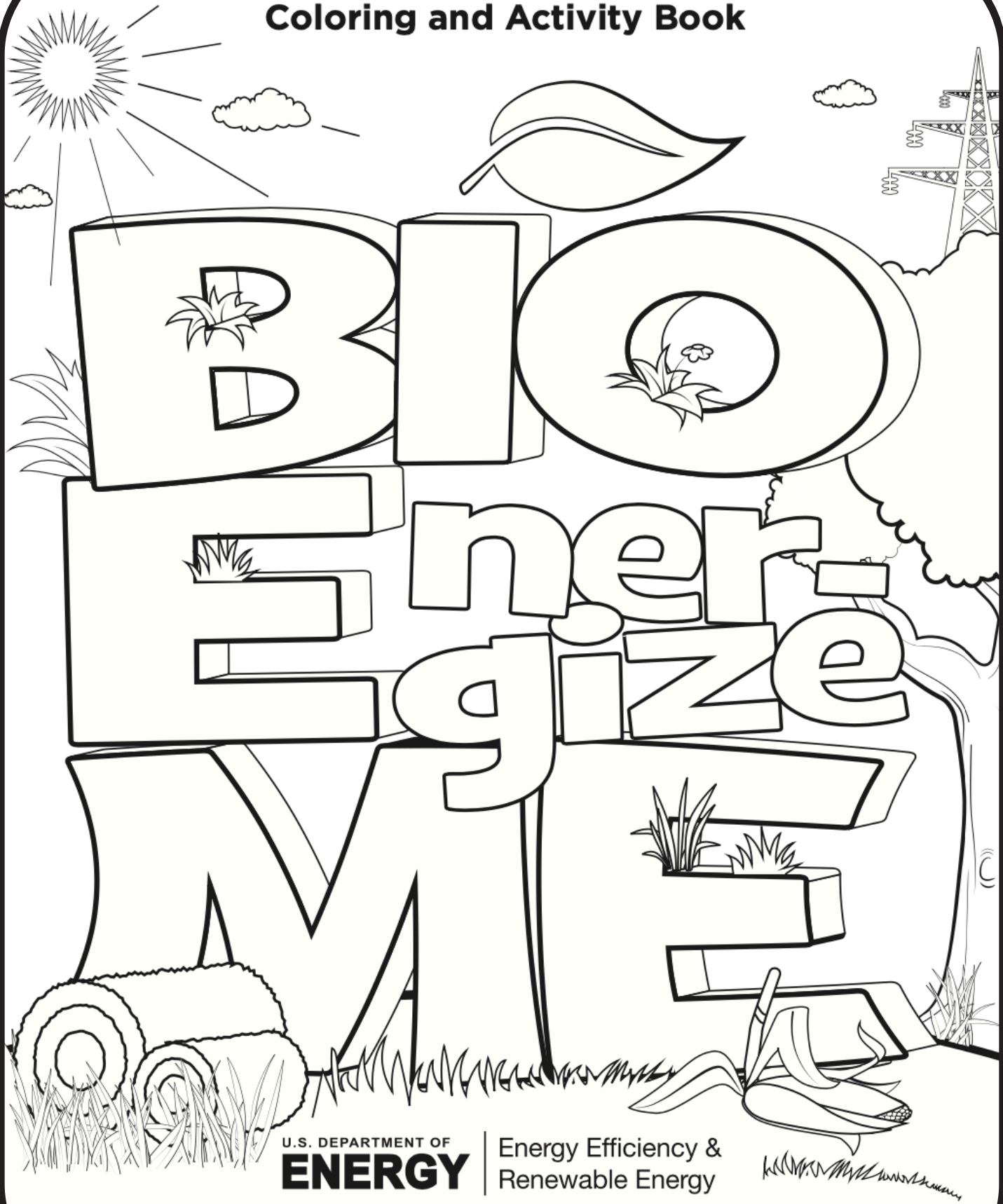


Coloring and Activity Book



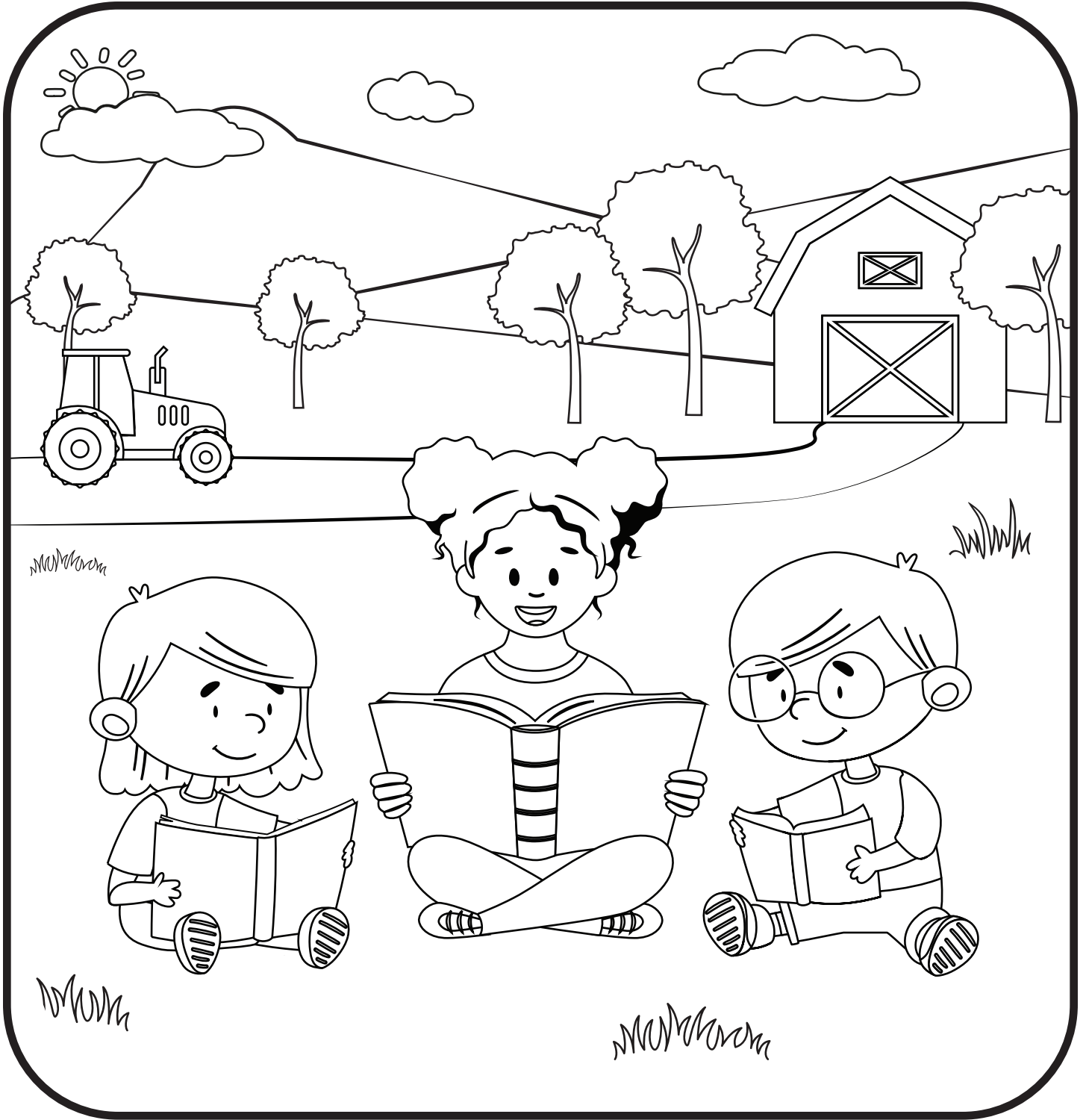
U.S. DEPARTMENT OF
ENERGY

Energy Efficiency &
Renewable Energy

BIOENERGY TECHNOLOGIES OFFICE

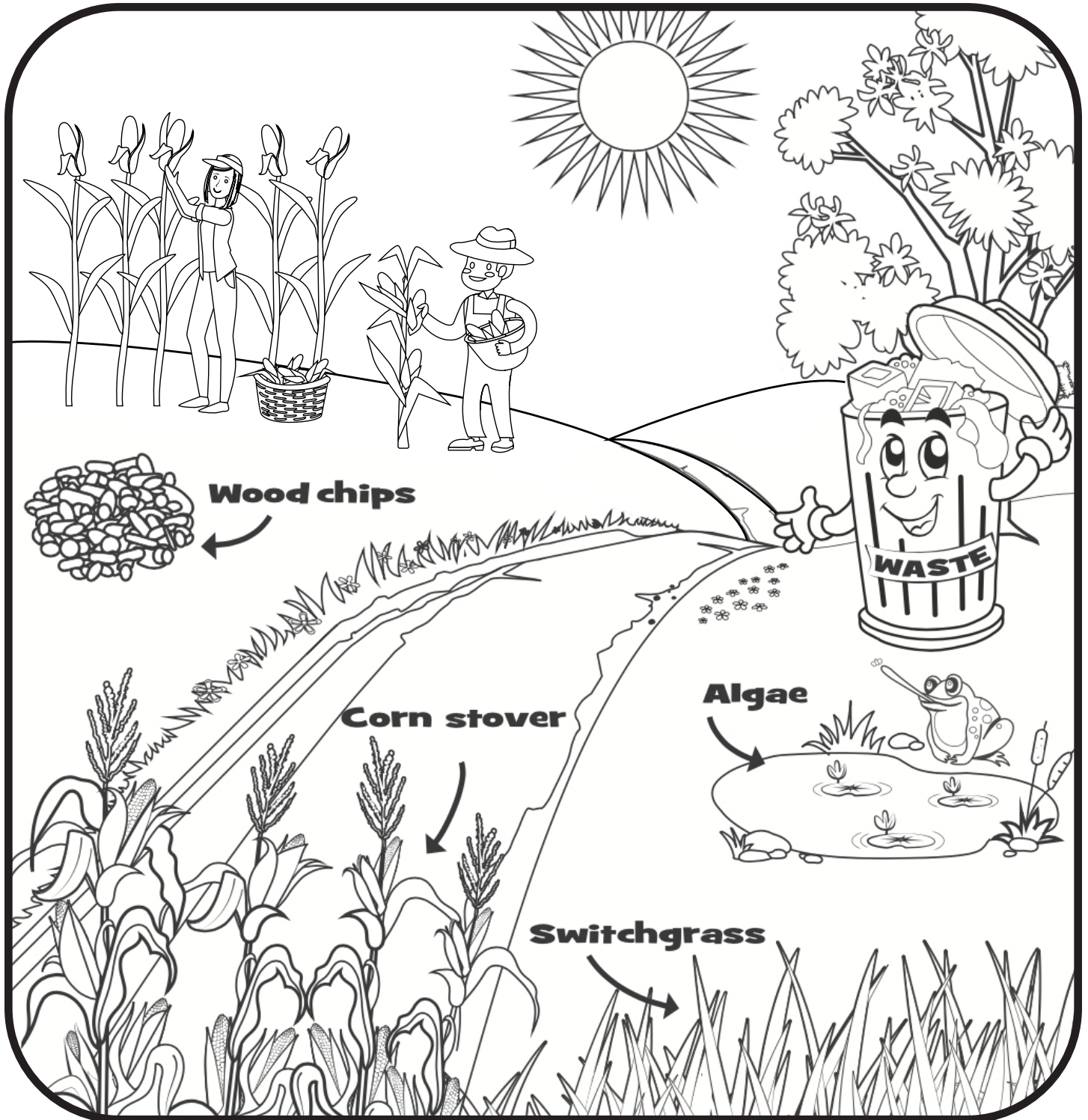
Second Edition, 2023

What is Bioenergy and Where Does it Come From?



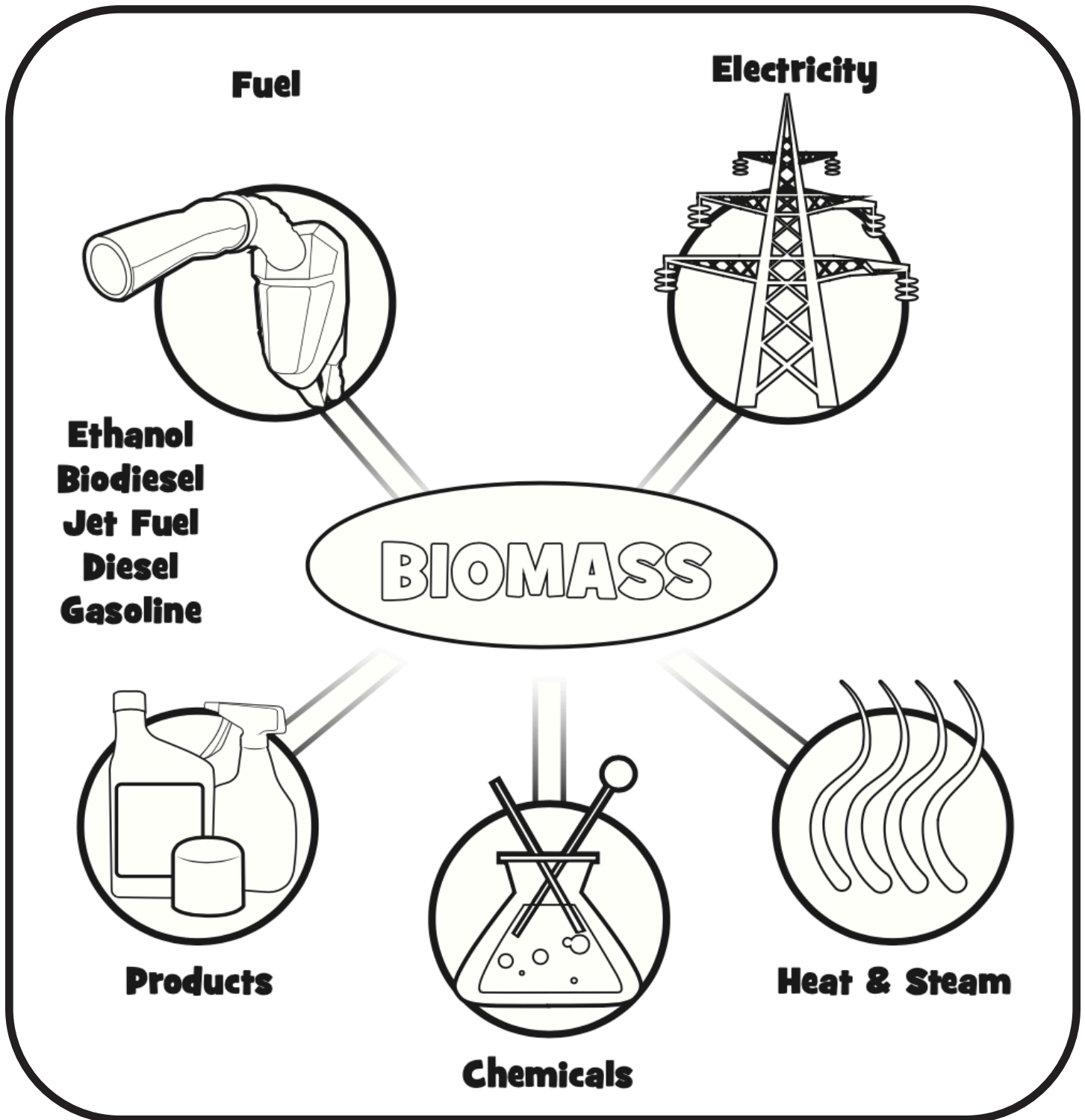
Bioenergy is a form of renewable energy that is produced from plants and other organic materials like algae, collectively referred to as biomass, which can be used to produce transportation fuels, heat, electricity, and products. When you see “bio-” in front of fuels, products, and power, it means these were made from biomass instead of petroleum.

