
<td><strong>1.4 Community, Engineering and our course</strong>&lt;br&gt;Standards&lt;br&gt;NGSS HS-ETS1-3. ETS1.b-</td>
<td><strong>Essential Question:</strong> What are problems in the community that can be solved by skills you are learning in the classroom?</td>
<td><strong>Major Concepts</strong>&lt;br&gt;- Service-Learning in the community&lt;br&gt;- Researching skills&lt;br&gt;- Application of Engineering to solve a real world problem</td>
</tr>
<tr>
<td><strong>1.5 Civic Engagement</strong>&lt;br&gt;Standards&lt;br&gt;NGSS HS- HS-ETS1-1.&lt;br&gt;HS-ETS1-3&lt;br&gt;ELA- RST.11-12.9 -</td>
<td><strong>Essential Question:</strong> Why is it important to give back to the community where you live with your time, talents and skills?</td>
<td><strong>Major Concepts</strong>&lt;br&gt;- Analyze a major global concern such as cancer with quantitative criteria&lt;br&gt;- Building Self-Efficacy through cooperative learning strategies.&lt;br&gt;- Application of Engineering to solve a real world problem.&lt;br&gt;- Use of skills, interests and talents to serve the community.&lt;br&gt;- Notebook and team building.</td>
</tr>
<tr>
<td>Section</td>
<td>Title</td>
<td>Essential Question</td>
</tr>
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</table>
| 1.1.2 | Prototype To Communicate | Can I use the backpack prototype as an interview tool to be able to determine the need of my partner? How do I figure out what we’ve missed? | • Communication with stakeholders  
• Speaking and listening skills  
• Building Self-Efficacy through cooperative learning strategies  
• Notebook and team building |
| 1.1.3 | Testing Proof of Concept Prototype | What is an essential specification that I want to test to determine the success of the Proof of Concept Prototype? | • Prototyping used in Engineering  
• Engineering design process  
• Testing protocol  
• Evaluating data to drive design |
| 1.7 | EP Prior Art | What are the backpacks that are already on the market that might be used by the stakeholder? How does our design differ? | • Project Specifications  
• Analyzing information and determining measurable criteria  
• Project Flow chart |
| 1.8 | EP Specifications for Backpack Project | What are the specification requirements for this backpack project and what is the prioritization of the tasks. | • Project Specifications  
• Analyzing information and determining measurable criteria  
• Project Flow chart |
| 1.9 | EP first Redesign | After evaluating the testing data and the information gained by interviewing the partner using the backpack prototype, what changes and modifications need to be made to make it more efficient and useful? | • Prototyping used in Engineering  
• Engineering design process  
• Testing protocol  
• Evaluating data to drive design |
| 1.10 | EP Presentation of Prototype | What are the compelling needs that I have discovered and how can I use the initial prototype describe that need to my peers, teachers and community? | • Demonstrating understanding of the needs of the partner  
• Organizing information.  
• Demonstrate and explain the Initial Prototype though Gate 0  
• Prototype Testing procedures  
• Personal reflection on learning and presentation skills. |
| 1.11 | EP Engineering in the Community | What are the compelling needs that I have discovered and how can I use the initial prototype describe that need to my peers, teachers and community? | • Demonstrating understanding of the needs of the partner  
• Organizing information.  
• Demonstrate and explain the Initial Prototype though Gate 0  
• Prototype Testing procedures  
• Personal reflection on learning and presentation skills. |
| 1.12 | EP Project Partners | Who are the people that can best be served by this project and are willing to commit to working with our group? | • Identify Project Partner demographics  
• Research and profile development  
• Building Self-Efficacy through cooperative learning strategies.  
• Notebook and team building |
<table>
<thead>
<tr>
<th>1.13 EP</th>
<th>Community Demographics</th>
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<tbody>
<tr>
<td><strong>Essential Question</strong>: What are the demographics of my community? How will this information help me determine the needs of my neighborhood?</td>
<td></td>
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<tr>
<td><strong>Major Concepts</strong></td>
<td></td>
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<tr>
<td>- Identify demographic factors that can determine needs</td>
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<td>- Building Self-Efficacy through cooperative learning strategies.</td>
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<td>- Notebook and team building.</td>
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<thead>
<tr>
<th>1.14 EP</th>
<th>Cultural Diversity</th>
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<tbody>
<tr>
<td><strong>Essential Question</strong>: What are the different cultures in our community and what needs might Service-Learning project be able to fill?</td>
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<tr>
<td><strong>Major Concepts</strong></td>
<td></td>
</tr>
<tr>
<td>- Impact of demographics, culture and traditions in a community.</td>
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<tr>
<td>- Create questions to ask family members and community partners to gather more information about possible needs in the community.</td>
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<thead>
