Lesson Title: Designing with S.T.E.M.

Cluster: Science, Technology, Engineering and Math
Essential Knowledge and Skills: Problem Solving, Critical Thinking
Career Concepts: Postsecondary Options, Career Research

Summary: Students will be given the opportunity to complete the design process allowing them to discover what many careers are like in the Science, Technology, Engineering and Math (S.T.E.M) cluster. They will begin by receiving information on the design process, its components and its relationship to many other problem solving processes. Students will then have the opportunity to implement the design process. After completing the design process on their own, students will be taught how it relates to most careers in the Science, Technology, Engineering, and Math cluster. Students will then create a profile on that career by researching it on the Internet. Note-taking versus plagiarism will be discussed before the research begins. Finally, students will present their profiles to the class.

Course Objectives:
1.2 Students will be able to identify compositions of clusters and the relationship to the field.
5.1 Students will be able to utilize technology to access information.
6.1 Students will be able to identify, compare and contrast postsecondary education options.
6.2 Identify postsecondary options in relationship to the clusters.

Lesson Objectives:
Students will…

- Understand the steps of the design process.
- Implement the design process.
- Discuss the design process in relationship to careers found in the S.T.E.M. cluster.
- Research a career while taking notes.
- Develop a career profile.
- Present a career profile to the class.

Time: Four Class Periods

Required Materials: 15 textbooks (any type), tape, scissors, paper, computers with Internet access, "Design Worksheet" handout

Optional Resources: An explanation of the design process can be found at www.brazosportisd.net/prog_services/cate/steps.htm, Online Occupational Outlook Handbook (also available in book format) at www.bls.gov/search/ooh.asp?ct=OOH**,** net.4careers.com/, www.NebraskaCareerConnections.org**,** EducationQuest Essential printed materials**,** Destination Imagination

PBS - Building Big computer interactive labs - www.pbs.org/wgbh/buildingbig/lab/index.html
Try Engineering: www.tryengineering.org/home.php
Engineering K-12: www.engineeringk12.org
Discover Engineering: www.discoverengineering.org

Contact the University of Nebraska - Lincoln (UNL). The College of Engineering offers DVD presentations (free to schools)

Guest presenters: N/A

Content and Teaching Strategies:

Anticipatory Set

Many times in life people are faced with complex problems they do not know how to solve; "I want to build a 50 story building that will last for 200 years"; "I have a heart condition and need a transplant yet am not very high on the donors list". Most of these problems are handed to people in the S.T.E.M. cluster to solve. Over the next two days you will be given the opportunity to see what opportunities are available in this cluster.

Lesson Components

1. Briefly introduce the S.T.E.M. career cluster by presenting the "Cluster at a Glance". (See page 116.) This "Cluster at a Glance" can be found at the Nebraska Career Connections website at www.NebraskaCareerConnections.org. Focus on the variety of programs of study and be sure to include the learning options available (example: Distance education).