Biofuels Come From Biomass (Plants and Trees) and Waste



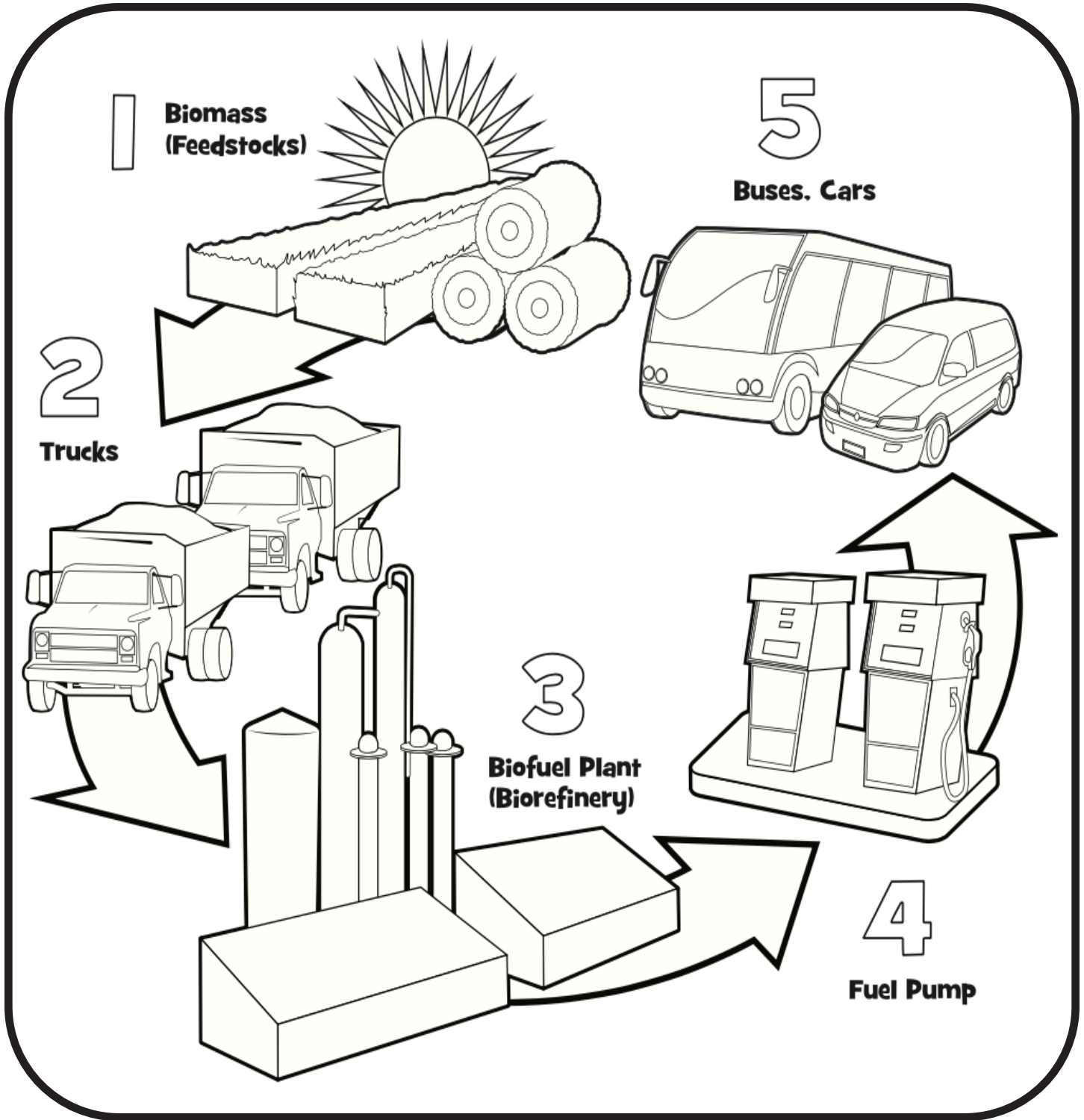
Biomass refers to a variety of resources. Some popular resources include waste streams, algae, wood chips, corn stover, and switchgrass.

What can Biomass Produce?



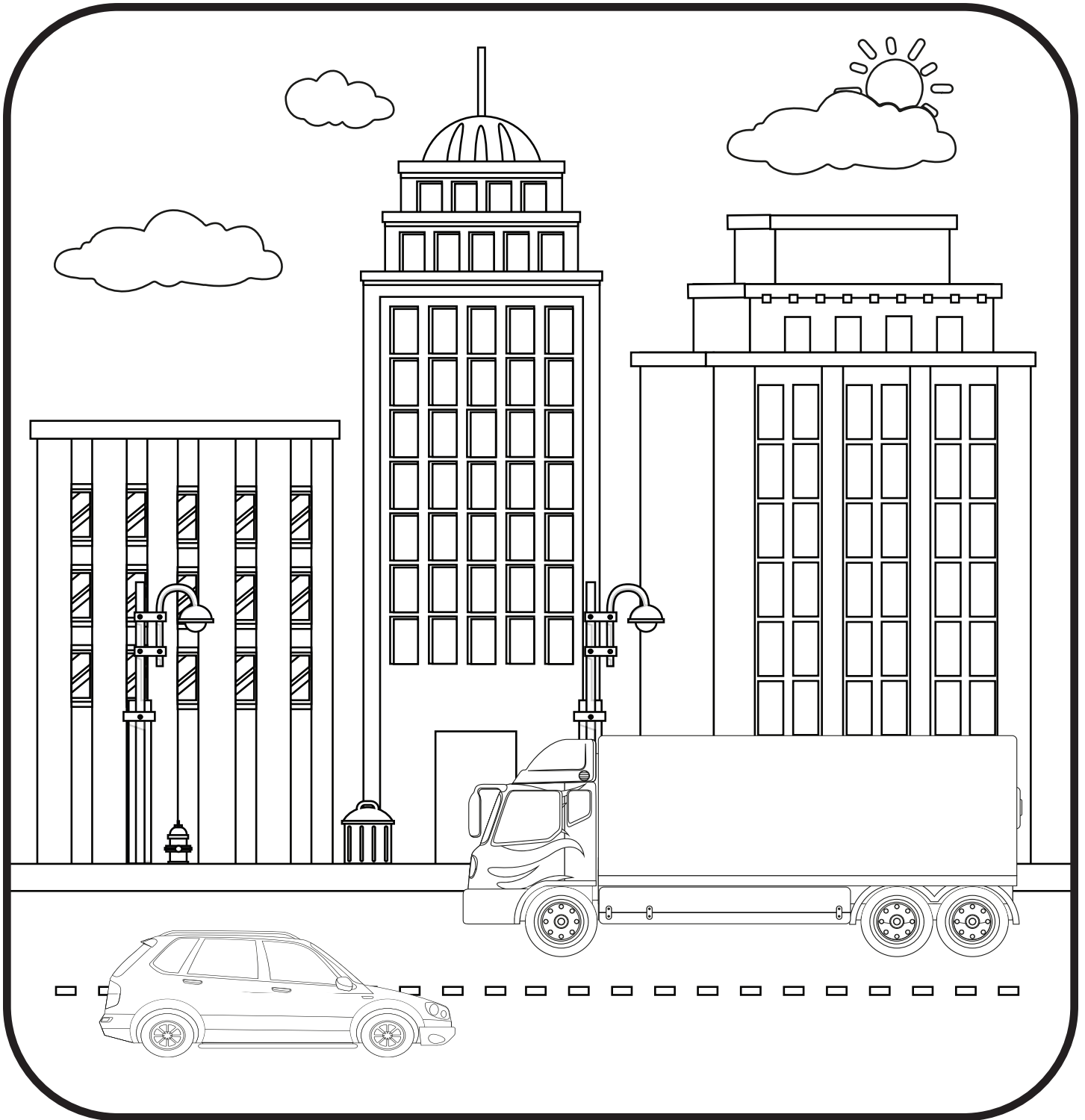
Biomass is a versatile energy resource. Not only can biomass be converted into fuel for vehicles, it can also be used as a type of renewable fuel in the manufacturing of products that are currently made from petroleum or natural gas. Some examples of these products are plastics, lubricants, and chemicals.