<tr>
<th>1.15 EP</th>
<th>Human-Centered Design Integration</th>
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<tbody>
<tr>
<td><strong>Essential Question</strong>: How can the Human-Centered design model help frame my project and how will all the information that we have collected fit into the process?</td>
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<tr>
<td><strong>Major Concepts</strong></td>
<td></td>
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<tr>
<td>- Service-Learning components</td>
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<tr>
<td>- EPICS Engineering Design mode</td>
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<td>- Notebook and team building.</td>
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<thead>
<tr>
<th>1.16 EP</th>
<th>Project Charter Community Needs Review</th>
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<tbody>
<tr>
<td><strong>Essential Question</strong>: How can I organize all of the information that I have gathered into a compelling document?</td>
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<tr>
<td><strong>Major Concepts</strong></td>
<td></td>
</tr>
<tr>
<td>- Summarizing quantitative and qualitative data</td>
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<tr>
<td>- Project Charter</td>
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<tr>
<td>- Project Flow chart</td>
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<tr>
<th>1.17 EP</th>
<th>Observation Human-Centered Design Tool</th>
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<tr>
<td><strong>Essential Question</strong>: How can I use the field notes and observations of the community? After further research into my community, were there parts that I need to revisit or explore further?</td>
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<tr>
<td><strong>Major Concepts</strong></td>
<td></td>
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<tr>
<td>- Observation of the Impact of demographics, culture and traditions in a community.</td>
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<tr>
<td>- Observing in detail</td>
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<tr>
<td>- Building Self-Efficacy through cooperative learning strategies.</td>
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<td>- Notebook and team building.</td>
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<tr>
<th>1.18 EP</th>
<th>Pert chart and Project Management</th>
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<tbody>
<tr>
<td><strong>Essential Question</strong>: What are the elements that will help me organize the information we have gathered about our community to create our service-learning project plan?</td>
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<tr>
<td><strong>Major Concepts</strong></td>
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<tr>
<td>- Project Management</td>
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<td>- Project Objectives</td>
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<td>- Project organization</td>
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<tr>
<th>1.19 EP</th>
<th>Gantt Chart</th>
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<tbody>
<tr>
<td><strong>Essential Question</strong>: How can I consolidate information that I have gathered to this point into a Gantt chart?</td>
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<tr>
<td><strong>Major Concepts</strong></td>
<td></td>
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<tr>
<td>- Project Management</td>
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<td>- Project Objectives</td>
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<td>- Project organization</td>
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<tr>
<td>- Gantt Chart</td>
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<tr>
<th>1.20 EP</th>
<th>Designing a Budget</th>
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<tbody>
<tr>
<td><strong>Essential Question</strong>: What are the projected costs of the project to complete and what will need to be purchased?</td>
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<tr>
<td><strong>Major Concepts</strong></td>
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<tr>
<td>- Project Budget management</td>
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<td>- Analyzing information to determine cost</td>
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<tr>
<th>1.21 EP</th>
<th>GATE 1</th>
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<tbody>
<tr>
<td><strong>Essential Question</strong>: What have I learned about the stakeholders in my community and what are my goals and objectives for the project along with constraints?</td>
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<tr>
<td><strong>Major Concepts</strong></td>
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<tr>
<td>- Engineering Design process</td>
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<td>- Organizing information</td>
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<tr>
<td>- Presentation skills</td>
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<tr>
<td>- Design Documentation and prototyping</td>
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<tr>
<td>- Personal reflection on learning and presentation skills.</td>
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**Year Long Curriculum Module 2- Specification Phase**

