Biomass: Nature's Most Flexible Energy Resource

RENEWABLE ENERGY
THE INFINITE POWER OF TEXAS

For Grades 6, 7 and 8

OVERVIEW

In this unit, students will learn the various sources and uses of biomass. Students will conduct a Lab Activity in which they will measure the amount and percent of waste material in common produce. Students will find the range, median, and mode from their measurements and identify resources for biomass in Texas.

OBJECTIVES

See Middle School Teacher Resource Guide for TEKS objectives and additional information regarding this and other middle school units.

SUGGESTED TIMEFRAME

Teacher will need to determine how many class periods to devote to each activity, based on the suggested timeframe and length of classes.

Time	Activity	Content Area
10 minutes	**Activity 1** – Teacher Introduction	
15 minutes	**Activity 2** – Assessment of Current Student Knowledge	Science
45 minutes	**Activity 3** – Reading Passage and Vocabulary **Homework Assignment** – Sentences with Vocabulary	Reading Vocabulary Language Arts
45 minutes	**Activity 4 –** Pre-Lab	Science &
45 minutes	**Activity 5 –** Lab	Math
30 minutes	**Activity 6 –** Post-Lab	Science
30 minutes	**Activity 7 –** Assessment	Science

REQUIRED MATERIALS

- copy of the Reading Passage and Student Data Sheets (includes reading comprehension questions, vocabulary and Lab Activity) for each student
- copy of the Assessment Questions for each student
- an equipment kit for each group containing the following items:
  - 1 balance/scale
  - 1 ear of corn with husk (additional vegetable/fruit with edible and inedible parts, such as banana, orange with peel, apple with core, peanut with shell, will be necessary to optionally repeat the lab as an additional activity)
  - 1 plastic serrated knife (or comparable tool capable of cutting kernels off corn cob)
  - 1 empty 200 or 250 ml beaker
  - calculator

BACKGROUND INFORMATION

Biomass is our oldest fuel, as plants provided a fuel source early in history. Solar energy through photosynthesis provides this biomass. Today it is still common to use firewood and animal dung (with partially digested fiber) for fuel. Fossil fuels like coal and oil are ancient biomass. Biomass waste from crops can be burned or processed into methane gas, oil, or alcohol (bio-fuels). The plant waste materials can be used as bio-energy. Corn is an example of a vegetable with significant inedible biomass. Grocery stores discard older vegetables

and fruits, which were once edible biomass, adding to collected waste materials. Agriculture in Texas involves specific crops, such as wheat and other grains, trees, cotton, vegetables, and fruits (especially in the Rio Grande Valley), nuts, and others that are suited for biomass energy production.

SUMMARY OF ACTIVITIES

Activity 1 – Teacher Introduction (10 minutes)

As an anticipatory set for this unit, the teacher should bring a bag of varied trash items to the classroom. Wet items can be placed in plastic bags. Display the items on a table and ask the question, "What do all of these items have in common?" After students correctly identify the items as waste material, garbage, etc., the teacher can ask, "How can we put these items to good use?" This will lead into a brief assessment of students' awareness about the subject. Continue the introduction by explaining to the class that for the next unit of study, they will be learning about biomass and how it can be used as an energy source. The class will engage in an activity in which they determine the ratio of edible to inedible portions of resources that could be used as biomass energy by measuring the amount and percent of waste material in common produce. This exercise will help them understand the feasibility of harvesting biomass resources. Students will find the range, median, and mode from their measurements and identify resources for biomass in Texas.

Activity 2 – Assessment of Current Student Knowledge (15 minutes)

To assess what students already know, prompt a class discussion based on the 4 questions listed below. Based on this discussion, create and display a graphic organizer of the points that were discussed, which can be displayed throughout the unit of study. Refer to the Teacher Resource Guide for sample graphic organizers.

1. What is biomass?
2. What is the difference between biomass and fossil fuels? How do you think biomass can replace fossil fuels for our energy needs?
3. How do you think that Americans would be willing to make lifestyle changes to create and use biomass fuels?
4. What are some biomass resources in Texas?

See Teacher Resource Guide for alternative or additional assessment activity.

