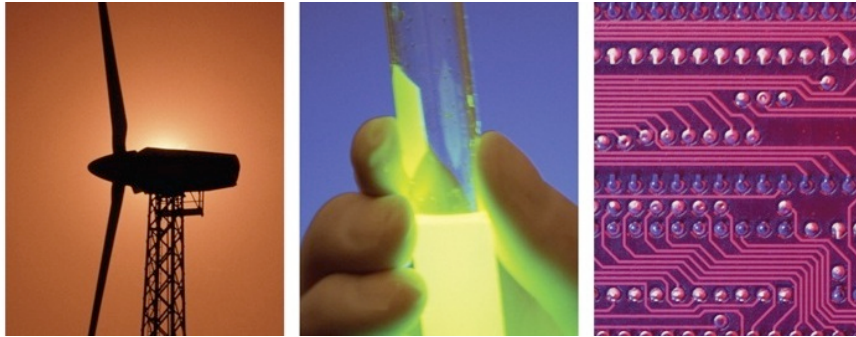


# **Engineering Your Future: A Project-Based Introduction to Engineering**

## **Sample chapter from the Instructor's Guide**



**All chapters are formatted in the same manner.  
Please scroll down to begin.**

## CHAPTER 2: Developmental Timeline For Engineering

### STANDARDS-BASED LEARNING ACTIVITIES

#### Activity 2.1: Moore's Law

Content: *Science*: A1, A2, A6, F6, G2, G3  
*Math*: 1C, 2A, 2C, 2D, 5A-D, 6A, 6D, 7B-D, 8A-D, 9A, 9C, 10A, 10C  
*Technology*: 1B, 1D, 2G, 3B, 3D, 4A, 4D, 6B-C, 7A-C, 7I, 12A, 13A-D  
*ABET*: B, G, H, I, J

Time: 3-5 hours

#### Teacher Preparation

Look up and become familiar with Moore's Law and related resources on the Web and in publications. A good resource for students and teachers is the article "Quantum Leap" by Corinna Wu (see the Resource section). Consult with the school media specialist concerning library resources and electronic databases that students may use. Prepare a list of recommended websites for accessing information. Prepare information that will help students in gathering and reporting their research. Establish class exhibit requirements.

Review information available at <http://www.intel.com/intel/museum/25anniv/hof/moore.htm>. This web site overviews the development of processors produced by a well-known company.

#### Activity

In this activity, students will research the development of the memory chip as well as forecast the future of processor technology. (A good start would be to look into molecular electronics.) Have students prepare detailed information based on the timeline for processor chip development and advancements in new technologies. Students should identify other significant technological developments that have a direct association with memory chips. Students can present findings orally and in display format to the entire class.

In 1965, Gordon Moore made an important observation regarding computer chips. When he started to graph data about the growth in memory chip performance, he realized there was a striking trend. Each new memory chip contained roughly twice as much capacity as its predecessor, and each chip was released within 18-24 months of the previous chip. If this trend continued, Moore reasoned, computing power would rise exponentially over relatively brief periods.

Moore's observation, now known as Moore's Law, described a trend that has continued and is still remarkably accurate. It is the basis for many computer performance forecasts. Over a 26-year period, the number of transistors on a chip has increased more than 3,200 times, from 2,300 on the 4004 processor chip in 1971, to 7.5 million on the Pentium II processor. This is an excellent example of technology driving developments in science.

**Assessment**

Students will present recent research on the development of processor chips, forecast the future of processor technology, and create an exhibit for others to view. Students may complete an oral presentation, a multimedia presentation, or a written report. The final product should include the history of the processor, the status of processor technology, and their predictions about the future of processor chips.

**Moore's Law Rubric**

Category	Exemplary 15-12	Accomplished 9	Developing 6	Beginning 3	Score
Forecast processor technology	Extensive examples and knowledge are present and tie in theories of processor technology	examples and knowledge are present and tie in theories of processor technology	examples and knowledge are present but do not connect to theories of processor technology	Information is presented on processor futures but incomplete	
Model/exhibit	The Model and sketches are complete with detail and labels	The Model and sketches are complete using labels	The Model is complete	The Model and sketches are incomplete, but an attempt was made	
Electronic presentation	Presents easy-to-follow information that is logical and adequately detailed. All graphics and supplemental information included	Most of the information is included. All graphics and supplemental information is included	Most of the information is included. No graphics or supplemental information included	Most of the information is missing, disordered or is confusing	
Research report	Information is well organized with ideas and details added to give meaning.	Information is well organized and an attempt is made to add meaning.	Student is demonstrating a basic understanding of content and information.	Limited effort is made to understand content at a very simplistic level.	