Biofuel: From Field to Fuel Pump



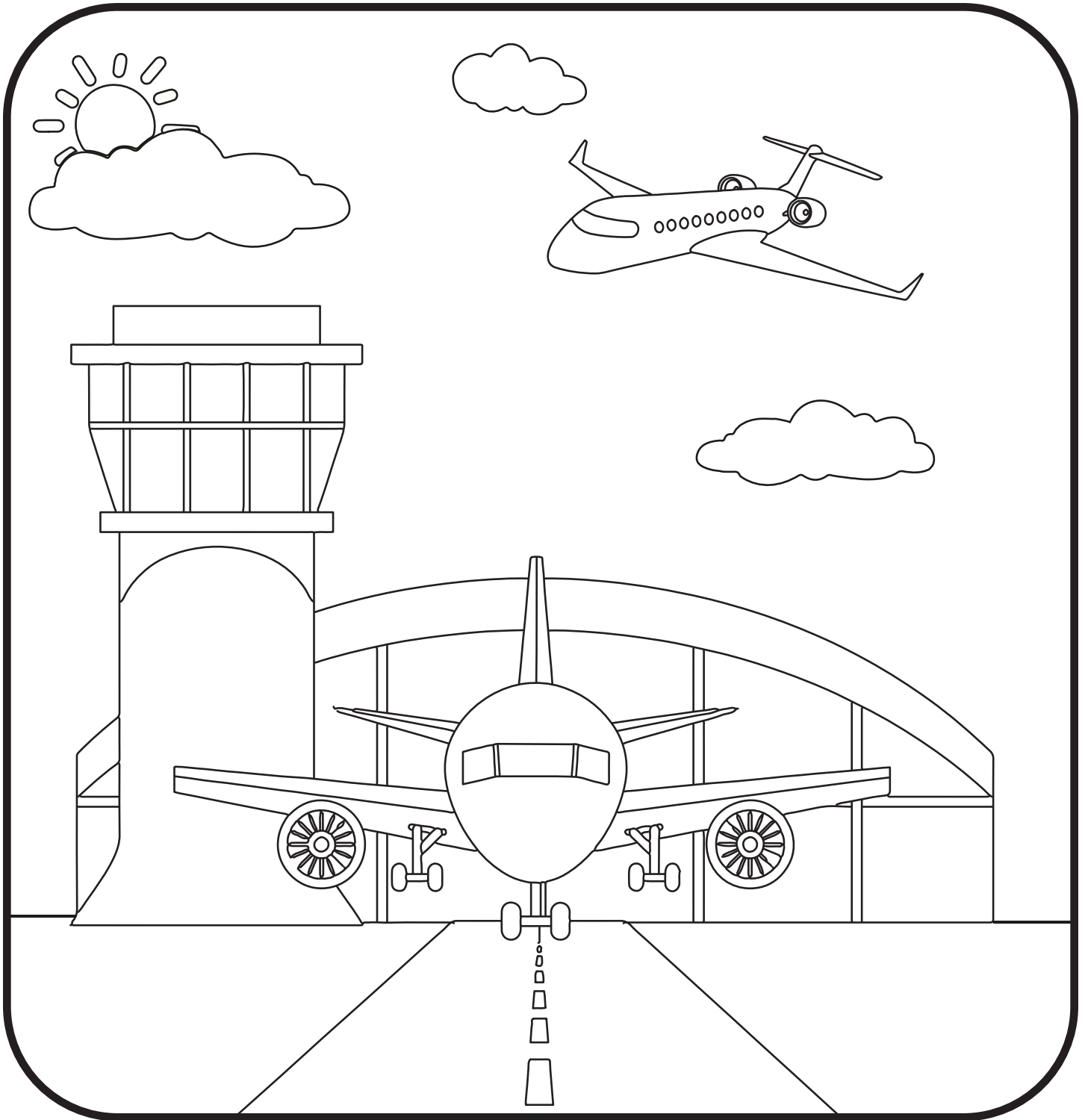
Plant-based biomass feedstocks include cornstalks, grasses, trees, and waste.

Biofuels can power cars and trucks!



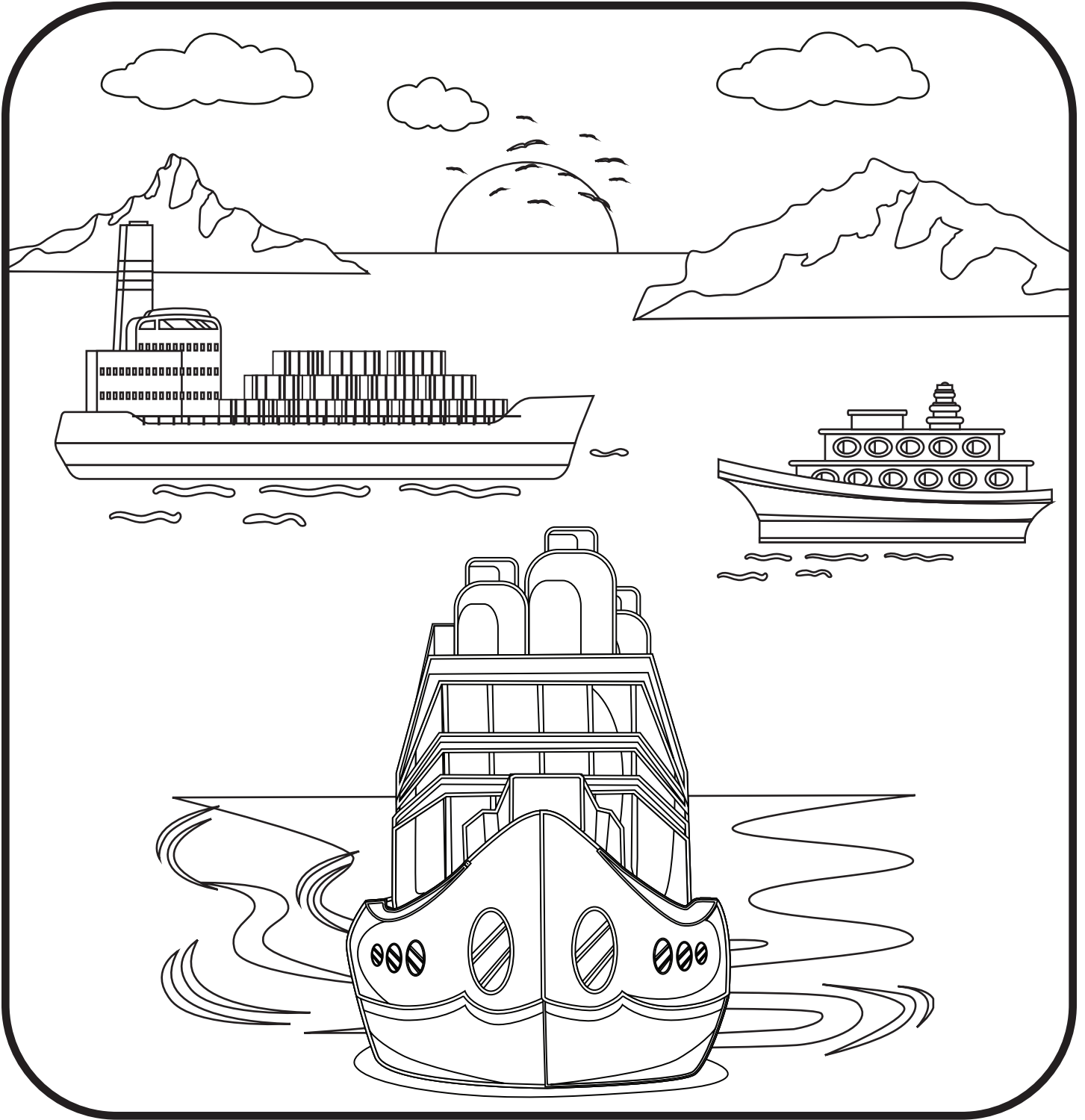
The two most common types of biofuels in use today are ethanol and biodiesel, both of which represent the first generation of biofuel technology.

Biofuels can power airplanes!