Activity 3 – Vocabulary and Reading Passage (45 minutes)

Each student will need a copy of the Reading Passage and the Student Data Sheets, which include reading comprehension questions, vocabulary words and the Lab Activity. (As an alternative to making copies, the Student Data Sheets can be displayed so the entire class can view them and copy the information into their science notebook.) Instruct students to study the Reading Passage and complete the questions and vocabulary. This activity will help them learn about energy from biomass resources and prepare them for the Lab Activity in which they will understand that some produce, such as corn, peanuts, bananas, etc., have different amounts and percentages of waste material that could affect their potential as a source of biomass energy. The ratio of waste material to total material can affect the feasibility of harvesting the waste materials for energy. Key vocabulary words in the Reading Passage will assist them in understanding the Lab Activity instructions. For students who wish to learn more of the detailed principles about biomass energy, direct them to the appropriate resources. Suggested resources are included in the Teacher Resource Guide. At the end of this activity, collect and grade the student's work. Return their graded work the following day.

Homework Assignment – Key Vocabulary List

1. Instruct students to create in their science notebooks meaningful sentences that reflect an understanding of the definition of each vocabulary word. Students should have written the definition of the words in their science notebooks during class. See Teacher Resource Guide for alternative vocabulary homework.
2. Collect and grade this assignment the next day.

Activity 4 – Pre-Lab (45 minutes)

1. The teacher should read the Lab Activity instructions first. For teachers interested in exploring the scientific method more fully as it applies to this Lab, see the Teacher Resource Guide for guidelines. The teacher should explain to the class how to separate the edible and inedible parts of the biomass and the proper use of the tool (plastic knife, fork, etc.) they are directed to use. Demonstrate the proper use of a scale. Appropriate safety guidelines should be reviewed for the activity. See Teacher Resource Guide for general safety guidelines.
2. Sample Calculations: Engage the class in an example problem to determine the range, median and mode of a set of numbers, as they will be required to determine these values for the dataset they obtain from their Lab Activity. Display the following set of numbers so the entire class can view it, such as on a transparency or on the chalkboard. You can explain that the dataset represents scores from a recent test or homework assignment.

   78, 99, 54, 83, 90, 65, 83, 87, 95, 58, 67, 83, 82, 69, 77, 83, 94, 91, 68, 60, 83, 91, 50

   Explain to the class that they will be determining the range, median and mode of the dataset displayed.

   a. Arrange the numbers from highest to lowest in rank order:
      99, 95, 94, 91, 91, 90, 87, 83, 83, 83, 83, 83, 82, 78, 77, 69, 68, 67, 65, 60, 58, 54, 50
   b. The range is the difference between the greatest and smallest values in a dataset. To calculate the range, subtract the lowest value from the highest value (99 – 50 = 49). The range is 49.
   c. The median is the middle value of a dataset arranged in order of magnitude. The median of the example dataset is the 12th score (83), since there are a total of 23 scores, with 11 above and 11 below the 12th score. If there were 22 scores, the median would be the average of the 11th and 12th scores. The median is similar to a "middle" geographical place, rather than to the size of a score.
   d. The mode is defined as the most frequently occurring value in a dataset. In this example the mode is 83, which occurs 5 times.

3. Explain to the class that the purpose of the Lab Activity is to gain an understanding of how the amount of unused or inedible part of a biomass resource is derived and quantified.
4. Divide the class into small groups and distribute a copy of the Lab Activity to each group.
5. Review the Lab Activity instructions with the entire class. Before performing the lab, students can summarize the steps involved and create a brief chart.

Activity 5 – Lab Activity (45 minutes)

1. Instruct each group to obtain the materials for one Lab Activity kit.
2. Instruct students to follow the directions outlined in the Lab Activity. To ensure that all students participate, instruct the groups to assign who will be responsible for each step in the activity before beginning.

3. As the directions indicate, once all the groups have taken their weight measurements, instruct students to share their measurements and calculations and record them on their Lab Report Form. If you are able to conduct this activity with other classes, you can compile all the results for a larger dataset.
4. Students should complete the answers to the lab questions.

Sample observations

The following is an example of weights obtained from four groups in 2 classes.

	Weight of corn on the cob
Class I	
#1	320.2 grams
#2	300.9 grams
#3	326.1 grams
#4	299.0 grams
Class II	
#1	350.2 grams
#2	299.0 grams
#3	350.0 grams
#4	299.0 grams
#5	293.8 grams

Rearrange the masses from greatest to least:

350.2 grams
350.0 grams
326.1 grams
320.2 grams
300.9 grams
299.0 grams
299.0 grams
299.0 grams
293.8 grams

The range is: 293.8 grams to 350.2 grams (350.2 - 293.8) = 56.4 grams

The median is the middle reading for the data. There were 9 entries so the middle reading is the 5th entry with 4 above and 4 below it. The median is 300.9 grams. The mode is the most frequent entry. Sometimes there is no mode. The mode in this example is 299.0 grams, which appears three times.

