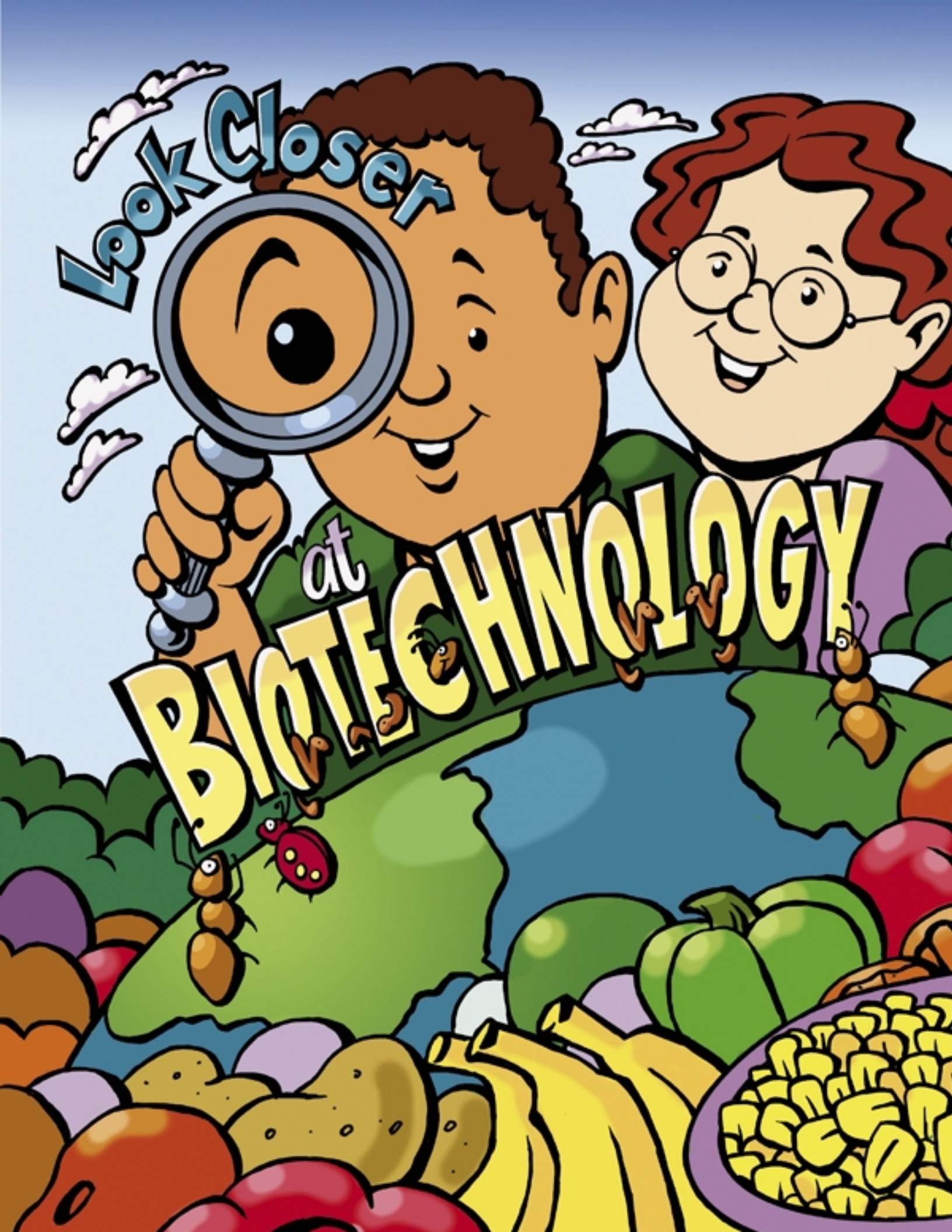


Look Closer

at
BIOTECHNOLOGY



Hi Kids,

Welcome to the Biotechnology Basics Activity Book. This is an activity book for young people like you about biotechnology — a really neat topic. Why is it such a neat topic? Because biotechnology is helping to improve the health of the Earth and the people who call it home. In this book, you will take a closer look

at biotechnology. You will see that biotechnology is being

used to figure out how to: **1) grow more food; 2) help the environment; and 3) grow more nutritious food**

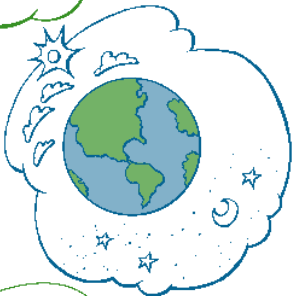
that improves our health. As you work through

the puzzles in this book, you will learn more about

biotechnology and all of the wonderful ways it can

help people live better lives in a healthier world.