**Resources**

<http://www.intel.com/intel/museum/25anniv/hof/moore.htm>

This site presents Intel's Processor Hall of Fame, and presents an overview of the development of their processors.

PRISM Magazine, a publication of the American Society of Engineering Education (ASEE), November, 2000, Quantum Leap. By Corinna Wu. As silicon chips are pushed closer to their technological limits, engineers are moving to the molecular level to deliver the next step in computing speed.

## **Chapter References**

A History of Technology, Volume II, Ed. Charles Singer, Oxford University Press, New York, 1956.

Burghardt, M. David, Introduction to Engineering, 2nd Ed., New York, Harper-Collins, 1995.

Burstall, A., A History of Mechanical Engineering, London: Faber, 1963.  
De Camp, L. Sprague, The Ancient Engineers, Cambridge, The MIT Press, 1970.

Great Engineers and Pioneers in Technology, Volume 1: From Antiquity through the Industrial Revolution, Eds. Roland Turner and Steven L. Goulden, New York, St. Martin's Press, 1981.

Kirby, R., et al., Engineering in History, New York, McGraw-Hill, 1956.

Miller, J. A., Master Builders of Sixty Centuries, Freeport, New York, Books for Libraries Press, 1972.

Red, W. Edward, Engineering The Career and The Profession, Monterey, California, Brooks/Cole Engineering Division, 1982.

## Questions for Chapter 2 – Developmental Timeline for Engineering

Name: \_\_\_\_\_

Answer the questions on this sheet of paper. If more space is needed to write on, you may use another sheet. Answers DO NOT have to be in complete sentences.

1. People and accomplishments that help us to create new futures and understand what good qualities are worth repeating and continuing is known as:

- A. Engineering
- B. History
- C. Learning
- D. Mankind

2. What is ABET's Definition of Engineering?

“The profession in which knowledge of the mathematical and natural sciences, gained by study, experience, and practice, is applied with judgment to develop ways to use, economically, the materials and forces of nature for the benefit of mankind.”

3. During the prehistoric culture period, needed items were designed and built by:

- A. Sharing of Knowledge
- B. Technological Advancements
- C. Trial and Error
- D. Written Instructions

4. True or False. Information that was passed down from generations during the prehistoric culture period was serious.

5. Place an X in the blank that was true about prehistoric man:

- \_\_\_ Known written language
- \_\_\_ Oral language was advancing
- \_\_\_ Significant means of transportation were nonexistent
- \_\_\_ Developing formal education concepts
- \_\_\_ Specialized methodology for discovery did not exist
- \_\_\_ Primitive weapons were used for hunting food
- \_\_\_ Material aspects of life came slowly

6. List some of the goals of early science in many cultures.

- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_
- 6. \_\_\_\_\_
- 7. \_\_\_\_\_

7. True or False. Our ancestors laid the foundations of engineering due to efforts of survival and improving the quality of life.

8. Between 4000 and 2000 B.C., one major focal point of engineering was the development of a writing system. What country developed this first system of writing?

- A. Egypt
- B. Great Britain
- C. Mesopotamia
- D. Rome

9. Pyramids in Egypt have been the study of engineering for many years. What are some of the engineering tactics used in the construction of the pyramids?

- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_

10. Inventions in the modern age seem to narrow, what is the cause of this phenomenon?

- A. Computers do all our thinking now
- B. Engineering is becoming obsolete
- C. Everything that has been thought of has been invented
- D. Humans are less motivated
- E. More focus on computers

11. Match the items/innovations on the left with a proper time period on the right.

Answers may be used more than once and ALL answers will be used.