**Specification Development Phase Overview Statement:** The goal of this phase is to understand "what" is needed by understanding the context, stakeholders, requirements of the project, and why current solutions don’t meet need, and to develop measurable criteria in which design concepts can be evaluated.

The students will be evaluating their initial idea of a project that will meet the needs of their community partners and will be developing specifications that will be used as a guide through this process. They develop an understanding of the users of the final product and under what conditions it will operate. The team will analyze:

- Who will use and benefit from the product – these people are called the **users and beneficiaries**.
- When the users and beneficiaries present specifications – these are called **customer requirements**.
- When the users and beneficiaries presents information to the designer concerning the function of the product including what the product looks like, how it works, what materials it can be built from, and how much it costs – these factors are called **design constraints**.
- The guidelines already in existence listing engineering requirements referring to specific design, manufacturing, and safety rules for this kind of product – these guidelines are called **engineering specifications**.
- How the final product will compare to other products readily available that do the job required – this is called a **benchmark product comparison**.

What specific features and abilities of the product that have been determined, after other factors listed above have been considered – this is called **determining design targets**.

<table>
<thead>
<tr>
<th>Overview and Essential Question</th>
<th>Major Concepts and Materials</th>
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</table>
| **2.1 EP Specifications for Project**  
Standards  
ELA- WHST.9-12.7 | Essential Question: What are the specification requirements for this project and what is the prioritization of the tasks.  
Major Concepts:  
- Project Specifications  
- Analyzing information and determining measurable criteria  
- Project Flow chart |
| **2.2 EP Functional Decomposition on the Backpack**  
Standards  
NGSS HS-ETS 1-1. 1-2. 1-3.  
ELA- SL.11-12.1d- SL.11-12.3 | Essential Question: What is the process of a functional decomposition and how does it relate to the backpack project? Secondly, what is the most general task that my design must be able to accomplish?  
Major Concepts:  
- Functional Decomposition  
- Analysis and critical thinking  
- Application of knowledge to new situation. |
| **2.3 EP Revisit Project Charter**  
Standards  
NGSS HS-ETS1-1  
ETS 1.b.  
ELA- SL.11-12.1d- SL.11-12.1c | Essential Question: What do I need to add to the original Project Charter to continue to organize my project?  
Major Concepts:  
- Review and Summarizing additional quantitative and qualitative data  
- Project Charter update |
| **2.4 EP Design process specifications**  
Standards  
NGSS HS-ETS1-3.  
ETS1.b.  
ELA- SL.11-12.1c | Essential Question: How can the EPICS Human-Centered design model help frame my project and how will all the information that we have collected fit into the process?  
Major Concepts:  
- Service-Learning components  
- EPICS Engineering Design mode  
- Notebook and team building |
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<tr>
<th>Section</th>
<th>Essential Question</th>
<th>Major Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5 EP Developing Specifications through Interviews</td>
<td><strong>Essential Question:</strong> How can I use the Interview tool to be able to determine a specific need for a special needs stakeholder in the community? How do I figure out what we’ve missed?</td>
<td><strong>Major Concepts</strong>&lt;br&gt;• Impact of demographics, culture and traditions in the community related to special needs.&lt;br&gt;• Create questions to ask family members and community partners to gather more information about possible needs in the community for special needs community members.&lt;br&gt;• Building Self-Efficacy through cooperative learning strategies.&lt;br&gt;• Notebook and team building.</td>
</tr>
<tr>
<td>2.5.5 EP Test Specs with Prototype</td>
<td><strong>Essential Question:</strong> Can I create a visual representation that will help me gather more information to be used in the project?</td>
<td><strong>Major Concepts</strong>&lt;br&gt;• Prototyping used in Engineering&lt;br&gt;• Engineering design process&lt;br&gt;• Building Self-Efficacy through cooperative learning strategies.&lt;br&gt;• Notebook and team building.</td>
</tr>
<tr>
<td>2.6 EP Additional observations to develop specifications</td>
<td><strong>Essential Question:</strong> After gathering more information about my community and having developed Specifications for my project, what information is missing that will help me further revise the project?</td>