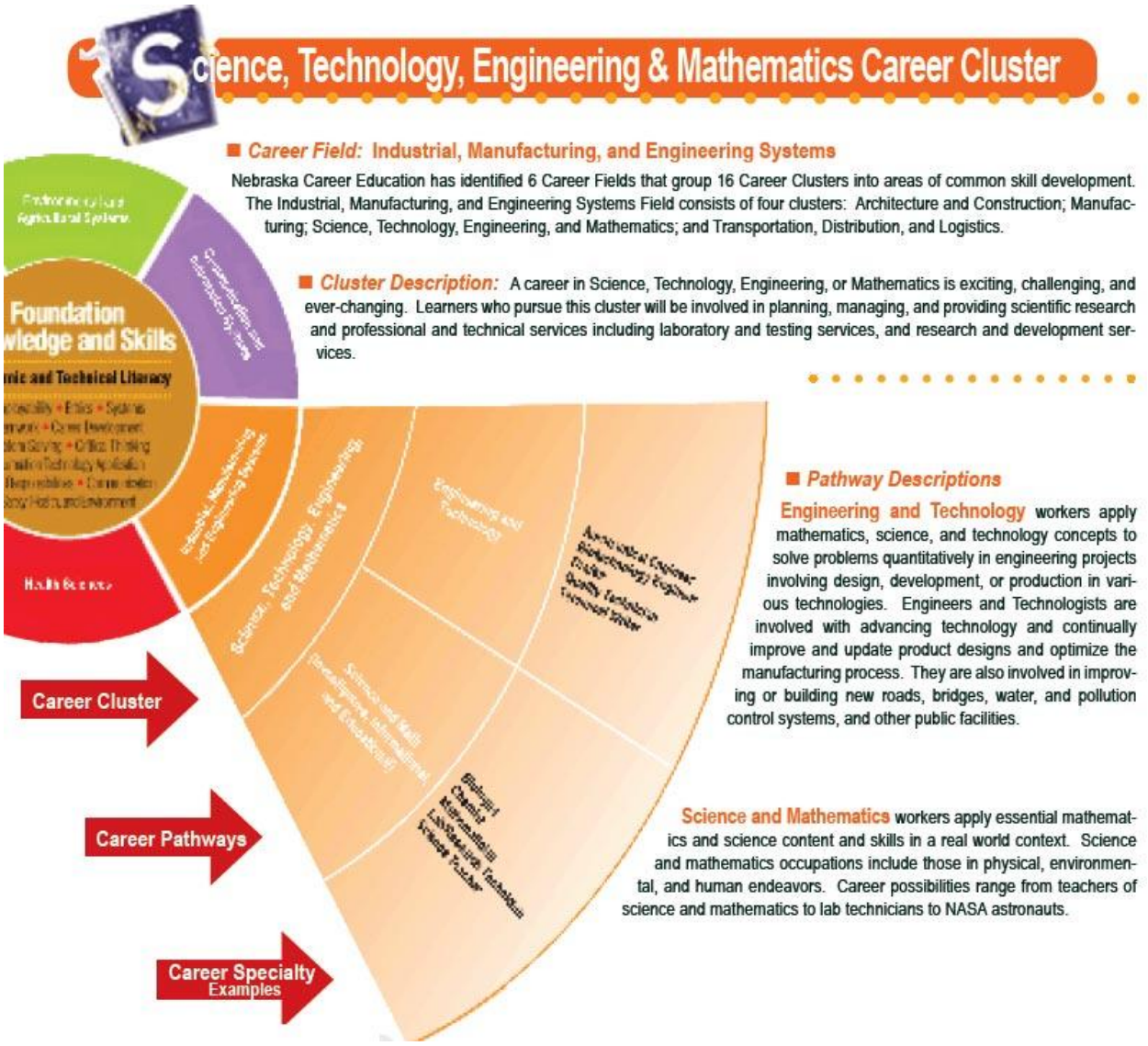
2. Gather information as a class to develop a list of careers that fit into the S.T.E.M. career cluster. Examples can be found at the Nebraska Career Connections website.
3. Each student should choose a career in the S.T.E.M cluster that is interesting to them and develop a profile that consists of the following components:
   a. Ten facts about the Career.
   b. One paragraph about educational requirements.
   c. One paragraph about helpful skills and aptitude.
   d. At least 3 resources from the Internet or print materials.

   This can be done using the Internet and/or print resources. Students should be reminded how to take notes from the resources they are using and properly cite the source. They should also be reminded not to plagiarize their work. Students should then present this profile to the class allowing the class exposure to multiple careers found in the S.T.E.M. cluster. Once each student has presented they should announce to the class the field, cluster, pathway and specialty the career they chose fits into.

