BLUE VALLEY DISTRICT CURRICULUM OVERVIEW

8th Pre-Engineering

UNIT 1: Mindset of an Engineer

ESSENTIAL QUESTIONS	BIG IDEAS
How do you develop the mindset of an Engineer?	• Students have opportunities to develop engineering skills, which include; being solution oriented problem solvers, perseverance, team building, collaboration, conflict resolution and visual communications. • Students understand the culture and expectations of an engineering environment through tiered levels of support. • Students understand how engineers think and operate safely. • Students understand how to operate in a blended learning environment.

GUIDING QUESTIONS

Content: Mindset

- What skills are important for an engineer?
- How do engineers communicate their designs visually?
- How do engineers think?
- How do engineers collaborate in a solution-oriented environment?
- How do engineers communicate?
- How do engineers give and receive feedback?
- Why is safety an integral part of the engineering environment?
- What role does reflection play in problem solving?
- What are some good strategies to use when you have a problem?

Content

- What is engineering?

- What kinds of drawings do engineers use to communicate their ideas?
- What do engineers do (including non-traditional)?
- What around you in life involves engineers?
- What process do engineers use to solve problems?
- What role does safety play in the engineering environment?
- What is tiered level of support and how can it help me?
- How do engineers navigate blended learning and technology?
- What impact does engineering have on your world?

Process
- What are the steps of an engineering design process?
- What purpose does this process serve for engineers?
- What does conflict resolution look like? What does compromise look like?
- What can collaboration teach us about problem solving?

Reflective
- How do engineers learn from failure?
- How can the engineering design process benefit us in solving problems in our daily lives?
- Why do we use an engineering design process?
- Why is it important to consider multiple points of view?

UNIT 2: Engineering Design Process

ESSENTIAL QUESTIONS	BIG IDEAS
How do engineers solve problems?	• Students understand why professionals use the engineering design process to solve problems. • Students seek feedback through a variety of protocols. • Students understand that engineering design process is both creative and critical thinking. • Students use the engineering design process to solve problems.

GUIDING QUESTIONS

Content: Mindset

- How do engineers think?
- What skills are important for a engineer?
- How do engineers communicate their designs visually?

Content: Computer Aided Drafting (CAD) Content

- What is a multiview drawing?
- Why do engineers develop a multi-view drawing? (manual &/or CAD).
- How do you show a design in 3D in a 2D format? (orthographic projection)
- How do engineers demonstrate visualization skills in orthographic (multi-view) projection using (manual &/or CAD)?
- How do engineers use drafting to communicate ideas and tell a story? (Human to Human, Human to Machine and Machine to Human)
- What role does the use of symbols, measurements, and drawings play in promoting a clear communication?(By providing a common universal language to express ideas- multi-view/orthographic projection)

Content and Process: Engineering Design Process

1. Identify the problem
    a. Creative Thinking
        i. What do I understand about the problem/challenge?
        ii. What are all the possible sub-problems?
        iii. What do I already know about the content?
        iv. What skills do I have that will help me?
    b. Critical Thinking
        i. For whom might this be a problem and what is their perspective?
        ii. Which sub-problem would be most important to solve?
        iii. What do I need to know or learn?
        iv. Where can I find credible information to help me gain knowledge and/or skills?
2. Brainstorm solution ideas
    a. Creative Thinking
        i. What are all the possible ways I might solve this problem?
        ii. What are all the ways we might .....(brainstorm solution ideas)?
        iii. What might the solution idea look like (initial sketch/description)?
        iv. Where can I get more ideas to help me?
    b. Critical Thinking
        i. Which idea will be most likely to solve the problem?
        ii. How can I provide feedback to others that is kind, specific, and helpful?
        iii. How can the feedback I received help me improve my design?
3. Design solution idea
    a. Creative Thinking
        i. How can I design and build a prototype of my solution idea?
        ii. How do I visually communicate my solution ideas?
        iii. How do we design for an unknown?
    b. Critical Thinking
        i. How will I test my solution to see if it meets the criteria and constraints?
        ii. How well did my prototype meet the criteria and constraints?
4. Re-design/ Iterate
    a. Creative Thinking
        i. How might I improve my design?
        ii. How can the feedback I received help me improve my design?
    b. Critical Thinking
        i. How well did my prototype perform when it was tested?
        ii. What did I change that made a positive or negative difference in the results?
        iii. What feedback will help me improve my design?
        iv. How can I provide feedback to others that is kind, specific, and helpful?
        v. What else do I need to learn to make additional improvements?
5. Share solution
    a. Creative Thinking

i. How might I share/communicate my solution?

b. Critical Thinking
   i. What will my audience need to see or hear to understand my solution?
   ii. How well did my solution perform?
   iii. What have I learned?
   iv. What feedback did I receive?

Reflective

- What parts of the engineering design process did I struggle with and which ones did I excel at?
- What can we learn from our failures and successes?
- How did your thinking change throughout the engineering design process?
- What are some examples of how you thought and worked like an engineer?
- What can we learn from analyzing the data? How can this help me on the next project?
- How well did my team work together? What helped us to be successful? What interfered with our productivity?