<td><strong>Major Concepts</strong>&lt;br&gt;• Observation of the Impact of demographics, culture and traditions in a community.&lt;br&gt;• Observing in detail&lt;br&gt;• Building Self-Efficacy through cooperative learning strategies.&lt;br&gt;• Notebook and team building.</td>
</tr>
<tr>
<td>2.7 EP Personas and Scenarios Stakeholder Analysis</td>
<td><strong>Essential Question:</strong> What tools can I use to better understand the stakeholders in my project?</td>
<td><strong>Major Concepts</strong>&lt;br&gt;• Analyzing Socioeconomic, demographic and cultural factors that can determine needs&lt;br&gt;• Building Self-Efficacy through cooperative learning strategies.&lt;br&gt;• Notebook and team building.</td>
</tr>
<tr>
<td>2.8 EP Engineering Applied to Everyday Life</td>
<td><strong>Essential Question:</strong> What is technology and engineering that is not just a luxury but an essential piece of life?</td>
<td><strong>Major Concepts</strong>&lt;br&gt;• Examples of essential technology and engineering&lt;br&gt;• Building Self-Efficacy through cooperative learning strategies.&lt;br&gt;• Identification of Engineering design that serve the essential needs of the community&lt;br&gt;• Notebook and team building.</td>
</tr>
<tr>
<td>2.9 EP Measurable specifications</td>
<td><strong>Essential Question:</strong> How am I going to measure the specifications for the project?</td>
<td><strong>Major Concepts</strong>&lt;br&gt;• Project Specifications&lt;br&gt;• Analyzing information and determining measurable criteria</td>
</tr>
<tr>
<td>2.10 EP Self Evaluation and Project Measurement</td>
<td><strong>Essential Question:</strong> What is the criterion that I will use to evaluation of my contributions to the project and how will we evaluate the progress of the project?</td>
<td><strong>Major Concepts</strong>&lt;br&gt;• Code of cooperation&lt;br&gt;• Self-evaluation&lt;br&gt;• Notebook and team building</td>
</tr>
<tr>
<td>2.11 EP Peer Evaluations</td>
<td><strong>Essential Question:</strong> What is the criterion that I will use to evaluation of my team members contributions to the project?</td>
<td><strong>Major Concepts</strong>&lt;br&gt;• Code of cooperation&lt;br&gt;• Self-evaluation&lt;br&gt;• Notebook and team building</td>
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</tbody>
</table>
| 2.12 EP Feedback to individuals and teams | Essential Question: What is true feedback and how can it help me learn? | Major Concepts:  
- Quality Feedback  
- Assimilation of assessment information into an action plan for learning  
- Team Assessment |
| 2.13 EP Benchmarking Prior Art Standards | Essential Question: What similar products are on the market or in use that might be used by the stakeholder and why would our design be of more use? | Major Concepts:  
- Project Specifications  
- Analyzing information and determining measurable criteria  
- Project Flow chart |
| 2.14 Identify Targets for design revisit Gantt chart Standards | Essential Question: What are the target specifications for this project and how do they align to the Gantt Chart? | Major Concepts:  
- Benchmarking Prior Art  
- Analyzing Specifications  
- Target Specifications |
| 2.15 EP Functional Decomposition of the project Standards | Essential Question: How can I apply my knowledge of Functional Decomposition to my project? Secondly, what is the most general task that my design must be able to accomplish? | Major Concepts:  
- Functional Decomposition  
- Analysis and critical thinking  
- Application of knowledge to a new situation |
| 2.16 EP Revisit and Update Specifications for Project Standards | Essential Question: How can I take the information I have created and integrate it into documents that will give my project guidance? | Major Concepts:  
- Functional Decomposition  
- Analysis and critical thinking  
- Application of knowledge to a new situation |
| 2.17 EP Debrief Specification Phase Standards | Essential Question: What information have I gathered that gives me a better idea of the needs of my stakeholders and the specifications and timeline for the potential project? How can I communicate that information in a clear and concise manner? | Major Concepts:  
- Engineering Design process  
- Organizing information  
- Presentation skills  
- Design Documentation  
- Personal reflection on learning and presentation skills. |
| 2.18 EP GATE 2 Specifications Phase Standards | Essential Question: What have I learned about the stakeholders in my community and how can I express that information through an oral and written presentation? | Major Concepts:  
- Engineering Design process  
- Organizing information  
- Presentation skills  
- Design Documentation  
- Project Specifications Development  
- Personal reflection on learning and presentation skills. |
**Year Long Curriculum Module 3- Conceptual Design Phase**