4. Students should be introduced to the design process which a variation of is used in almost all careers found in the S.T.E.M. cluster. The steps of the design process are as follows:
   i. State the problem
   ii. Research
   iii. Think of alternative solutions
   iv. Choose the best solution
   v. Implement
   vi. Evaluate

Using the design process, students will complete a structure building activity in groups:

a. Students are divided into small groups (three to four) students



b. Each group is told they must build a free standing structure which can hold 15 textbooks at least 2" off the ground – you can tell them what materials they may use to solve the problem but do not give them the materials until they have completed their research, developed possible solutions and selected the best solution
c. Research – to study the impact of force on a geometric, have students go to: www.pbs.org/wgbh/buildingbig/lab/shapes.html or have them look at different tessellations in math, from artists (M. C. Escher), or nature (bees honeycomb)
d. Students sketch possible solutions
e. Students choose the best solutions
f. To implement, each group is given the following list of materials
    1. 8 inches of tape
    2. One sheet of 8 ½" x 11" notebook paper
    3. One pair of scissors
g. Students should then be required to evaluate their success or failure.

For additional Career Cluster Information, visit: www.NebraskaCareerConnections.org.

Preparation for a Career in the Science, Technology, Engineering & Mathematics Cluster Includes...

Coursework

- CAD (Computer Aided Drafting)
- Engineering Technology
- Industrial Technology
- Math
- Science

School Activities

- SkillsUSA
- OPPD/NPPD PowerDrive
- Math Club
- Mathematic Student Competitions
- TEAMS (Tests of Engineering Aptitude, Mathematics, and Science)
- Discover Engineering Day
- Science Club
- Science Fairs

Community Activities

- Participate in the following Programs and Activities provided by the University of Nebraska:
  - Engineers Week
  - Academy of Excellence
  - MESA (Mathematics, Engineering, Science Achievement) Program
- Participate in a Bright Lights Summer Learning Adventure

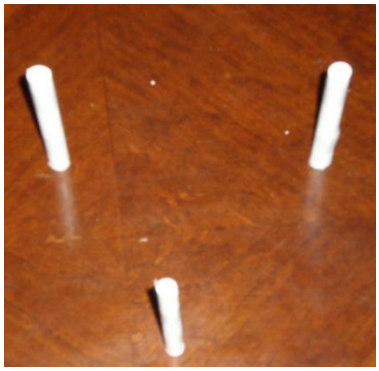
Example Science, Technology, Engineering & Mathematics Postsecondary Programs of Study

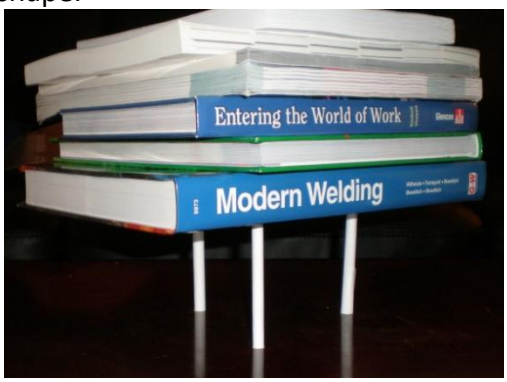
Students preparing for a career in the Science, Technology, Engineering, and Mathematics Career Cluster have a variety of postsecondary options. Education and training can be obtained through on-the-job training, technical colleges, two-year community colleges, four-year colleges/universities, and apprenticeship programs. They can enter programs leading to a certificate or a degree at the associate, baccalaureate, or advanced degree level.

The table below shows examples of postsecondary Science, Technology, Engineering, and Mathematics programs of study organized by pathway.