- |     |  |                       |
|-----|--|-----------------------|
| ___ | Cosmonauts orbit Earth for record 180 days                       | A. 1200 B.C. – A.D. 1 |
| ___ | Isaac Newton constructs a reflecting telescope                   | B. A.D. 1 – 1000      |
| ___ | Quality of wrought iron is improved                              | C. 1000 – 1400        |
| ___ | First oil well drilled near Titusville, PA                       | D. 1400 – 1700        |
| ___ | Sputnik 1 goes into space  | E. 1700 – 1800        |
| ___ | Robots walk on Mars  | F. 1800 – 1825        |
| ___ | Cotton and silk are manufactured                                 | G. 1825 – 1875        |
| ___ | Detroit becomes center of auto industry                          | H. 1875 – 1900        |
| ___ | Leibniz makes a calculating machine                              | I. 1900 – 1925        |
| ___ | Society of Engineers is formed in London                         | J. 1925 – 1950        |
| ___ | Wright Brothers complete first sustained flight                  | K. 1950 – 1975        |
| ___ | Rotary printing press comes into service                         | L. 1975 – 1990        |
| ___ | Internet society is chartered                                    | M. 1990 – Present     |
| ___ | Simple wire telegraph is invented                                |                       |
| ___ | Industrial Revolution begins                                     |                       |
| ___ | Gottlieb Daimler invents gasoline engine                         |                       |
| ___ | Channel Tunnel (Chunnel) is completed between France and England |                       |
| ___ | Automation is first used in France                               |                       |
| ___ | Diesel “Automobile Plows” produced by Ford                       |                       |
| ___ | Global Positioning Satellite technology is declassified          |                       |
| ___ | Rubber is vulcanized by Goodyear in U.S.                         |                       |

- \_\_\_ Columbia Space Shuttle is first launched A. 1200 B.C. – A.D. 1
- \_\_\_ Volkswagen Beetle goes into production B. A.D. 1 – 1000
- \_\_\_ First Nuclear Bombs are used C. 1000 – 1400
- \_\_\_ Alexander Graham Bell patents first telephone D. 1400 – 1700
- \_\_\_ Charles II charters the Royal Society E. 1700 – 1800
- \_\_\_ Archimedes introduces mathematics in Greece F. 1800 – 1825
- \_\_\_ Karl Benz introduces automobile G. 1825 – 1875
- \_\_\_ First water closet is invented in England H. 1875 – 1900
- \_\_\_ Stainless steel introduced in Germany I. 1900 – 1925
- \_\_\_ Leonardo Fibonacci writes first algebra text J. 1925 – 1950
- \_\_\_ Reinforced concrete is used K. 1950 – 1975
- \_\_\_ Modern sound recording introduced L. 1975 – 1990
- \_\_\_ Hubble Space Telescope goes into orbit M. 1990 – Present
- \_\_\_ Typewriter is perfected
- \_\_\_ Telstar, first communication satellite goes into orbit
- \_\_\_ Computer processor speeds increase dramatically
- \_\_\_ MP3 audio format traded widely through computer servers
- \_\_\_ Chinese further development of mathematics
- \_\_\_ Computers first enter commercial market
- \_\_\_ Concrete is used for arched bridges, roads, and aqueducts in Rome
- \_\_\_ First commercial airline service between London and Paris commences
- \_\_\_ Supersonic transport from U.S. to Europe begins
- \_\_\_ Explorer I goes into space

## Answer Key Questions for Chapter 2 – Developmental Timeline for Engineering

Answer the questions on this sheet of paper. If more space is needed to write on, you may use another sheet. Answers DO NOT have to be in complete sentences.

1. People and accomplishments that help us to create new futures and understand what good qualities are worth repeating and continuing is known as:

- A. Engineering
- B. History
- C. Learning
- D. Mankind

2. What is ABET’s Definition of Engineering?

“The profession in which knowledge of the mathematical and natural sciences, gained by study, experience, and practice, is applied with judgment to develop ways to use, economically, the materials and forces of nature for the benefit of mankind.”

4. During the prehistoric culture period, needed items were designed and built by:

- A. Sharing of Knowledge
- B. Technological Advancements
- C. Trial and Error
- D. Written Instructions

4. **True** or False. Information that was passed down from generations during the prehistoric culture period was serious.