**Conceptual Design Phase Overview Statement:** Goal is to expand the design space to include as many solutions as possible. Evaluate different approaches and selecting “best” one to move forward. Exploring “how”.

In this phase, the students will:

- Determine the smaller functions of their product in order to complete its overall task, and create a diagram that compares these functions. For example, a team designing a bike fender might make the following functional decomposition diagram to show what smaller functions go into the fender’s overall function of protecting the rider from water and dirt off the wheel. The process of making this chart is called **Functional Decomposition**. Later in the design process, the students will dissect this process in more depth and detail.
- Make a list of decisions to be made to determine how the product works and list the tasks in a sequence for an effective and efficient process.
- Decide how the stakeholders will interact with the product. For example, will they talk to it, push buttons, manipulate it another way, simply look at it? How will they tell the product what to do? How will the user’s body fit on, around, or into the product?
- Evaluate possible solutions for how the product will work in general, comparing them against each other to find positive and negative aspects of each one.
- Choose the best solution from their potential options.

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<tr>
<th>3.1 EP Brainstorming</th>
<th>Overview and Essential Question</th>
<th>Major Concepts and Materials</th>
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<tbody>
<tr>
<td><strong>Standards</strong></td>
<td><strong>Essential Question:</strong> Are there brainstorming techniques that will help me explore service-learning opportunities within my community?</td>
<td><strong>Major Concepts</strong></td>
</tr>
<tr>
<td>NGSS HS-ETS 1-3.</td>
<td></td>
<td>• Brainstorming techniques</td>
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<tr>
<td>ELA- RST.11-12.7- RST.11-12.9</td>
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<td>• Metacognition and transfer</td>
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<tr>
<td><strong>3.2 EP Idea List</strong></td>
<td><strong>Essential Question:</strong> How can I generate a list of potential project ideas that will meet the needs of my stakeholder?</td>
<td><strong>Major Concepts</strong></td>
</tr>
<tr>
<td><strong>Standards</strong></td>
<td></td>
<td>• Project Specifications</td>
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<tr>
<td>NGSS-HS-ETS 1-1. 1-2. 1-3. EST 1.b.</td>
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<td>• Analyzing information and determining measurable criteria</td>
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<tr>
<td>ELA- SL.11-12.1d- SL.11-12.3</td>
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<td><strong>3.3 EP Brainstorming using SCAMPER</strong></td>
</tr>
<tr>
<td><strong>Standards</strong></td>
<td><strong>Essential Question:</strong> How can I use the brainstorming technique SCAMPER as a way to further refine my ideas for service-learning opportunities within my community?</td>
<td><strong>Major Concepts</strong></td>
</tr>
<tr>
<td>NGSS-HS-ETS1-1. EST1.b.</td>
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<td>• Brainstorming techniques</td>
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<tr>
<td>ELA- RST.11-12.7- RST.11-12.9</td>
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<td>• Metacognition and transfer</td>
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<tr>
<td><strong>3.4 EP Modified Brainstorming</strong></td>
<td><strong>Essential Question:</strong> How can I apply brainstorming techniques with my group to refine the ideas on my list?</td>
<td><strong>Major Concepts</strong></td>
</tr>
<tr>
<td><strong>Standards</strong></td>
<td></td>
<td>• Project Specifications</td>
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<tr>
<td>NGSS-HS-ETS1-3.</td>
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<td>• Analyzing information and determining measurable criteria</td>
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<tr>
<td>ELA- SL.11-12.1c</td>
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<td><strong>3.5 EP Functional Decomposition with Brainstorming</strong></td>
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<tr>
<td><strong>Standards</strong></td>
<td><strong>Essential Question:</strong> How will the information I have gathered through the brainstorming process influence the Functional Decomposition of the project?</td>
<td><strong>Major Concepts</strong></td>
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<tr>
<td>NGSS HS- HS-ETS1-1. HS-ETS1b</td>
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<td>• Functional Decomposition</td>
</tr>
<tr>
<td>ELA- SL.11-12.1d- SL.11-12.1c</td>
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<td>• Analysis and critical thinking</td>
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<td><strong>Major Concepts</strong></td>
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<td>• Application of knowledge to new situation</td>
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<td>Topic</td>
<td>Essential Question</td>
<td>Major Concepts</td>
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<td><strong>3.6 EP Decision Making tools</strong> Standards NGSS HS-ETS 1-1. 1-2. 1-3. EST 1b ELA- SL.11-12.1d- SL.11-12.1c Mathematics Number and Quantity HS Math- N-VM. 6.</td>
<td>Is there a way of evaluating the information that I have gathered to this point to be able to determine a good possible project to meet the needs of my community? How will I make those decisions?</td>
<td>• Decision making tools • Application of Engineering to solve a real world problem • Notebook and team building</td>
</tr>
<tr>
<td><strong>3.7 EP Introduction of the Decision Matrix</strong> Standards NGSS HS-ETS 1-1. 1-2. 1-3. EST 1b ELA- SL.11-12.1d- SL.11-12.3 Mathematics Number and Quantity HS Math- N-VM. 6</td>
<td>Can I use the weighted decision matrix to make critical decisions with the information I have gathered from the Functional Decomposition?</td>
<td>• Decision making tools • Application of Engineering to solve a real world problem • Notebook and team building</td>
</tr>
<tr>
<td><strong>3.8 EP Application of Decision Matrix to Functional Decomposition</strong> Standards NGSS HS-ETS 1-1. ETS 1b- ELA- SL.11-12.1d</td>
<td>What is the purpose of creating multiple prototypes for our service-learning project?</td>
<td>• Prototyping used in Engineering • Multiple prototype ideas • Engineering design process • Building Self-Efficacy through cooperative learning strategies. • Notebook and team building.</td>
</tr>
<tr>
<td><strong>3.9 EP Creating Multiple prototypes</strong> Standards NGSS HS-ETS1-1, HS-ETS1-2, HS-ETS1-3 ELA- SL.11-12.1d- SL.11-12.3</td>
<td>How can I use the redesigned prototype as an interview tool to be able to determine a specific need for a special needs stakeholder in the community? How do I figure out what we've missed?</td>
<td>• Communication with stakeholders • Speaking and listening skills • Building Self-Efficacy through cooperative learning strategies. • Notebook and team building.</td>
</tr>
<tr>
<td><strong>3.10 EP Prototype to communicate</strong> Standards NGSS HS-ETS1-3, ETS 1b- ELA- SL.11-12.3, SL.11-12.1d</td>
<td>How can I take the information gathered from the interviews with multiple prototypes and create an action plan for a working prototype that will meet the needs of the stakeholders.</td>
<td>• Feedback analysis • critical thinking and problem solving • Application of knowledge to new situation.</td>
</tr>
<tr>
<td><strong>3.11 EP Prototype Feedback</strong> Standards NGSS HS-ETS1-3. ELA- SL.11-12.3, SL.11-12.1d</td>
<td>What is an essential specification that I want to test to determine the success of the Proof of Concept Prototype?</td>
<td>• Prototyping used in Engineering • Engineering design process • Testing protocol • Evaluating data to drive design</td>
</tr>
<tr>
<td><strong>3.12 EP Testing and Redesign of the Proof of Concept Prototype</strong> Standards NGSS HS-ETS1-1. HS-ETS1-2. HS-ETS1-3. ELA- SL.11-12.1d, SL 11-12.3</td>
<td>After revisions and the evaluation of the specifications and feedback from the stakeholders, what are the projected costs of the project to be completed and what will need to be purchased?</td>
<td>• Project Budget management • Analyzing information to determine cost</td>
</tr>
</tbody>
</table>
| 3.14 EP Revisiting timeline | **Essential Question:** What is the best way to update the Gantt Chart and create a plan to move into the Detailed Design Phase? | **Major Concepts**  
- Project Management  
- Project Objectives  
- Project organization  
- Gantt Chart |
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<tbody>
<tr>
<td><strong>Standards</strong></td>
<td>NGSS HS-ETS1-3, ELA- SL.11-12.4, SL.11-12.5</td>
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</table>