Have fun!



What is Biotechnology?

Biotechnology (by-o-tek-nawl-a-gee) is a big word, but it is easy to figure out what it means if you just look closer! **Bio** is short for biology, which is the study of all living things. **Technology** is another word for tools. **Biotechnology** then, is a tool that uses biology to make new products. For example, agricultural biotechnology is a precise way to make seeds with special qualities. These seeds will allow farmers to grow plants that are more nutritious, more resistant to pests and more productive. Biotechnology is a tool for looking closer at nature to find solutions that improve the health of the Earth and its people.

Unscramble the letters below to spell the two words that make up the word, BIOTECHNOLOGY.

o y l o i b g

y c o e t l n o g h



How does biotechnology work?

Biotechnology allows scientists to look closer at genes and make improvements in them. Your body is composed of millions of individual units called cells. Within each cell are genes that carry all of the information that allows your body to work and determines how you look. You get your genes from your parents. This is why you may look like your parents. All people, plants and animals inherit traits from their parents through their genes.

One of the first people to study how traits are passed from parents to their young was a monk in Austria named Gregor Mendel. Almost 200 years ago, he used plants to show how certain things such as flower size and color are passed on from the parent to the offspring.



Biotechnology allows for scientists to study how plants grow and how they react to the environment. As a result, scientists can now insert a specific gene into a plant that will help it adapt to its environment, make it more pest resistant, or even make it more nutritious.

How many new words can you make using the letters in **BIOTECHNOLOGY**? Use the following scoring table to figure your points for each word and write that number beside the word.

3-letter word = 1 point 4-letter word = 2 points 5-letter word = 3 points

Add 1 point for each letter over 5

How many total points can you score?

WORD	POINTS	WORD	POINTS
1. <u> B O O T </u>	<u> 2 </u>	10. _____	_____
2. _____	_____	11. _____	_____
3. _____	_____	12. _____	_____
4. _____	_____	13. _____	_____
5. _____	_____	14. _____	_____
6. _____	_____	15. _____	_____
7. _____	_____	16. _____	_____
8. _____	_____	17. _____	_____
9. _____	_____	18. _____	_____

My Total Points _____

How can biotechnology help the health of the Earth and its people?

You may not know it, but biotechnology has already made our lives better and can continue to do so in the future. Look closer and use the decoder at the side of the page to figure out three ways that biotechnology helps us.



A	B	C	D	E	F	G	H	I	J	K	L	M
26	25	24	23	22	21	20	19	18	17	16	15	14
N	O	P	Q	R	S	T	U	V	W	X	Y	Z
13	12	11	10	9	8	7	6	5	4	3	2	1

Puzzle Example:

T A K E A
7 26 16 22 26

C L O S E R L O O K
24 15 13 8 22 9 15 12 12 16

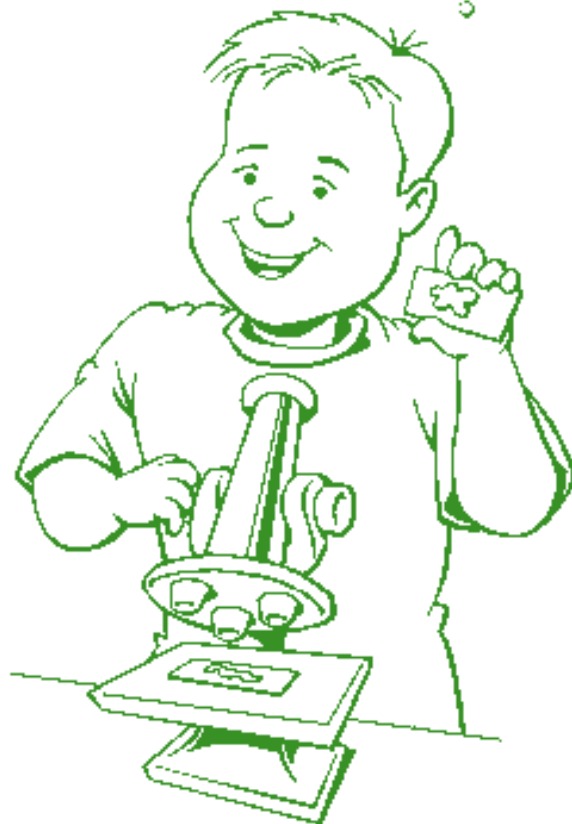
25 18 12 7 22 24 19 13 12 15 12 20 2

24 26 13 19 22 15 11 6 8 :