Activity 6 – Post-Lab (30 minutes)

After students have completed their Lab Report Forms, discuss their results and their answers to the data analysis questions.

Activity 7 – Assessment (30 minutes)

Distribute a copy of the Assessment Questions to each student. Instruct each student to work alone and answer the short answer and multiple-choice questions. Collect the handouts, grade and return them to the students.

ADDITIONAL ACTIVITIES

1. **Compare Results With Different Biomass**
   Repeat the Lab Activity using a different fruit or vegetable such as a banana, an orange with peel, peanut(s) with shell. The teacher may want to use fruits or vegetables with high edible mass, such as apple with core, for a comparative analysis. Instruct students to compare results of the different biomass resources.
2. **Internet Research**
   Students can research information available on the Internet about biomass. Refer to the Teacher Resource Guide for suggested web sites. You may divide the class into 4 groups and assign each group to a particular topic. Each group can create a display of the information that they found and provide a short summary of their findings. If time and resources allow, students can create a PowerPoint presentation of their research. Suggested group topics include:
   - Group 1 – Biomass plants in Texas
   - Group 2 – Comparison of biomass throughout the United States
   - Group 3 – Most commonly used resources for biomass
   - Group 4 – Biofuels for vehicles

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HIGHLIGHTS

- **Biomass fuels can be used in place of fossil fuels**
- **Wood and wood wastes are already a significant energy source in the US**
- **Biomass can provide extra income to Texas farmers, ranchers and industries with a lot of waste materials**

SUMMARY

Biomass is plant materials and animal waste that can be used as a fuel source for our energy needs. It is a chemical energy that is among the most precious and flexible resources on Earth. Biomass has many important uses. It provides food that all animals can eat. Biomass also provides building materials, paper, fabrics, medicines and chemicals. Biomass has been used for energy purposes ever since fire was first discovered. Today, biomass fuels have many uses such as heating your home, fueling your car and providing electricity to run your computer.

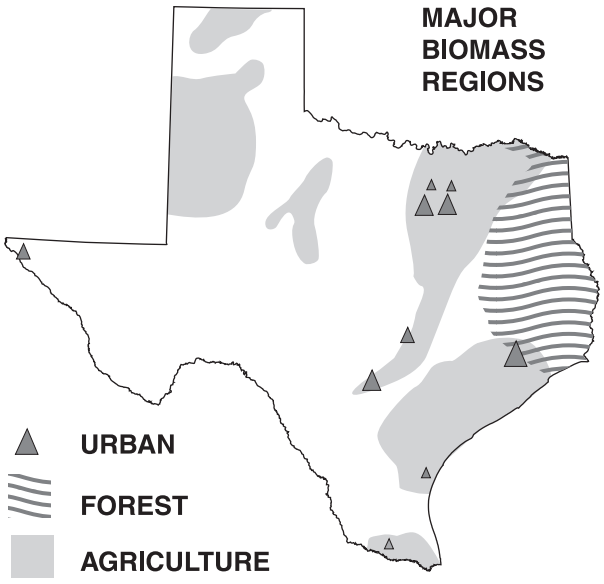
WHAT IS BIOMASS?

Wood may be the best-known example of biomass. Through photosynthesis, trees convert the radiant energy of the sun and combine it with carbon dioxide and water to create plant tissue. When burned, the wood releases the energy the tree captured from the sun's rays.

But wood is just one example of biomass. Rice hulls, waste straw, animal manure, surplus corn, peanut shells and any other plentiful organic material can also be used as an energy source.

SOURCE: BAYLOR UNIVERSITY

AIRPLANE POWERED BY BIOMASS *Biomass materials can be converted into fuels capable of just about any energy service, from powering airplanes and cars to making electricity to heating the family living room.*



SUMMARY OF TEXAS ENERGY RESOURCE AREAS
Texas' forests, ranches, farms and even cities produce biomass materials that can be used to satisfy many energy needs.

Can you think of other examples of biomass energy sources?