	High School Diploma, On-the-Job Training	Certificate/License	Associate's Degree	Bachelor's Degree	Master's/Doctoral/ Professional Degree
Science & Mathematics			■ Biology ■ Chemistry ■ Laboratory Science Technology ■ Medical Laboratory Technology	■ Chemistry ■ Economics ■ Mathematics ■ Molecular Biology ■ Physics	■ Biochemistry ■ Biological Sciences ■ Chemistry ■ Physics & Astronomy ■ Statistics
Engineering & Technology		■ Industrial Technology	■ Architectural Design Technology ■ Civil Engineering Technology ■ Industrial Technology ■ Surveying & Computer Aided Drafting (CAD)	■ Agricultural Engineering ■ Biological Systems Engineering ■ Chemical Engineering ■ Construction Engineering Technology	■ Agricultural & Biological Systems ■ Architectural Engineering ■ Chemical Engineering ■ Civil Engineering ■ Mechanical Engineering

A sample solution to this design prompt is shown below. You will notice a piece of paper has been cut into three even sections and then rolled into tight cylinders. These cylinders were then placed into a triangular shape.





5. A discussion should be held on what careers from the S.T.E.M. cluster would be utilized if a project such as this was completed on a much larger scale. Use these talking points:

a. Mathematician
b. Environmental engineer
c. Chemical technician
d. Material scientist
e. Mechanical drafter
f. Engineering manager
g. Statistician
h. Commercial and industrial designers
i. Drafters
j. Inspectors

6. Students should complete a design worksheet to hand in to be graded.
7. Students should retake the CALS assessment in the area of problem solving.

Lesson Closure

The class should have a discussion explaining the relationship of the design process to most of the careers in the science, technology, engineering and mathematics cluster.

Essential Knowledge and Skills Connection

The components of this lesson emphasize **teamwork, problem solving, critical thinking, and communication**. Choose one of the following activities to help students connect the lesson with their own development of EKS:

- Write a journal entry, reflecting on one of the EKS used in this lesson. Students could choose a strength or weakness they wish to improve or enhance.
- Students complete a graphic organizer (see Supporting Documents—Teacher Resources) to emphasize EKS used in this lesson connected to home, school, and work.
- Have students use the model to identify EKS used during the activity.

Formative Assessment:

Students should be evaluated based upon their "Design Reflection Worksheet" and career profiles.

Design Reflection Worksheet

Name(s): _____

Directions: Complete this worksheet using the printed resources provided, or go to www.NebraskaCareerConnections.org.

What are the steps used in the design process to create a product?

What additional steps would need to be taken in real life?

What careers would be involved in creating this product?

Which of these careers am I most interested in and why?

Which of these careers am I least interested in and why?

What other career clusters have I learned about thus far would be directly involved in creating this project?

What are two others things I have learned?

What is one question I still have?

Sample Career Profile

Name: _____

Profile: Engineer

- Work with drafting equipment including computers.
- Must be functional, safe, and economical.
- Meet building codes, fire regulations, and other requirements.
- Know how the structure will respond to loads, weather, and other variables.
- Make changes during the planning stage to satisfy the client's needs.
- Obtain help from architects.
- Must interact with clients, engineers, urban planners, interior designers, landscape architects, and construction workers.
- Must also prepare reports, proposals, and other construction documents.
- Often visit construction sites, which may mean being outside in bad weather.
- Occasionally the works is stressful, requiring long hours to meet deadlines.

Education and Training
Engineers must earn at least a bachelor's degree in engineering from a program accredited by the National Engineering Accrediting Board. After graduation, they must spend at least three years as an intern working with a registered architect and then pass a state licensing exam. It is a legal requirement that n architect be licensed before taking supervisory responsibility for a career.

Helpful Skills and Aptitudes
Although artistic and drawing ability are very useful to an engineer, especially when preparing freehand sketches, they are not absolutely necessary. It is usually more helpful to be creative and a problem-solver and to have a good imagination and a sense of how objects relate in space. Engineers should have the ability to solve technical problems and should be able to work independently. Good communication skills, computer skills, and knowledge of CAD are important, as are an understanding of design, engineering, and project management and supervision.

Information Source

Society of American Registered Engineers	Occupational Outlook Handbook
www.sara-national.org	www.bls.gov/oc