UNIT 3: Engineering Technology

ESSENTIAL QUESTIONS	BIG IDEAS
How do engineers shape the world?.	• Students apply foundational scientific principles in the engineering classroom. • Students use engineering technologies to create efficient solutions. • Students engage in the engineering design process to experience concepts in the field of construction, manufacturing, power, energy and transportation. • Students analyze data to modify prototypes and determine overall efficiency.

GUIDING QUESTIONS

Computer Aided Drafting (CAD) Content

- What is a multiview drawing?
- Why do engineers develop a multi-view drawing? (manual &/or CAD).
- How do you show a design in 3D in a 2D format? (orthographic projection)
- How do engineers demonstrate visualization skills in orthographic (multi-view) projection using (manual &/or CAD)?
- How do engineers use drafting to communicate ideas and tell a story? (Human to Human, Human to Machine and Machine to Human)
- What role does the use of symbols, measurements, and drawings play in promoting a clear communication?(By providing a common universal language to express ideas- multi-view/orthographic projection)
- How do engineers develop a isometric drawing? (manual &/or CAD).

Engineering Technology in Power, Energy and Transportation: Content

- What is power?
- What is energy?
- What is work?
- What is potential energy?
- What is kinetic energy?
- What is mechanical advantage?
- What are simple machines?
- What are complex machines?
- What is flight?
- What are Newton's Laws?
- What is hydrodynamic?
- What is aerodynamic?

Engineering Technology in Power, Energy and Transportation: Process

- How do we utilize power and energy concepts to modify iterations of our designs during the engineering design process?
- How do we determine our mechanical advantage and how do we modify our prototype to improve our mechanical advantage to improve performance?
- How does yaw, lift, drag and roll affect flight.
- How do power, energy and work impact performance?
- How do we utilize the concepts in Newton's Laws to maximize the efficiency of our prototype?
- How do we apply our knowledge of simple and complex machines and their functionality to build prototypes?

Engineering Technology in Power, Energy and Transportation: Reflective

- What were the strengths and weaknesses of my design?
- Why was my design successful? (use evidence from the class data to support your response)
- Based on the class data, how could I improve upon my design?
- What advice would you offer someone else attempting this project?

Engineering Technology in Construction: Content

- What are forces and how do they act upon structures? (compression, tension, torsion, sheer, load)
- What materials do we use to build structures?
- What geometric shapes are used in construction and what shapes provide the most stability?
- What types of joints and construction components are used in your design? (ex: columns, girders)
- What is a truss and what are the various truss types?
- How do you calculate structural efficiency?

Engineering Technology in Construction: Process

- What geometric shapes should be used for strong, safe and functional design?
- How can I use precision construction to improve my designs efficiency?
- How do you determine the best material to use?
- What construction processes are utilized to create structurally stable prototypes?
- How do materials properties differ and how do these varying properties affect their uses and stability?

Engineering Technology in Construction: Reflective

- What were the strengths and weaknesses of my design?
- Why was my design successful? (use evidence from the class data to support your response)
- Based on the class data, how could I improve upon my design?
- What advice would you offer someone else attempting this project?

Engineering Technology in Manufacturing: Content

- What is manufacturing?
- How has manufacturing changed over the last century?
- What technologies are used in manufacturing?
- How does a laser engraver work?
- What are the features and benefits of manufacturing?

- Where does computer aided design play into manufacturing?

Engineering Technology in Manufacturing: Process

- What does the manufacturing process look like?
- How can technology help me be more effective, efficient and professional with the products I create?
- How can technology help me create opportunities to explore my passions and interests further?
- How do you determine which computer aided design program best fits your project?

Engineering Technology in Manufacturing: Reflective

- What were the strengths and weaknesses of my design?
- What advice would you offer someone else attempting this project?
- How does using technology in manufacturing benefit the me/consumer?
- How do we use technology in manufacturing?
- What impact does manufacturing have on my world?
- How can manufacturing skills be applied to further my interests and passions?
- What skills are going to be necessary for future manufacturing?

UNIT 4: Engineering Solutions

ESSENTIAL QUESTIONS	BIG IDEAS
How do engineers communicate solutions?	• Students explore passions and interests around power, energy, tranon, manufacturing and visual communications. • Students use the engineering design process to document their learnings through a manual or virtual design journal. • Students collect, analyze and evaluate data to enhance their prototype for optimal performance. • Students explain their learning through a reflective process of critique, revision and final outcome.

GUIDING QUESTIONS

Capstone Engineering Strands

- Engineering Technology in Power, Energy and Transportation
- Engineering Technology in Construction
- Engineering Technology in Manufacturing
- Engineering Technology in Visual Communications

Student Expectations

- Students will utilize content specific skills to execute Capstone Project.
- Students utilize skills they have developed in areas which include; being solution oriented problem solvers, perseverance,collaboration, conflict resolution and visual communications.
- Students utilize skills about how engineers think and operate safely.
- Students reflect on how their thinking changed throughout the engineering design process.
- Students seek feedback through a variety of protocols.

Outcomes

- Students will use the engineering design process to document their learning.
- Students collect, analyze and evaluate data to enhance their prototype for optimal performance.
- Students explain their learning through a reflective process of critique, revision and final outcome.
- Students will display learning using appropriate platform of their choice.(Blended Learning)
- What are some examples of how you thought and worked like an engineer?
- Are there applications to real world problems or industry?