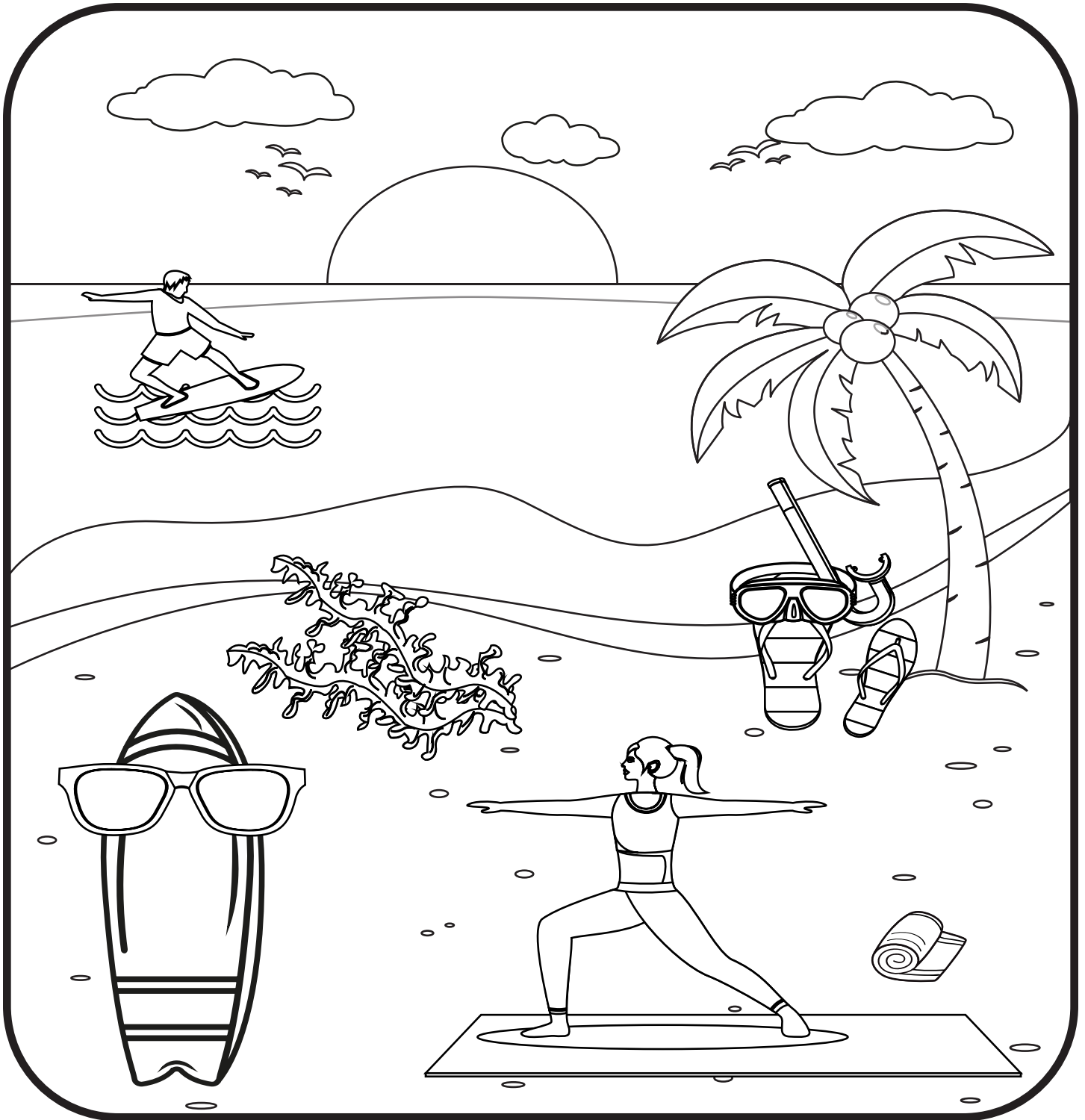
Sustainable Aviation Fuel is a biofuel used to power aircraft that has similar properties to conventional jet fuel but less of an impact on the environment.

Biofuels can power ships!



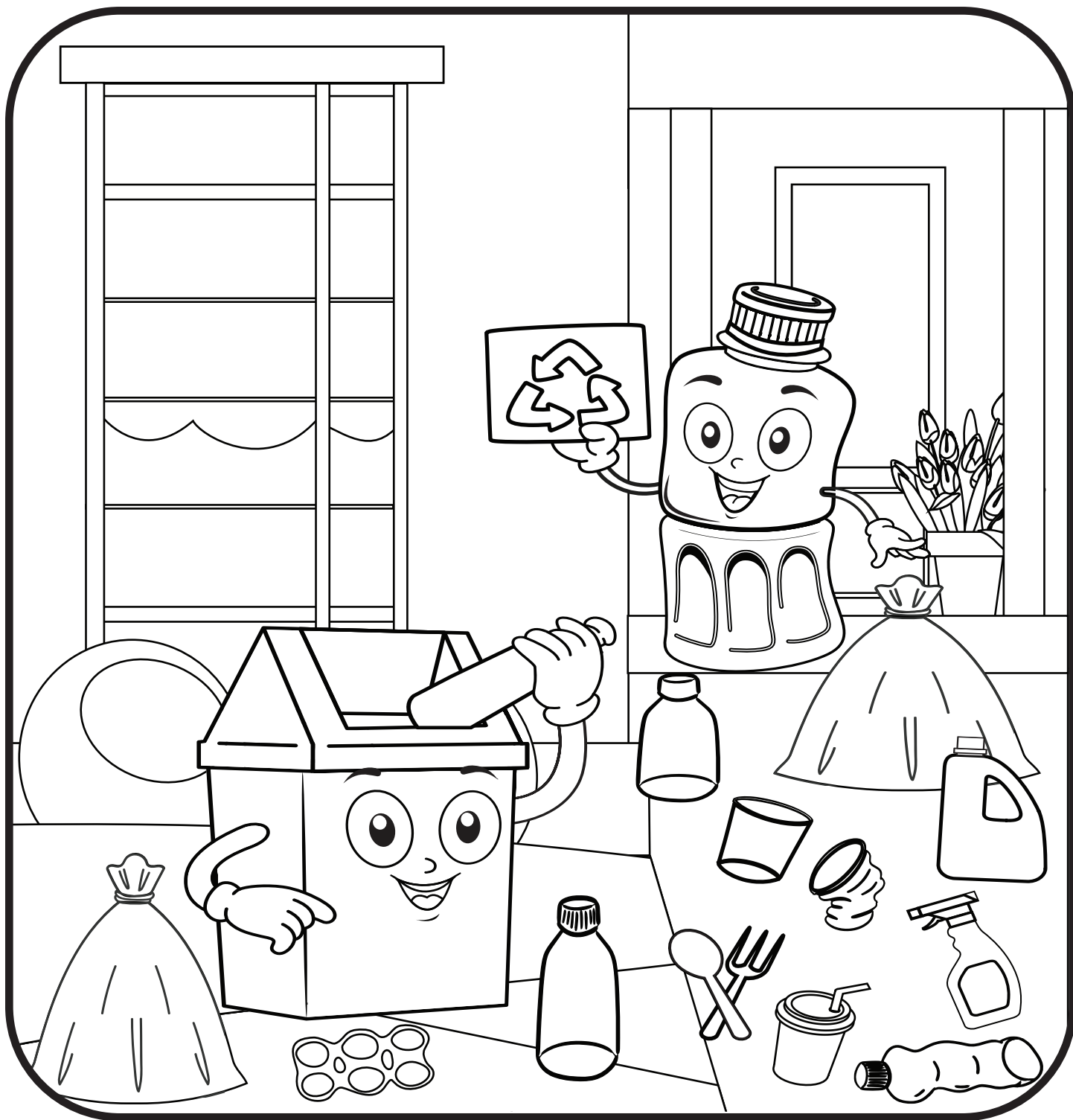
Sustainable Marine Fuel is a biofuel used to power ships with similar properties to conventional fuel but less of an impact on the environment.

Algae can create flip-flops, surfboards, yoga mats + more!



Fast-growing and able to store energy from sunlight, algae can be transformed into a variety of products, such as fuel, food, fertilizer, industrial compounds, and animal feed.

Plastic waste can create valuable resources!



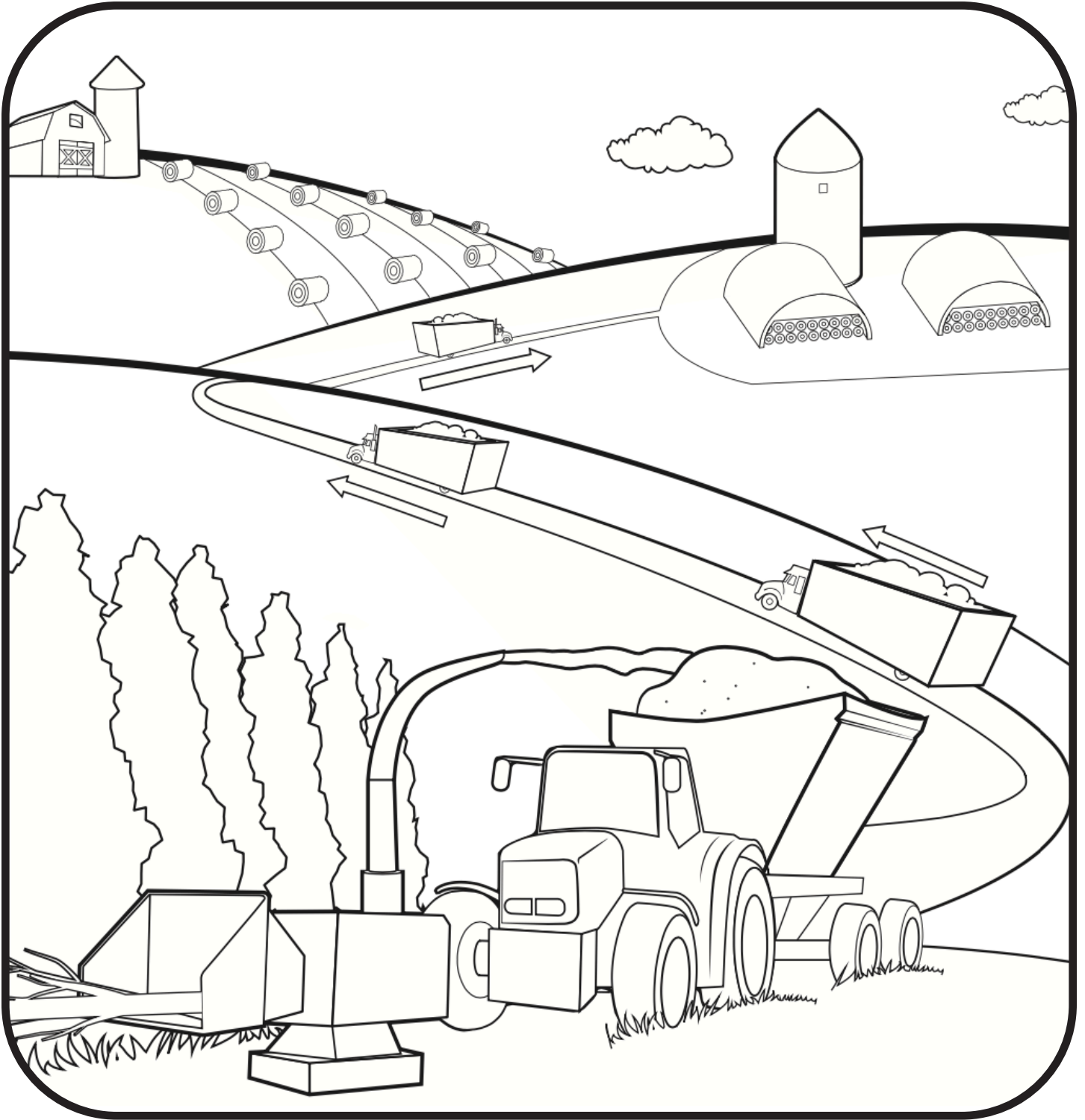
The U.S. Department of Energy Bioenergy Technologies Office is combating plastic waste by supporting research and development of innovative technologies that transform plastic waste into new materials and creating tomorrow's plastics to be recyclable-by-design.