| 3.15 EP Debrief Conceptual Design Phase | **Essential Question:** What information have I gathered that gives me a better idea of the needs of my stakeholders and the specifications and timeline for the potential project so I can move to the Detailed Design Phase of the EPICS design model? How can I communicate that information in a clear and concise manner? | **Major Concepts**  
- Engineering Design process  
- Organizing information  
- Presentation skills  
- Design Documentation  
- Project Specifications Development  
- Personal reflection on learning and presentation skills. |
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<tr>
<td><strong>Standards</strong></td>
<td>NGSS HS-ETS1-3, ELA- SL.11-12.4, SL.11-12.5</td>
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| 3.16 EP GATE 3                        | **Essential Question:** What information have I gathered that gives me a better idea of the needs of my stakeholders and the specifications and timeline for the potential project so I can move to the Detailed Design Phase of the EPICS design model? How can I communicate that information in a clear and concise manner? | **Major Concepts**  
- Engineering Design process  
- Organizing information  
- Presentation skills  
- Design Documentation  
- Project Specifications Development  
- Personal reflection on learning and presentation skills. |
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<tbody>
<tr>
<td><strong>Standards</strong></td>
<td>NGSS HS-ETS1-3, ELA- SL.11-12.4, SL.11-12.5</td>
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</table>
Detailed Design Phase Overview Statement: The goal of this phase is to design a working prototype which meets the functional specifications.

They will need to:
Use the engineering specifications developed in phase two, to draw designs for every part of their product (and for the ways in which those parts will work together), starting with the simplest parts that need to be designed. Since this process uses specifications at the top of the functional decomposition chart to design starting with the functions at the bottom of the chart, it is called top-down specification/ bottom-up implementation.
Create a report that defends their design detailing how it will work and how the design constraints will be addressed. This report is called a proof-of-concept.
Create a prototype, test the product and ask targeted stakeholders to use it and give feedback on how well it works.
Compile a detailed list of potential ways that the product could malfunction (these malfunctions are called design failures), and develop a list of solutions of how these failures can be prevented. The students will go through several iterations in this process, where they will cycle back through Phase 4, or even to Phase 3 until they are satisfied that all design failures have been addressed. Later in the design process the students will learn advanced skill for determining possible failures, called Design Failure Mode Effects Analysis (DFMEA).
Determine the information that they stakeholders need to know in order to use the product.

Lesson | Overview and Essential Question | Major Concepts and Materials
---|---|---
4.1 EP DFMEA 1 | Essential Question: How can I anticipate possible failures in my design and what can I do to minimize the impact of these potential hazards? | Major Concepts
Standards
NGSS HS-ETS
ELA
NGSS HS-ETS 1-1, 1-2, 1-3, ELA- SL.11-12.1d- SL.11-12.3.

4.2 EP DFMEA Detailed Design Applied | Essential Question: How can I take the information I have gathered about potential failures in the design and minimize the risks? | Major Concepts
Standards
NGSS HS-ETS1-1, ETS 1-2, ETS 1-3 ETS 1.b.
ELA- RST.11-12.8, RTS.11-12-9, RTS.11-12-7.
Mathematical Practices-
MP.2, MP.4

4.3 EP Usability Test field testing | Essential Question: How can I create reliability and usability test for the product that will help me determine how the product will be used in the field? | Major Concepts
Standards
NGSS HS- HS-ETS1-1.
HS-ETS1b
ELA- SL.11-12.1d- SL.11-12.1c

4.4 EP User Manuals and training materials | Essential Question: What information will the community partners and stakeholders need to continue the project and or product after it is delivered? How will I create that document in a clear and concise manner? | Major Concepts
Standards
NGSS HS-ETS 1-1
ELA- W.9-10.4, W 9-10.5, W 9-10.6

4.5 EP Materials list | Essential Question: What are the materials that I will need to implement this project, what is the name of the merchant and the cost? | Major Concepts
Standards
NGSS HS- HS-ETS1-1.ETS 1.3
HS-ETS1b
ELA- SL.11-12.1c SL.11-12.1d
HS Math- N-Q.2

Mathematical Practices
MP.2, MP.4

Essential Question: How can I anticipate possible failures in my design and what can I do to minimize the impact of these potential hazards?

Major Concepts
- DFMEA
- Analysis and critical thinking
- Application of knowledge to new situation.