5. Place an X in the blank that was true about prehistoric man:

\_\_\_ Known written language

\_\_\_ Oral language was advancing

**\_X\_** Significant means of transportation were nonexistent

\_\_\_ Developing formal education concepts

**\_X\_** Specialized methodology for discovery did not exist

**\_X\_** Primitive weapons were used for hunting food

**\_X\_** Material aspects of life came slowly

6. List some of the goals of early science in many cultures.

1. **Proper connection to God** \_\_\_\_\_

2. **Truth** \_\_\_\_\_

3. **Justice** \_\_\_\_\_

4. **Fate** \_\_\_\_\_

5. **Reality** \_\_\_\_\_

6. **Life** \_\_\_\_\_

7. **Ancestry** \_\_\_\_\_

7. **True** or False. Our ancestors laid the foundations of engineering due to efforts of survival and improving the quality of life.
8. Between 4000 and 2000 B.C., one major focal point of engineering was the development of a writing system. What country developed this first system of writing?
- A. Egypt
  - B. Great Britain
  - C. Mesopotamia**
  - D. Rome
9. Pyramids in Egypt have been the study of engineering for many years. What are some of the engineering tactics used in the construction of the pyramids?
- 1. **Stones properly transported** \_\_\_\_\_
  - 2. **Stones effectively lifted into place** \_\_\_\_\_
  - 3. **Everything fit** \_\_\_\_\_
  - 4. **Tombs secure against robbery** \_\_\_\_\_
11. Inventions in the modern age seem to narrow, what is the cause of this phenomenon?
- A. Computers do all our thinking now
  - B. Engineering is becoming obsolete
  - C. Everything that has been thought of has been invented
  - D. Humans are less motivated
  - E. More focus on computers**

11. Match the items/innovations on the left with a proper time period on the right.

Answers may be used more than once and ALL answers will be used.

- |          |  |                       |
|----------|--|-----------------------|
| <u>L</u> | Cosmonauts orbit Earth for record 180 days                       | A. 1200 B.C. – A.D. 1 |
| <u>D</u> | Isaac Newton constructs a reflecting telescope                   | B. A.D. 1 – 1000      |
| <u>A</u> | Quality of wrought iron is improved                              | C. 1000 – 1400        |
| <u>G</u> | First oil well drilled near Titusville, PA                       | D. 1400 – 1700        |
| <u>K</u> | Sputnik 1 goes into space  | E. 1700 – 1800        |
| <u>M</u> | Robots walk on Mars  | F. 1800 – 1825        |
| <u>B</u> | Cotton and silk are manufactured                                 | G. 1825 – 1875        |
| <u>I</u> | Detroit becomes center of auto industry                          | H. 1875 – 1900        |
| <u>D</u> | Leibniz makes a calculating machine                              | I. 1900 – 1925        |
| <u>E</u> | Society of Engineers is formed in London                         | J. 1925 – 1950        |
| <u>I</u> | Wright Brothers complete first sustained flight                  | K. 1950 – 1975        |
| <u>G</u> | Rotary printing press comes into service                         | L. 1975 – 1990        |
| <u>M</u> | Internet society is chartered                                    | M. 1990 – Present     |
| <u>F</u> | Simple wire telegraph is invented                                |                       |
| <u>E</u> | Industrial Revolution begins                                     |                       |
| <u>H</u> | Gottlieb Daimler invents gasoline engine                         |                       |
| <u>M</u> | Channel Tunnel (Chunnel) is completed between France and England |                       |
| <u>F</u> | Automation is first used in France                               |                       |
| <u>I</u> | Diesel “Automobile Plows” produced by Ford                       |                       |
| <u>M</u> | Global Positioning Satellite technology is declassified          |                       |
| <u>G</u> | Rubber is vulcanized by Goodyear in U.S.                         |                       |

- \_L\_** Columbia Space Shuttle is first launched A. 1200 B.C. – A.D. 1
- \_J\_** Volkswagen Beetle goes into production B. A.D. 1 – 1000
- \_J\_** First Nuclear Bombs are used C. 1000 – 1400
- \_H\_** Alexander Graham Bell patents first telephone D. 1400 – 1700
- \_D\_** Charles II charters the Royal Society E. 1700 – 1800
- \_A\_** Archimedes introduces mathematics in Greece F. 1800 – 1825
- \_H\_** Karl Benz introduces automobile G. 1825 – 1875
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- \_M\_** MP3 audio format traded widely through computer servers
- \_B\_** Chinese further development of mathematics
- \_K\_** Computers first enter commercial market
- \_A\_** Concrete is used for arched bridges, roads, and aqueducts in Rome
- \_I\_** First commercial airline service between London and Paris commences
- \_L\_** Supersonic transport from U.S. to Europe begins
- \_K\_** Explorer I goes into space

## Chapter 2 TEST: Developmental Timeline for Engineering

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Directions:

The following items will be used to assess your knowledge in the Engineering Technology area of technology and society. You may begin the assessment when the instructor directs you to do so. Read and follow all the directions provided; failure to do so may result in miscomprehension of the question. All answers are to be recorded on the answer sheet provided unless instructed different. Circle each answer. If at any point you have a question about a testing item, bring your test up to the instructor. Any suspects of cheating will receive a failing grade and a mandatory meeting with the instructor and administration.