Trash can be transformed into valuable resources!



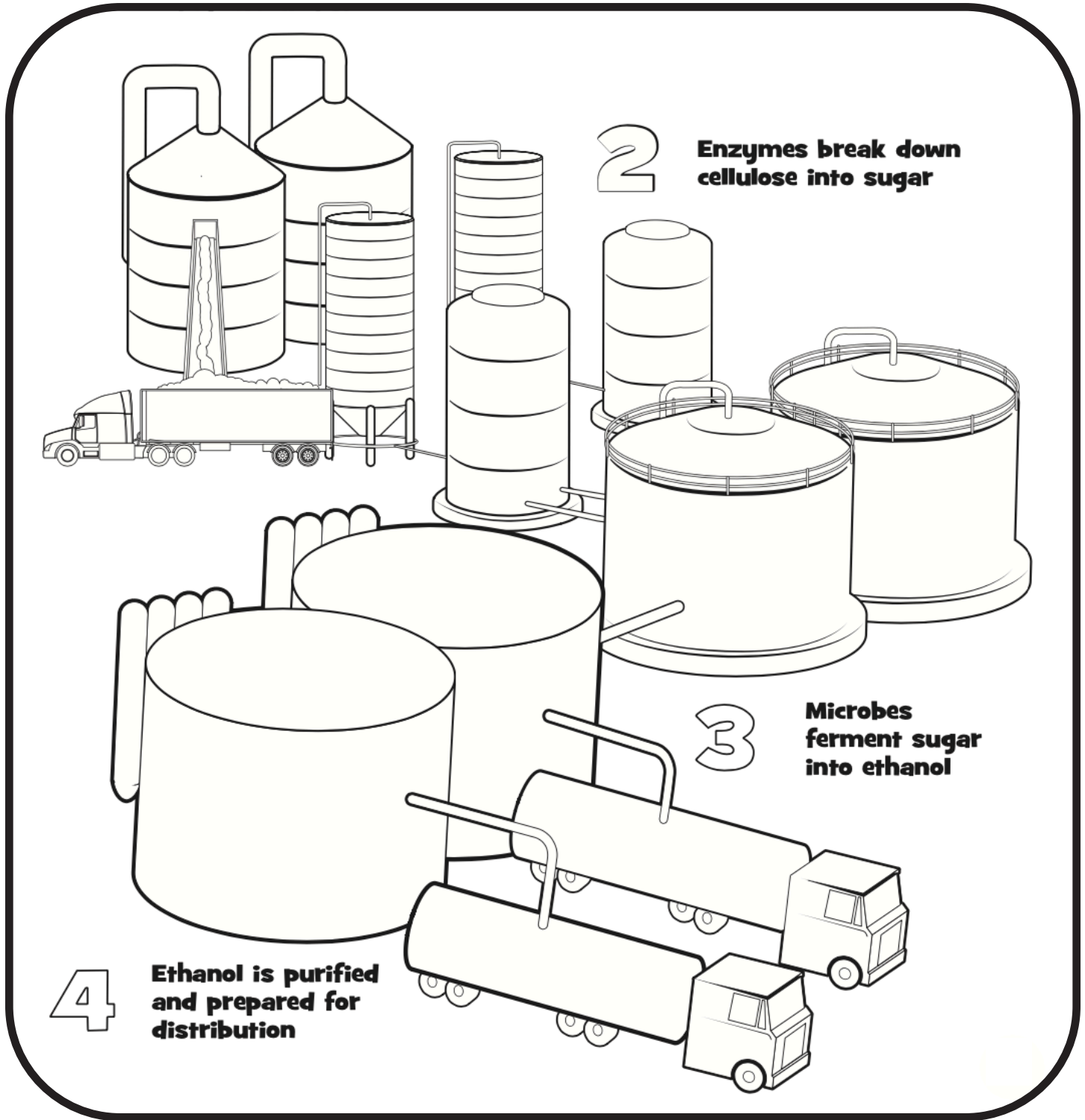
Waste streams, including municipal solid waste, animal manure, wastewater residuals, and other organic wastes, are a key feedstock for producing biofuels and bioproducts.

How is Biomass Processed?



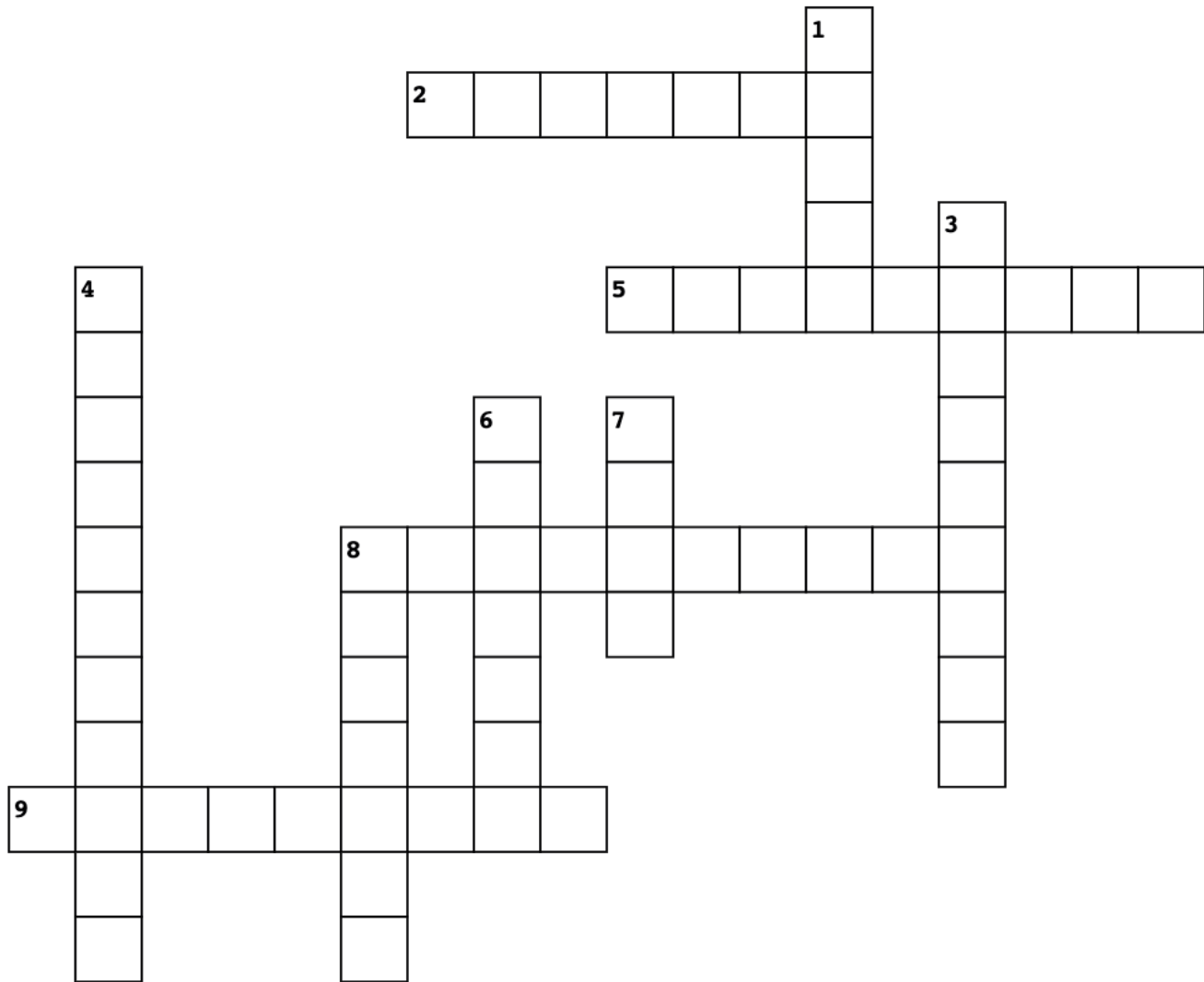
Plant-based renewable biomass is harvested, chopped into small pieces, or rolled into bales. Processed biomass is transported to a storage site at a biofuel plant or biorefinery.

