



Name _____

Vocabulary Review

Use the terms in the box to complete the sentences.

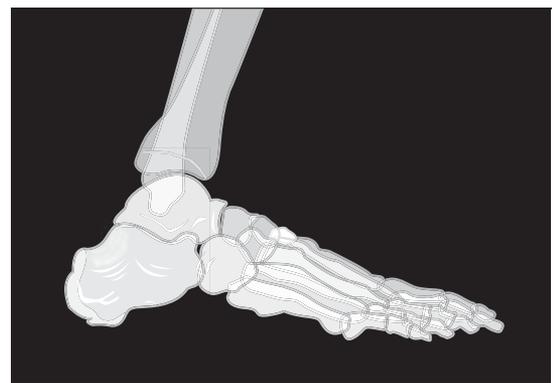
1. Any device that people use to meet their needs and solve practical problems is _____.
2. Using science and math for everyday purposes such as designing structures, machines, and systems is _____.
3. The standards for measuring how well a design does its job are _____.
4. The process of applying the engineering design process to living things is _____.
5. The working model on which tests are performed is a(n) _____.
6. Artificial legs are an example of _____.

bioengineering
biotechnology
criteria
engineering
prototype
technology

Science Concepts

Fill in the letter of the choice that best answers the question.

7. Computer models, along with mathematical data, can help to provide which information to bioengineers?
 - (A) which prosthesis is more appealing
 - (B) which prosthesis would be less necessary
 - (C) what kinds of changes need to be made to a prosthetic device
 - (D) what kinds of adjustments need to be made to the marketing plan.
8. This foot x-ray is an example of which kind of science or engineering?



- (F) biotechnology
- (G) microbiology
- (H) prototype design
- (I) prosthetic devices

9. Suppose you are a bioengineer who is designing a prosthetic shoulder joint. You are building a prototype. Which is an **important** design criterion for a shoulder joint that you should include?

- (A) It should be realistic in color and appearance.
- (B) It should be capable of full movement within a shoulder socket.
- (C) It should keep the person for whom it is designed from injuring himself or herself again.
- (D) It should be stronger than a typical shoulder joint and support more weight.

10. A sports designer wants to produce a profitable product that will benefit the wearer. The data below show the result of a survey about students' favorite sport activities.

Sports Participation in High School	
Sport	Percentage of students
basketball	80
bicycling	60
soccer	50
swimming	30

Which can you infer would be the **most** needed product among the students surveyed?

- (F) a helmet to protect from accidental head injuries
- (G) high-impact, ankle-supporting shoes
- (H) water-repelling racing swim trunks
- (I) shorts with padded backs

11. You and your design team have designed a new waterproof wristwatch made of a soft, flexible, clothlike material. Which of the following prototypes could be tested to predict how well the watch would work in real life?

- (A) a graphic drawing of the watch
- (B) a computer model of the watch that actually moves
- (C) a wearable model of the watch made of plastic or cloth
- (D) a wearable version of the watch made of the new material

12. A company has developed a new skateboard that can more easily roll over gravel or grass. Some users of these new boards are wearing paths through the local park. What aspect of technology does this situation represent?

- (F) benefits and risks
- (G) design and redesign
- (H) computer models and prototypes
- (I) brainstorming and communication

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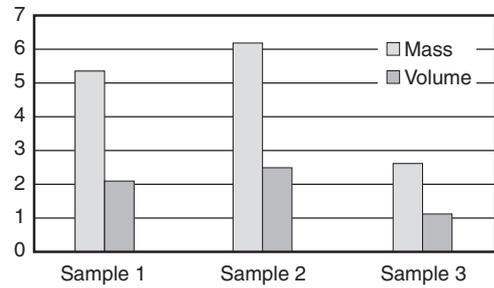
13. Bioengineers designed a prosthetic hand that is capable of grasping small objects between the thumb and index finger. The thumb was not one of the prosthetic hand's original design criteria. Which process was most responsible for including this feature in the final design?

- (A) troubleshooting after manufacture
- (B) safety concerns among doctors
- (C) brainstorming sessions within the design team
- (D) prototype testing and redesigning

14. You are determining the criteria you will use to decide how well your prototype racecar works. Which units would you use to determine the distance your car traveled?

- (F) grams
- (G) degrees
- (H) meters
- (I) liters

15. Engineers are investigating several materials that they think might be suitable for use in an artificial knee joint. They need to select a strong material that has a density (mass ÷ volume) in the range of 2.3–2.6.



What can the engineers conclude using the data from the graph?

- (A) All of the samples meet the density criteria that the engineers identified.
- (B) Sample 3 has the least volume and should not be considered for the knee.
- (C) Sample 2 has the greatest mass per volume and is the densest material.
- (D) All samples are outside the acceptable range and show a mass of 5–6.

16. An engineering team is developing a device that will help individual farm families clean drinking water. The device must be inexpensive enough that families can afford to buy one. At what stage in the engineering process should the team take into account the need for the device to be affordable?

- (F) before they build a prototype
- (G) after the device is on the market
- (H) before they identify the problem
- (I) after the testing has been completed

Apply Inquiry and Review the Big Idea

Write the answers to these questions.

17. Building a prototype of a prosthetic human body part means that you must use materials in ways that will resemble the actions of the real body parts. For example, you can use rubber bands to simulate the action of muscles on bones in order to move them. Describe two ways that rubber bands can imitate muscles in a model of a human arm.

(1) _____

(2) _____

18. A fully loaded backpack should not exceed 20 percent of a student's weight. However, most doctors recommend a 15-percent weight limit. These data are shown in the table below.

Body weight (lb)	Recommended limit of 15% (lb)	Maximum weight of 20% (lb)
70	$10\frac{1}{2}$	14
80	12	16
90	$13\frac{1}{2}$	18
100	15	20
110	$16\frac{1}{2}$	22
120	18	24

Materials that are often used to make backpacks have the following properties:

Material	Cost	Durability	Weight
plastic	low	low	low
canvas	moderate	average	medium
leather	high	high	high

a. What is the maximum weight a student who weighs 70 lb should carry?

b. What is the range of weights for a student who weighs 80 lb?

c. Make a claim about the best material for a backpack that will be used by a 70 lb student to carry 9 lb of books and materials. Give evidence for your answer.