All of the fossil fuels we use – coal, oil and natural gas – are simply ancient biomass. Over millions of years, the earth has buried ages-old plant material and converted it into these valuable fuels. But while fossil fuels have similar contents as those found in fresh biomass – hydrogen and carbon – they are not considered renewable because they take such a long time to create.

The effects on our environment are also different between biomass and fossil fuels. When a plant decays, it releases most of its chemical matter back into the atmosphere. But, fossil fuels are locked away deep in the ground and do not affect the Earth's atmosphere until they are dug up and burned. The negative effect on the environment caused from burning fossil fuels is a good reason to consider biomass and other clean renewable resources.

HOW BIOMASS IS USED

Heat

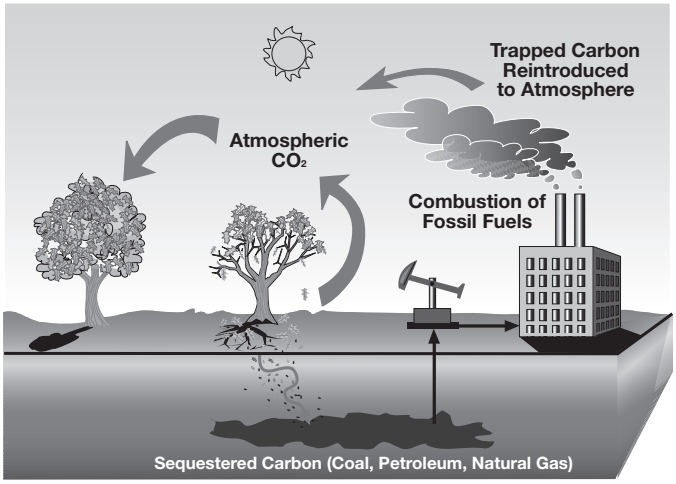
When you burn wood in your fireplace to heat your home, you are using a biomass resource. The use of wood to heat your home may be the most familiar use of biomass. Businesses and factories can use other forms of biomass energy to create heat from biomass fuels.

Steam, Electricity and Gases

For many years, mills and factories have burned biomass waste (especially wood waste) to produce steam for heat or electricity. Biomass materials that decay over time, such as garbage in landfills, produce methane, which is similar to natural gas. It can be captured and burned to generate electricity at the landfill or sold as gas that is transported to other areas. New technologies may be developed that can turn biomass into energy even more quickly.

Vehicle Fuels

Biomass can also be turned into alcohol. Ethanol is an alcohol created from biomass. The gasoline that we use in our cars often includes a small amount of ethanol. If we added 10% ethanol to our gasoline, our cars would perform better, and



SIMPLIFIED CARBON CYCLE *Unlike fossil fuels, biomass does not increase atmospheric greenhouse gases when burned.*

they would not produce as much air pollution. Ethanol fuels are usually made from corn. Flex fuel vehicles (FFV) use a mixture of gasoline and an alcohol fuel like ethanol. FFVs can run on a mixture of 85% ethanol and 15% gasoline. This mixed fuel is called E-85. Also, diesel engines with minor changes can use a special type of diesel made from waste vegetable oils or crops such as soybeans. This special type of diesel fuel is called biodiesel.

BIOMASS RESOURCES IN TEXAS

Texas has many materials that can be used for biomass energy. From its forests to its huge grain and fiber farms, the state is rich with biomass resources. Perhaps the best sources are concentrated waste materials. If just half of the available biomass wastes were used to make electricity, they could supply 10% of the state's electric needs. Here are the most promising resources:

Forests

The highly productive forests of east Texas have many biomass resources that can be obtained at a reasonable cost. The sawdust and waste wood from sawmills and pulp mills are already being used. Sawdust and waste wood are burned to generate steam and electricity at many Texas timber-processing plants.

Agriculture

When crops like cotton, rice, peanuts and sugar cane are harvested, there are large amounts of waste material that are left behind. Items such as crop wastes, manure from feedlots and dairies and stalks are left behind. All of these items can be used for fuel.

Urban Sources

All large cities have concentrated biomass sources that could be used for biomass energy. Examples of these sources include sewage treatment facilities, landfills, furniture factories, breweries, and food packaging plants.

Energy Crops

Crops that grow quickly, like switch grass and cottonwood trees, could be used as fuel and would greatly increase our biomass resources. It is possible that 25% or more of Texas' transportation and electricity needs could be provided from these types of energy crops if more trees are grown.