How Does a Biorefinery Operate?



Biorefineries are facilities that convert a broad range of biomass feedstocks into affordable biofuels, bioproducts, and biopower.

Bioenergy Crossword Puzzle



ACROSS

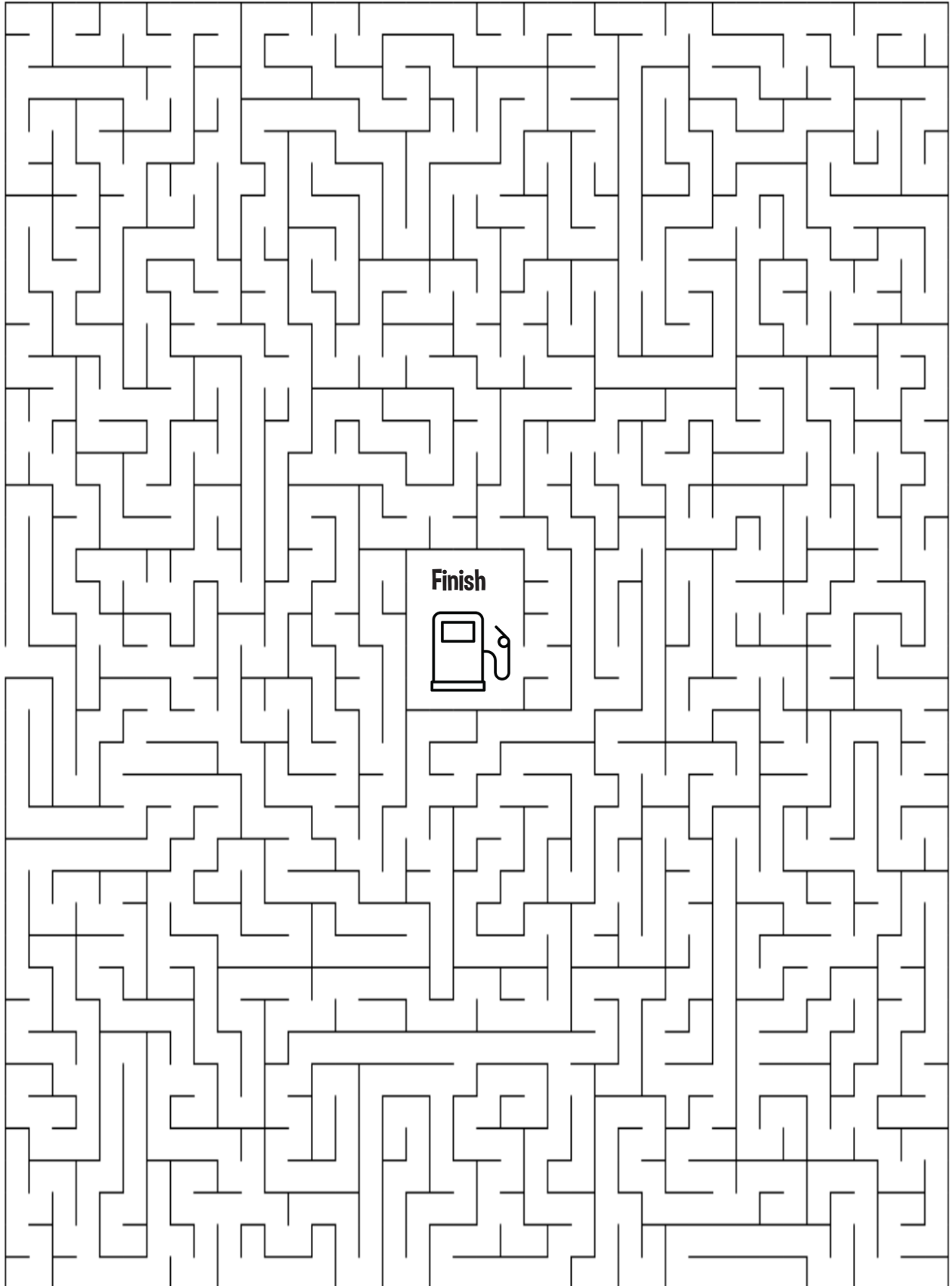
2. A renewable fuel that can be made from various plant materials, collectively known as “biomass.”
5. A form of renewable energy that is produced from recently living organic materials known as biomass.
8. A material derived from bioenergy feedstocks.
9. A term used for natural resources.

DOWN

1. Plantlike small aquatic organisms that convert sunlight into energy.
3. Renewable biomass resources used either directly as a fuel or converted to another form or energy product.
4. Facilities that convert biomass feedstocks into affordable biofuels, bioproducts, and biopower.
6. A fuel made from biomass feedstocks.
7. An automobile used for transportation.
8. A renewable energy resource derived from plant and algae-based materials.

Find the Way to the Fuel Pump

Find your way through the maze.



Bioenergy Word Search

Find these words:

Algae

Aviation

Bioenergy

Biofuel

Biomass

Bioproduct

Biorefinery

Clean

Energy

Ethanol

Farm

Feedstock

Fuel

Green

Maritime

Natural

Plastic

Renewable

Transportation

Waste

B C N V W X Y I N N I X K D B
V I I Q E A O I O X Z R C I I
C B O T Z T S I B H N O O T O
L N G E S E T T O U P M T C F
E J L E N A F U E L A R S U U
A F R E I E L W Z S Y L D D E
N O R V Q L R P S C I M E O L
F G A S D U A G M D J K E R N
Y L O N A H T E Y R P N F P A
A L G A E A G H A G A U H O T
Y R E N I F E R O I B F D I U
M A R I T I M E E M X L L B R
P X D U R I R E A E K B H U A
N O I T A T R O P S N A R T L
M Z S E L B A W E N E R Q Q R

Some Words to Learn

Harvesting: Only an appropriate amount of biomass is removed to ensure the process is sustainable and the soil health is maintained.

Feedstock: Biomass resources that are available on a renewable basis and are used either directly as a fuel or converted to another form of energy product.

Corn Stover: Stalks, leaves, and cobs that remain after the removal of corn.

Bale: Harvested corn stover, either round or square shaped.

Algae: Plantlike small aquatic organisms that convert sunlight into energy – the green stuff in ponds or seaweeds in oceans or lakes. Most algae grow in freshwater or seawater.

Cellulose: Main component of plant cell walls.

Biodiesel: Biodiesel is a liquid fuel produced from renewable sources, such as new and used vegetable oils and animal fats and is a cleaner-burning replacement for petroleum-based diesel fuel.

Bioproducts: Materials that are derived from bioenergy feedstocks. Examples include paper, ethanol, and plastics.

Bioeconomy: A global transition to the sustainable use of renewable biomass resources in energy and products aiming to increase economic, environmental, and social benefits and reduce environmental and social harm.