Essential Question: How can I take the information I have gathered about potential failures in the design and minimize the risks?

Major Concepts
- DFMEA
- Analysis and critical thinking
- Application of knowledge to new situation.

Essential Question: How can I create reliability and usability test for the product that will help me determine how the product will be used in the field?

Major Concepts
- Reliability
- Testing protocol
- Evaluating data to drive design

Essential Question: What information will the community partners and stakeholders need to continue the project and or product after it is delivered? How will I create that document in a clear and concise manner?

Major Concepts
- Engineering Design process
- Organizing information
- Design Documentation
- Personal reflection on learning and presentation skills.

Essential Question: What are the materials that I will need to implement this project, what is the name of the merchant and the cost?

Major Concepts
- Analyzing information and develop a list of materials that will be needed for the project and update the budget.
<table>
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<tr>
<th>Component</th>
<th>Essential Question</th>
<th>Major Concepts</th>
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</table>
| **4.6 EP Redesign build and test cycle** Standards NGSS HS- ETS1-1. HS-ETS1b ELA- W.9-12.4, W 9-10.5, W 9-10.6 | **What information will the community partners and stakeholders need to continue the project and or product after it is delivered? How will I create that document in a clear and concise manner?** | - Engineering Design process  
- Organizing information  
- Design Documentation  
- Personal reflection on learning and presentation skills. |
| **4.7 Materials list** Standards | **What are the materials that I will need to implement this project, what is the name of the merchant and the cost?** | - Analyzing information and develop a list of materials that will be needed for the project and update the budget. |
| **4.8 EP Safety Analysis** Standards NGSS HS-ETS1-3. ELA- SL.11-12.3 SL.11-12.1d | **Are there safety issues that we need to address with the development of the working prototype? If so how do we analyze the risks and minimize the possible hazards?** | - Safety and Hazard analysis  
- Testing protocol  
- Evaluating data to drive design |
| **4.9 EP Timeline check** Standards NGSS HS-ETS1-3. ELA- SL.11-12.4, SL.11-12.5 | **What are the changes that I have to make to the timeline delivery of the project based upon prototype testing?** | - Project Management  
- Project Objectives  
- Project organization  
- Gantt Chart |
| **4.10 EP Updated Field Testing** Standards NGSS HS-ETS1-1. ETS1-2, ETS1-3. ELA-RST.11-12.7, RST 11-12.8, RST 11-12.9 | **How can I create reliability and usability test for the product that will help me determine how the product will be used in the field?** | - Reliability  
- Testing protocol  
- Evaluating data to drive design |
| **4.11 EP Persona Evaluation** Standards NGSS HS-ETS1-3. ELA- RST.11-12.7, WST.11-12.2, WST.11-12.3 | **What information have I learned about our stakeholders that I will need to update the Persona for this project?** | - Analyzing Socioeconomic, demographic and cultural factors that can determine needs  
- Building Self-Efficacy through cooperative learning strategies.  
- Notebook and team building. |
| **4.12 EP Peer Evaluation** Standards NGSS HS-ETS1-3. ELA- SL.11-12.1.d SL.11-12.3 | **What is the criterion that I will use to evaluation of my team members contributions to the project?** | - Review the Code of cooperation  
- Self-evaluation  
- Notebook and team building |
| **4.13 EP Self Assessment and Project Assessment** Standards NGSS HS-ETS1-3. ELA- SL.11-12.1.d SL.11-12.3 | **Using the criterion for the EPICS project, what are my contributions to the project and how will we evaluate the progress of the project?** | - Review the Code of cooperation  
- Self-evaluation  
- Notebook and team building |
| **4.14 EP Feedback to Individuals and Teams** Standards NGSS HS-ETS1-3. ELA- SL.11-12.4, SL.11-12.5 | **What is true feedback and how can it help me learn?** | - Quality Feedback  
- Assimilation of assessment information into an action plan for learning  
- Project assessment |
### 4.15 EP Prep for Detailed Design Preview

**Standards**
- NGSS HS-ETS1-3
- ELA- SL.11-12.4, SL.11-12.5

**Essential Question:** What information have I gathered that gives me a better idea of the needs of my stakeholders and the specifications and timeline for the potential project so I can move to the Detailed Design Phase of the EPICS design model? How can I communicate that information in a clear and concise manner?

**Major Concepts**
- Engineering Design process
- Organizing information
- Presentation skills
- Design Documentation
- Personal reflection on learning and presentation skills.

### 4.16 EP GATE 4

**Standards**
- NGSS HS-ETS1-3
- ELA- SL.11-12.4, SL.11-12.5

**Essential Question:** What information have I gathered that gives me a better idea of the needs of my stakeholders and how I will be able to deliver the project in a timely and efficient manner?