True/False Items

Read each statement carefully and determine whether the entire item is true or false and mark the correct answer on the provided answer sheet.

- 
- True    False    1. Modern age inventions appear to narrow, with much focus on  
Computers.
- True    False    2. Prehistoric cultures designed and built needed items by written  
language, such as cave paintings.

- True False 3. During the beginning of engineering, people within the community acted separately to accomplish tasks.
- True False 4. History is about people and accomplishments.
- True False 5. Sharing of knowledge was prevented among the prehistoric cultures due to lack of communication and transportation.
- True False 6. Mesopotamia was the first civilization to develop a system of writing.
- True False 7. Prehistoric cultures educated their youth much like we do today.

Multiple Choice Items

Read each item carefully and choose the best response of those listed.

---

- A B C D E 8. Who, of the following selections, OCCURRED FIRST in a timeline dealing with the development of mathematics:
- A. Archimedes
  - B. The Chinese
  - C. Leonardo Fibonacci
  - D. Leibniz
  - E. None of the Above

- A B C D E 9. A goal of early science in many cultures was proper connection to:
-

- A. Fate
- B. Justice
- C. Life
- D. Reality
- E. All of the Above

A B C D 10. In the “Space Race,” which of the following occurred first?

- A. Challenger’s flight
- B. Cosmonauts’ 180 days
- C. Explorer I orbit
- D. Sputnik 1 orbit

A B C D E 11. The Great Pyramid of Khufu once had casing blocks of limestone attached to all sides, which weighed 58 million tons. Why are those limestone blocks nonexistent today?

- A. The British sold them when they conquered Egypt
- B. Taken off for other uses
- C. The bricks currently exist on the pyramid
- D. No such pyramid exists
- E. The bricks fell off, due to bad engineering tactics

A B C D 12. Between which years are classified as focal points for engineering according to the text and presentation?

- A. 1200 B.C. – A.D. 1
- B. 1875 A.D. – 1925 A.D.
- C. 1400 A.D. – 1700 A.D.
- D. 4000 B.C. – 2000 B.C.

A B C D E 13. What is the largest masonry structure ever built?

- A. Chunnel between France and England
- B. The Great Pyramid of Khufu
- C. Petronas Towers 1 & 2– Kuala Lumpur, Malaysia
- D. Roman Aqueducts
- E. Stepped Pyramid in Sakkara

A B C D 14. Who still lives like their ancestors while taking advantage of modern technology but still preserving their culture?

- A. Aborigines
- B. Amish
- C. A & B
- D. Neither A nor B

A B C D 15. Which society was the first Engineering society to be established?

- A. ABET
- B. Challenge Expedition

- C. Royal Society
- D. Society of Engineers

Matching

Match an item on the left with the correct item on the right. Responses will be used once.

---

Place the following in order of occurrence, from earliest to latest:

- |           |   |                  |
|-----------|---|------------------|
| A B C D E | 16. Ford produces diesel engine tractors.                                       | A. 1200 B.C. - 1 |
| A B C D E | 17. First oil well drilled near Titusville, PA.                                 | B. 1700 – 1800   |
| A B C D E | 18. James Watt’s rotary engine developed.                                       | C. 1825 – 1875   |
| A B C D E | 19. Karl Benz introduces automobile.  | D. 1875 – 1900   |
| A B C D E | 20. Concrete is being used for arched bridges,<br>roads, and aqueducts in Rome. | E. 1900 – 1925   |

Fill-In the Blank

Read each statement carefully and fill the blanks with the proper word. Some words may be used more than once.

---

- 21. History allows for understanding where we \_\_\_\_\_, where we \_\_\_\_\_, and where we are \_\_\_\_\_.
- 22. Prehistoric cultures were \_\_\_\_\_ about their surroundings and \_\_\_\_\_ was marvelous in effectiveness.
- 23. ABET defines Engineering as, “The profession in which knowledge of the \_\_\_\_\_ and \_\_\_\_\_, gained by study,

experience, and practice, is applied with judgment to develop ways to use, economically, the materials and forces of nature for the benefits of mankind.”