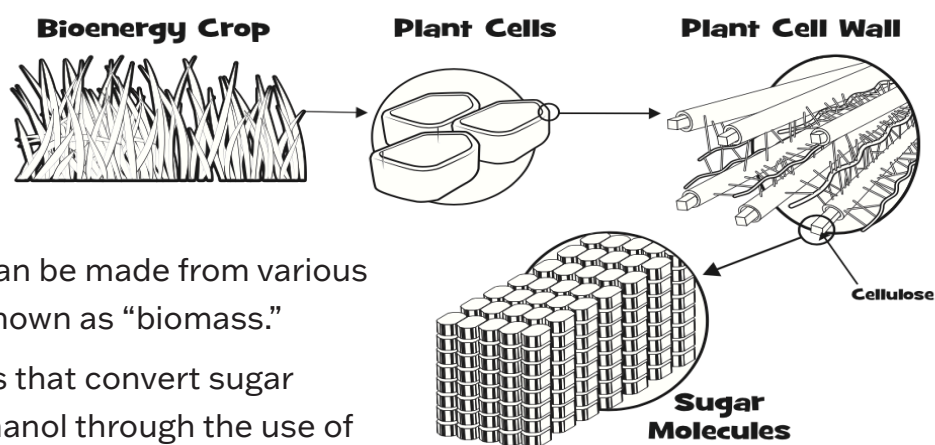
Municipal Solid Waste (MSW): Trash or garbage, such as everyday items we use and then throw away, can be converted to a clean gas by using heat. With chemical processes, gas is turned into liquid alcohol fuels.

Ethanol: A renewable fuel that can be made from various plant materials, collectively known as “biomass.”

Fermentation: Chemical reactions that convert sugar molecules in biomass into ethanol through the use of microbes or enzymes.

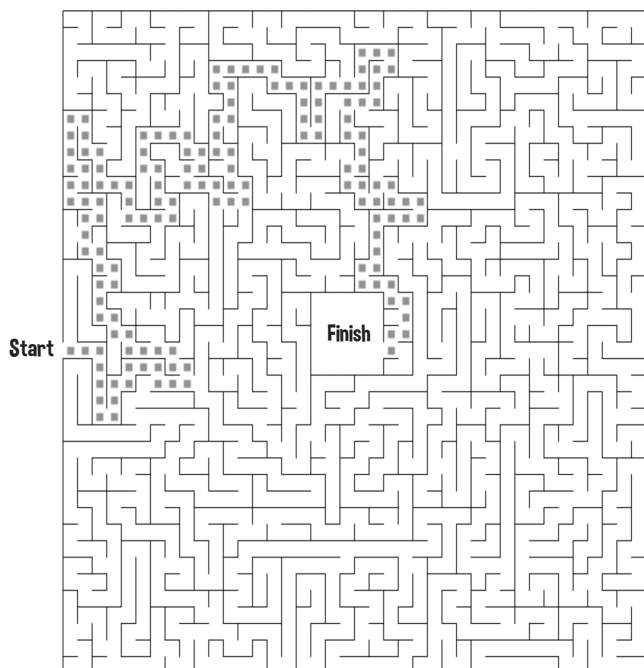
Enzymes: Proteins made by cells in all living organisms. Enzymes speed up chemical reactions and make fermentation possible.

Recyclable-By-Design: To consider a product’s recyclability in the design phase, to increase the likelihood that parts of the product will be recycled.

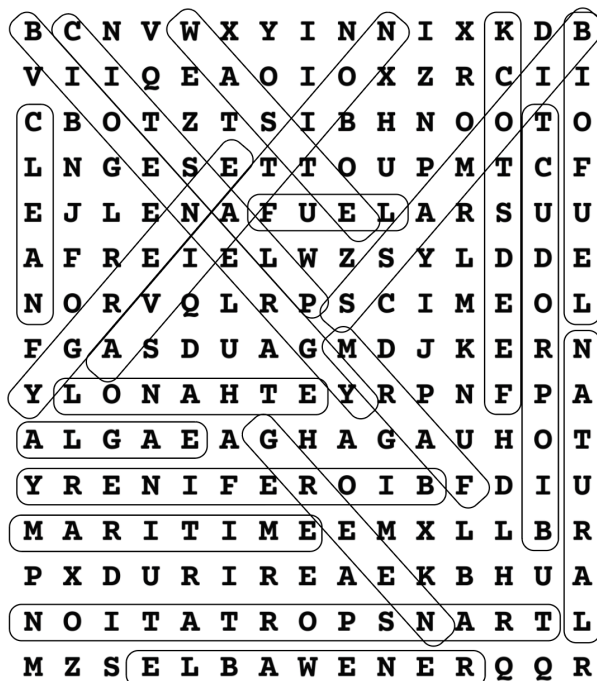


Solutions

Maze



Word Search



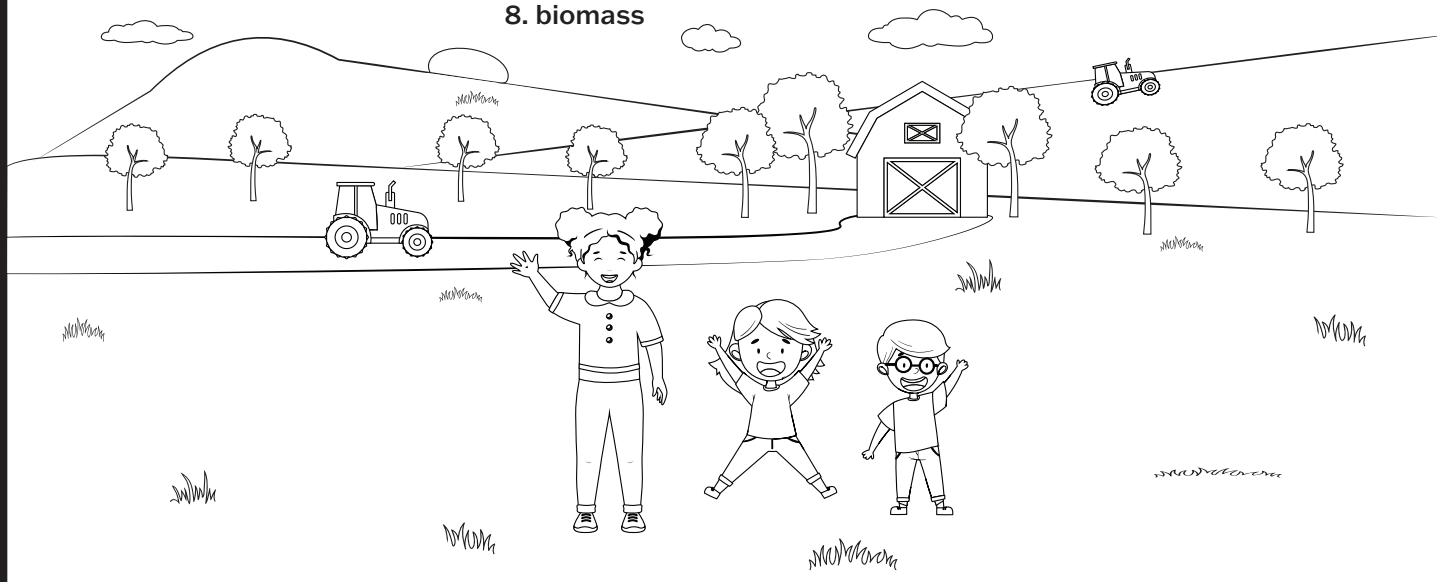
Crossword Puzzle

ACROSS








2. ethanol
5. bioenergy
8. bioproduct
9. renewable

DOWN

1. algae
3. feedstock
4. biorefinery
6. biofuel
7. cars
8. biomass



Energy Literacy Principles

- 1** Energy is a physical quantity that follows precise natural laws. 
- 2** Physical processes on Earth are the result of energy flow through the Earth system. 
- 3** Biological processes depend on energy flow through the Earth system. 
- 4** Various sources of energy can be used to power human activities, and often this energy must be transferred from source to destination. 
- 5** Energy decisions are influenced by economic, political, environmental, and social factors. 
- 6** The amount of energy used by human society depends on many factors. 
- 7** The quality of life of individuals and societies is affected by energy choices. 

U.S. Department of Energy

Office of Energy Efficiency and Renewable Energy
www.energy.gov/eere/education/teach-and-learn

Energy Information Administration

www.eia.gov/kids/

Energy Star Kids

<http://www.energystar.gov/kids>



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This coloring and activity book is developed as part of OPERATION BioenergizeME initiative of the Bioenergy Technologies Office. BioenergizeME is an education and workforce development base camp for students and educators and anyone seeking to better understand the promises and challenges in developing a thriving bioeconomy.