**Major Concepts**
- Engineering Design process
- Organizing information
- Presentation skills
- Design Documentation
- Project delivery process
- Personal reflection on learning and presentation skills.
Year Long Curriculum Module 5- Delivery Phase

**Overview Statement Delivery Phase:** The goal of this phase is to refine the detailed design so as to design a product that is ready to be delivered! In addition, the goal is to develop user manuals and training materials.

In the final phase of the design process, teams will finalize all of the documentation for the project and prepare for a smooth delivery of the prototype. They will finalize the information from the Project Charter, Gantt Chart, the Specifications for the project, the decision matrices that were used to determine the design of the prototype. They will also include all of the testing data, the budget and materials list, the User’s Manual and of course the working prototype.

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<tr>
<th>Lesson</th>
<th>Overview and Essential Question</th>
<th>Major Concepts and Materials</th>
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</table>
| 5.1 Detailed Design Table | **Essential Question:** After evaluating the testing data and the information gained by interviewing the stakeholder after using the prototype, what changes and modifications need to be made to the prototype to be able to deliver the project to meet the needs of the stakeholders. | **Major Concepts**  
- Prototyping used in Engineering  
- Engineering design process  
- Testing protocol  
- Evaluating data to drive design |
| Standards |  
NGSS HS-ETS 1-3, ETS1.b  
ELA- SL-11-12.1c, SL-11-12.1d |  
| 5.2 EP Final Field Testing | **Essential Question:** How can I create a test for the final prototype that will help me determine if there are any major flaws in my working prototype? | **Major Concepts**  
- Reliability  
- Testing protocol  
- Evaluating data to drive design |
| Standards |  
NGSS HS-ETS 1-3, ETS1.b  
ELA- SL-11-12.1d- SL-11-12.3 |  
| 5.3 EP Finalization of Project Charter other documents | **Essential Question:** What do I need to add to the original Project Charter, Specifications Document and Gantt Chart to represent the progression of my project? | **Major Concepts**  
- Review and Summarizing  
- additional quantitative and qualitative data  
- Project Charter update |
| Standards |  
NGSS HS-ETS1-1, ETS 1.b  
ELA- SL-11-12.1d- SL-11-12.3 |  
| 5.4 EP Finalize Testing data | **Essential Question:** What information can I give in the Design Review about the decisions that were made with our project through the analysis of the testing data? | **Major Concepts**  
- Reliability  
- Testing protocol  
- Evaluating data to drive design |
| Standards |  
NGSS HS-ETS1-1, ETS 1.b  
ELA- SL-11-12.1d- SL-11-12.3 |  
| 5.5 EP Finalize Budget and Materials documentation | **Essential Question:** What is the final materials list along with the budget for the working prototype? | **Major Concepts**  
- Project Budget management  
- Analyzing information to determine cost |
| Standards |  
NGSS HS- HS-ETS1-1, HS-ETS1-2, HS-ETS1-3, HS-ETS1b  
Mathematical Practices: N-Q.2 MP.2, MP.4 |  
| 5.6 EP Finalize User Manuals | **Essential Question:** Does my User’s Manual reflect the information that is needed by the community partners and stakeholders to continue the project and or product after it is delivered? | **Major Concepts**  
- Engineering Design process  
- Organizing information  
- Design Documentation  
- Personal reflection on learning and presentation skills. |
| Standards |  
NGSS HS- HS-ETS1-1, ETS 1.3  
HS-ETS1b  
ELA- SL-11-12.1c SL-11-12.1d  
HS Math- N-Q.2 |  
| 5.7 EP Analysis of user feedback on delivered project | **Essential Question:** What is the criterion that I will use to evaluate of my contributions to the project and how will I use the feedback from the stakeholders to improve my next project? | **Major Concepts**  
- Project Evaluation  
- Customer feedback  
- Notebook and team building |
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<tr>
<th>Section</th>
<th>Description</th>
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<th>Major Concepts</th>
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</table>
| 5.9 EP Preparation for Design Review | Standards | What information can I gather that will help show the progression of the project from an idea through the testing and the redesigns to the working prototype? How can I communicate that information in a clear and concise manner? | • Engineering Design process  
• Organizing information  
• Presentation skills  
• Design Documentation  
• Personal reflection on learning and presentation skills. |
| 5.10 EP Delivery Design Review | Standards | What information can I gather that will help show the progression of the project from an idea through the testing and the redesigns to the working prototype? How can I communicate that information in a clear and concise manner? | • Engineering Design process  
• Organizing information  
• Presentation skills  
• Design Documentation  
• Project delivery process  
• Personal reflection on learning and presentation skills. |
| 5.11 EP Reflection on Design | Standards | What have I learned about engineering design, my community and myself through this project? | • Self-reflection  
• Assimilation of assessment information into an action plan for learning  
• Team Assessment |
| 5.12 EP Celebration of Delivery Debrief | Standards | What have I learned about engineering design, my community and myself through this project? | • Self-reflection  
• Use of celebration  
• Team Assessment |