ADDING VALUE IN RURAL COMMUNITIES

Small biomass energy projects can provide many needed benefits in rural areas that are involved in agriculture. For example, a biomass generator could be installed on a feedlot that uses manure as its energy source. This would solve the feedlot's problem of manure disposal, reduce odors and provide jobs for the community.

WASTE SOURCES	(Quads)
Agricultural Wastes	
Harvest residues	0.081
Processing residues	0.028
Woody Wastes	
Logging residues	0.084
Mill residues	0.066
Biogas	
Animal manure	0.026
Municipal sewage	0.025
Urban	
Landfilled biomass	0.150
TOTAL	**0.46**

ENERGY POTENTIAL FROM TEXAS BIOMASS WASTE RESOURCES *Waste resources from food and lumber processing facilities are low cost sources of biomass fuel. Examples include rice hulls, cotton boll stems, sugar cane stalks, sawdust and wood chips. (Quad - 1 quadrillion BTUs, 1 kWh = 3,412 BTUs)*

Understanding the Reading Passage

1. What is biomass? _____

_____

_____

2. What are some examples of biomass that are used today? _____

_____

_____

3. How is biomass similar to fossil fuels? _____

_____ How is it different?

_____

_____

4. How is biomass used as a fuel? _____

_____

_____

5. How can biomass resources add value to rural Texas communities? _____

_____

_____

Vocabulary

Based on the Reading Passage, write down your understanding of these words or word pairs and verify your definitions in a dictionary, on the Internet if available or with your teacher:

biomass _____

decay _____

edible _____

energy _____

ethanol _____

fossil fuel _____

inedible _____

landfill _____

matter _____

median _____

methane _____

mode _____

natural gas _____

organic _____

quad _____

radiant energy _____

range _____

renewable _____

LAB ACTIVITY – Determining Edible And Inedible Mass Of Corn

INTRODUCTION

The purpose of this activity is to determine the ratio of edible to inedible portions of resources that could be used as biomass energy by measuring the amount and percent of waste material in common produce.

BEFORE YOU START

Review the vocabulary words from the Reading Passage. Ask your teacher if you are unsure of any of the meanings. Divide up all the steps in the Lab Activity first, so that everyone has a clear job to do.

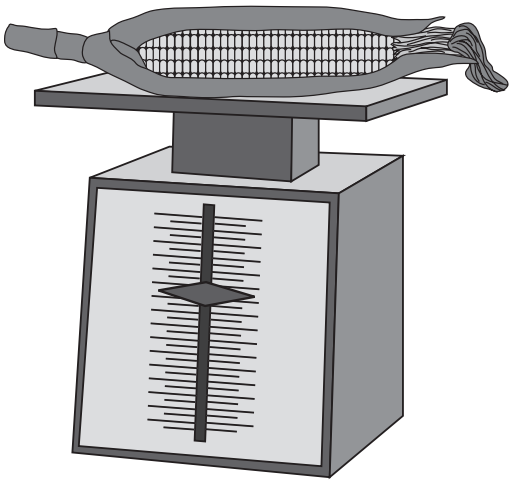
MATERIALS

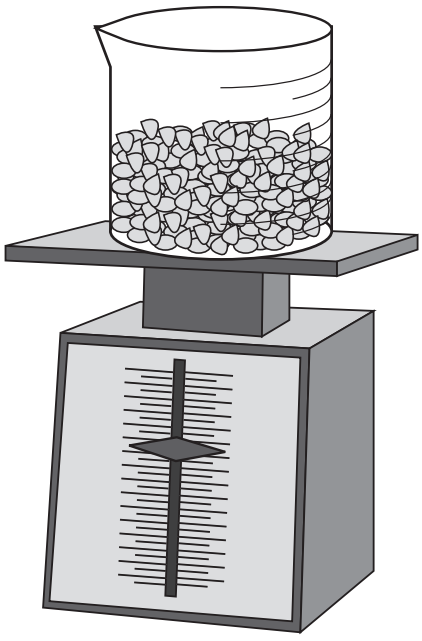
Obtain an equipment kit from your teacher. Check that it contains the following materials:

- 1 balance/scale with readings in grams
- 1 ear of corn with husk
- 1 tool for removing kernels
- 1 200 or 250 ml beaker
- 1 calculator