Name: \_\_\_\_\_

True/False Items

- 1. True False
- 2. True False
- 3. True False
- 4. True False
- 5. True False

Matching Items

- 16. A B C D E
- 17. A B C D E
- 18. A B C D E
- 19. A B C D E
- 20. A B C D E

6. True False

7. True False

Fill-In the Blank

21. \_\_\_\_\_  
(Two Words)

Multiple Choice Items

8. A B C D E

\_\_\_\_\_

9. A B C D E

10. A B C D

\_\_\_\_\_

11. A B C D E

12. A B C D

22. \_\_\_\_\_

13. A B C D E

14. A B C D

\_\_\_\_\_

15. A B C D

23. \_\_\_\_\_

\_\_\_\_\_

(Two Words)

**Answer Key Chapter 2 TEST: Developmental Timeline for Engineering**

True/False Items

Read each statement carefully and determine whether the entire item is true or false and mark the correct answer on the provided answer sheet.

---

**True** False 1. Modern age inventions appear to narrow, with much focus on computers.

True **False** 2. Prehistoric cultures designed and built needed items by written

language, such as cave paintings.

True **False** 3. During the beginning of engineering, people within the community acted separately to accomplish tasks.

**True** False 4. History is about people and accomplishments.

**True** False 5. Sharing of knowledge was prevented among the prehistoric cultures due to lack of communication and transportation.

**True** False 6. Mesopotamia was the first civilization to develop a system of writing.

True **False** 7. Prehistoric cultures educated their youth much like we do today.

### Multiple Choice Items

Read each item carefully and choose the best response of those listed.

---

**A** B C D E 8. Who, of the following selections, **OCCURRED FIRST** in a timeline dealing with the development of mathematics:

**A. Archimedes**

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D. Leibniz

E. None of the Above

A B C D **E** 9. A goal of early science in many cultures was proper connection to:

- A. Fate
- B. Justice
- C. Life
- D. Reality

**E. All of the Above**

A B C **D** 10. In the “Space Race,” which of the following occurred first?

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A B C **D** 12. Between which years are classified as focal points for engineering according to the text and presentation?

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- A. ABET
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Matching

Match an item on the left with the correct item on the right. Responses will be used once.

---

Place the following in order of occurrence, from earliest to latest:

- |          |          |          |          |          |   |                  |
|----------|----------|----------|----------|----------|---|------------------|
| A        | B        | C        | D        | <b>E</b> | 16. Ford produces diesel engine tractors.                                       | A. 1200 B.C. - 1 |
| A        | B        | <b>C</b> | D        | E        | 17. First oil well drilled near Titusville, PA.                                 | B. 1700 – 1800   |
| A        | <b>B</b> | C        | D        | E        | 18. James Watt’s rotary engine developed.                                       | C. 1825 – 1875   |
| A        | B        | C        | <b>D</b> | E        | 19. Karl Benz introduces automobile.  | D. 1875 – 1900   |
| <b>A</b> | B        | C        | D        | E        | 20. Concrete is being used for arched bridges,<br>roads, and aqueducts in Rome. | E. 1900 – 1925   |

Fill-In the Blank

Read each statement carefully and fill the blanks with the proper word. Some words may be used more than once.

---

21. History allows for understanding where we have been, where we are, and where we are going.
22. Prehistoric cultures were knowledgeable about their surroundings and craftsmanship was marvelous in effectiveness.
23. ABET defines Engineering as, “The profession in which knowledge of the mathematical and natural sciences, gained by study, experience, and practice, is applied with judgment to develop ways to use, economically, the materials and forces of nature for the benefits of mankind.”
-

**SINGLE SHEET ANSWER KEY Chapter 2 TEST: Developmental Timeline for Engineering**

True/False Items

- 1. **True** False
- 2. True **False**
- 3. True **False**
- 4. **True** False
- 5. **True** False
- 6. **True** False
- 7. True **False**

Matching Items

- 16. A B C D **E**
- 17. A B **C** D E
- 18. A **B** C D E
- 19. A B C **D** E
- 20. **A** B C D E

Fill-In the Blank

21. \_\_\_\_\_ **HAVE BEEN** \_\_\_\_\_  
(Two Words)

Multiple Choice Items

- 8. **A** B C D E
- 9. A B C D **E**
- 10. A B C **D**
- 11. A **B** C D E

\_\_\_\_\_ **ARE** \_\_\_\_\_

\_\_\_\_\_ **GOING** \_\_\_\_\_

12. A B C **D**

13. A **B** C D E

14. A B **C** D

15. A B **C** D

22. \_\_\_\_\_ **KNOWLEDGEABLE** \_\_\_\_\_

\_\_\_\_\_ **CRAFTSMANSHIP** \_\_\_\_\_

24. \_\_\_\_\_ **MATHEMATICAL** \_\_\_\_\_

\_\_\_\_\_ **NATURAL SCIENCES** \_\_\_\_\_  
(Two Words)