PERFORMING THE ACTIVITY

1. Weigh the corn on the cob, complete with husk, to one decimal place. Record the total mass of the corn in grams on your Lab Report Form.
2. Weigh an empty beaker in grams and record the mass.
3. Remove the cornhusk. Using the plastic serrated knife, remove the kernels from the corncob as the teacher directs. Collect the kernels.
4. Place all of the kernels into the beaker and weigh the kernels and beaker together. Record in grams.
5. Subtract the mass of the beaker (#2) from the mass of the beaker plus the corn kernels (#4). The difference is the mass of the kernels alone in grams.
6. Weigh the inedible portion of the corn (husk and cob) to one decimal point. Record the mass.
7. Calculate the percent of edible kernel biomass. Record this value in your Lab Report Form.





$$\text{Percent} = \frac{\text{Mass of edible part (kernels) in grams (from \#5)} \times 100}{\text{Mass of total ear (husk, kernels and cob) in grams (from \#1)}}$$

For example, if the whole ear weighed 320.2 grams and the kernels weighed 48.6 grams:

$$\text{Percent of edible kernels} = \frac{48.6 \text{ grams (of kernels)} \times 100}{320.2 \text{ grams (total ear)}} = 0.152 \times 100 = 15.2\%$$

8. Calculate the percent of inedible biomass in the ear of corn. Record this value in your lab report.

$$\text{Percent} = \frac{\text{Mass of inedible part (husk and cob) in grams (from \#6)} \times 100}{\text{Mass of total ear (husk, kernels and cob) in grams (from \#1)}}$$

For example, if the inedible part weighed 271.6 grams and the whole ear weighed 320.2 grams:

$$\text{Percent of inedible part} = \frac{271.6 \text{ grams (inedible part)} \times 100}{320.2 \text{ grams (total ear)}} = 0.848 \times 100 = 84.8\%$$

9. As the teacher directs, share the mass of your group's whole ear of corn with husk and kernels with the class. Record in your Lab Report From the weight of each group's ear of corn. Rank the values from the largest to the smallest. If there were six groups in the class, you would have a list for the mass of six ears of corn, starting with the heaviest.

10. Using the class data for the mass of each group's whole ear of corn find the following:
    a) the range of masses (from heaviest to lightest)
    b) the median mass (the middle reading)
    c) the mode for masses reported (the mass that appears the most)

Lab Report Form – Determining Edible And Inedible Mass Of Corn

Date _____

Purpose of this lab is to _____

_____

Instructions:
Follow the instructions listed in the Lab Activity and record your measurements in the data table below. Once you have completed all the measurements and calculations, answer the questions at the end of this form.

DATA TABLE. Weight Measurements of Corn (Edible and Inedible Portions)

	Weight measurements (grams)						
Group	(1) Corn on Cob	(2) Empty Beaker	(3) Corn kernels in beaker	(4) Corn kernels	(5) Husk and cob	(6) % of edible biomass	(7) % of inedible biomass
1							
2							
3							
4							
5							
6							
7							
8							
9							
Range							
Median							
Mode							

DATA ANALYSIS

1. How does the edible % compare to the inedible %? _____

2. How do the percentages of edible mass and inedible mass affect the produce's potential as a biomass resource?

   _____

   _____

   _____

   _____

3. What does this tell you about using a biomass such as corn for a fuel source? _____

   _____

   _____

   _____

Assessment Questions

1. What biomass is present in Texas as an energy source?

_____

_____

2. What kind of biomass is discarded in our homes?

_____

_____

3. What are the advantages and disadvantages of using biomass as a fuel source?

_____

_____

_____

4. If 25 students received their averages in science, and the highest average was 99.9 and the lowest was 56.8, what was the range? _____

5. If 11 of the 25 students received an 83.7, what was the mode? _____

6. If the scores were ranked 1 - 25 in order from highest to lowest, which # would you look for to find the median? _____

7. Why is there more biomass in east Texas?

_____

_____

Multiple Choice Questions

1. Biomass can be defined as:
   a) energy from the wind
   b) electricity
   c) hydroelectric energy
   d) chemical energy from plants and animals

2. The following is an example of biomass:
   a) tomato plant
   b) manure
   c) pine tree
   d) all answers a, b, and c

3. The greatest quantity of biomass in Texas is found in:
   a) west Texas
   b) east Texas
   c) the Panhandle
   d) south Texas

4. Biomass includes:
   a) grain
   b) cotton hulls
   c) wood pulp
   d) all answers a, b, and c

5. Large cities have biomass sources including:
   a) sewage treatment plants
   b) land fills
   c) breweries
   d) all answers a, b, and c

6. Fossil fuels:
   a) increase greenhouse gases
   b) increase atmospheric CO_2
   c) are nonrenewable when burned
   d) all answers a, b, and c

7. Biomass derived gases:
   a) are similar to natural gas
   b) are made from common materials
   c) can be sold as gas delivered to other places
   d) all answers a, b, and c

8. If 5 grams of a vegetable are edible and 7 grams are inedible, what is the percent of edible biomass?
   a) 41.7%
   b) 71.4%
   c) 140%
   d) 58.3%

9. Groups of students massed samples of apples with the following results:
   Group a = 212 grams, Group b = 250 grams, Group c = 202 grams,
   Group d = 197 grams, Group e = 250 grams.
   The mode is:
   a) 212 grams
   b) 250 grams
   c) 197 grams
   d) 202 grams

10. The median for the data in #9 is:
    a) 212 grams
    b) 250 grams
    c) 197 grams
    d) 202 grams

TEACHER ANSWER KEY

Understanding The Reading Passage

1. Biomass contains plant and animal materials (wood, hay, vegetables, etc.) that have chemical energy stored in their organic molecules.
2. Examples of biomass resources are wood, rice hulls, waste straw, animal manure, surplus corn, and peanut shells. Students may come up with other examples of low cost organic materials.
3. Biomass and fossil fuels have similar contents: hydrogen and carbon. Biomass and fossil fuels have different effects on the environment.
4. Biomass is used as a fuel for heating homes, in creating steam, electricity and marketable gases for manufacturing and industry, and ethanol for vehicle fuel combinations to reduce air pollution from cars.
5. A rural community could begin by utilizing various biomass resources available within rural agricultural communities more effectively. Students may arrive at multiple answers.

Lab Activity Data Analysis

1. Answers will vary, but the edible percentage will always be the lesser amount.
2. A greater percentage of inedible mass makes the produce a better biomass resource.
3. Because corn has a high inedible percentage, it is a good biomass resource.

Assessment Questions

1. Texas has crop wastes from cotton, rice, sugar cane, peanuts, manure, as well as trees, garbage, switch grass, waste from breweries and food packaging plants.
2. People discard paper, vegetable, fruit, and meat wastes, fabric, plastic, and other waste materials from their homes.
3. Advantages of biomass use include no cost, benefit to the environment, reduced need for fossil fuels and less dependence on foreign countries. Disadvantages of biomass use might include transportation of the materials and regional availability of materials.
4. The range was 99.9 minus 56.8 or 43.1.
5. The mode was 83.7.
6. The median would be the middle score or the 13th score, with 12 scores falling above and 12 scores falling below that point.
7. East Texas has more rainfall for plants to grow.

Multiple Choice Questions

1 d; 2 d; 3 b; 4 d; 5 d; 6 d; 7 d; 8 b; 9 b; 10 a

Vocabulary Definitions

biomass – plant and animal materials (wood, hay, vegetables, etc.) that have chemical energy stored in their organic molecules

decay – change of an element into a different element, usually with some other particle(s) and energy emitted

edible – fit to be eaten

energy – the ability to do work; resources that can be used to do work, such as electricity

ethanol – an alternative fuel; a liquid alcohol fuel with vapor heavier than air; produced from agricultural products such as corn, grain and sugar cane

fossil fuel – naturally occurring carbon or hydrocarbon fuel (eg. coal, natural gas and oil), formed by the decomposition of pre-historic organisms

inedible – unfit to be eaten

landfill – disposal area where garbage is piled up and eventually covered with dirt and topsoil

matter – that which has mass and occupies space; the substance or substances of which a physical object consists

median – the middle term in a series of numbers after the series is arranged from greatest to least

methane – an odorless gas produced by the decomposition of organic matter

mode – the prevailing term in a series of numbers; the most common data entry

natural gas – a naturally occurring gas found either alone or together with oil in underground reservoirs

organic – something living or derived from living things

quad – unit of energy equivalent to one quadrillion (1,000,000,000,000,000) British Thermal Units (BTU)

radiant energy – energy emitted by the sun, typically in photons and waves

range – the difference observed in the largest and smallest data points, collected for some variable

renewable – something that can be used over and over again with out running out

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