20 9 12 4 14 12 9 22

21 12 12 23





11 9 12 7 22 24 7

20 9 12 4 14 12 9 22

7 19 22

13 6 7 9 18 7 18 12 6 8

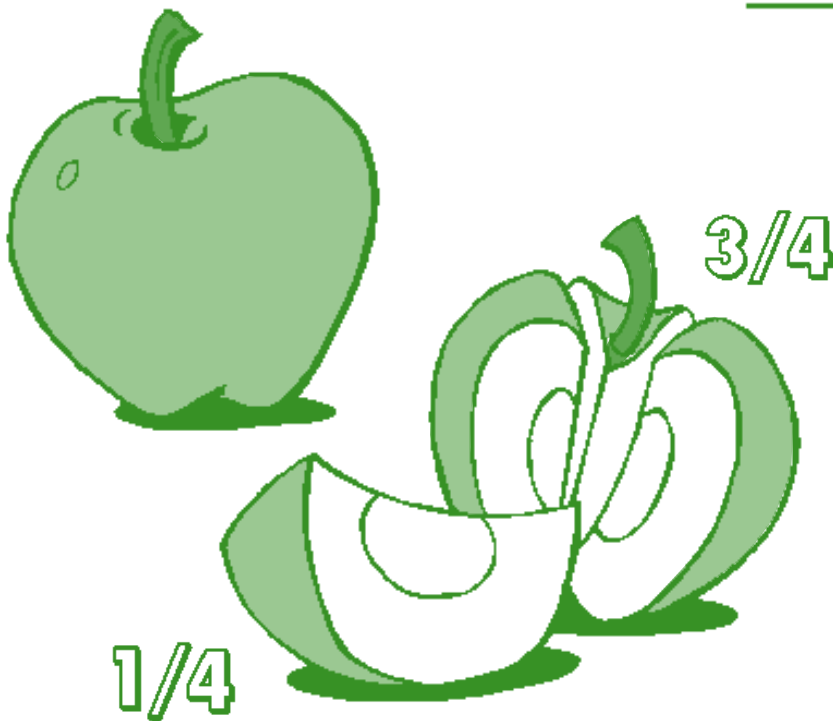
22 13 5 18 9 12 13 14 22 13 7

21 12 12 23

How can biotechnology help us grow more food?

Today the world's population is growing, but the amount of land we have for farming is not! This means that it will become harder to grow food for everyone on Earth.

Imagine this apple represents the Earth.



If you cut the apple into four equal pieces, three of those pieces are covered by water. Only one of the pieces is land, or $1/4$ of the Earth!

If you slice this piece in half, you get two pieces that are each $1/8$ of the whole apple. One of these pieces represents the land that people can live on. The other piece represents deserts, mountains and forests where people do not live.



If you cut this piece of apple into four equal pieces, you would find that three of those pieces are for cities, neighborhoods, homes, schools and stores — places where we can live, but can't grow food.



All that is left is this tiny piece — this is $1/32$ of the whole earth.

Take this last piece of apple and carefully peel off the skin. This tiny piece of skin represents the farmable land or topsoil layer where we grow our food.



Our land is a precious resource. Scientists and farmers are looking closer to find ways of growing more food. Biotechnology is one method being used to help farmers grow more food. Someday, farmers also could grow food on land that before was not good for farming. For example, a crop could be grown on very dry land or very rocky land.

How can biotechnology help the environment?

Biotechnology can help farmers and the environment in many ways. Bugs and weeds are big problems for farmers. Farmers have many tools to choose from to protect their crops. Sometimes farmers use special chemicals to help control the weeds and bugs when they are really bad. Biotechnology is another option. For example, many farmers grow cotton. Some young insects, or larvae, love to eat cotton plants. To stop the larvae from feasting on cotton plants, scientists have found ways to use biotechnology to help the cotton plant protect itself from insect larvae worms. Farmers who grow these special cotton plants do not need to spray as much insecticide on their crops, and they can still grow as much or more cotton!

Weeds can be a problem for farmers too. Weeds crowd out farm crops and rob them of the water, light and nutrients they need to grow. Many farmers plow their fields to destroy these weeds, but plowing can cause soil erosion. Thanks to biotechnology, a farmer can manage the weeds without having to plow. This saves energy as well as the soil! Giving farmers more choices to control harmful bugs and weeds helps their farms and the environment.

Farmers who grew cotton plants that were made from biotechnology were able to reduce the amount of insecticide used by more than 2 million pounds.



Farmers grow lots of cotton since it used to make so many things.

Below is a list of items made from cotton. Each word is missing some vowels.
Add the letters A, E, I, O, U to spell the name of the item made from cotton.

S H _ _ R T

J _ _ _ N S

S W _ _ _ T _ R

D _ _ L L _ _ R

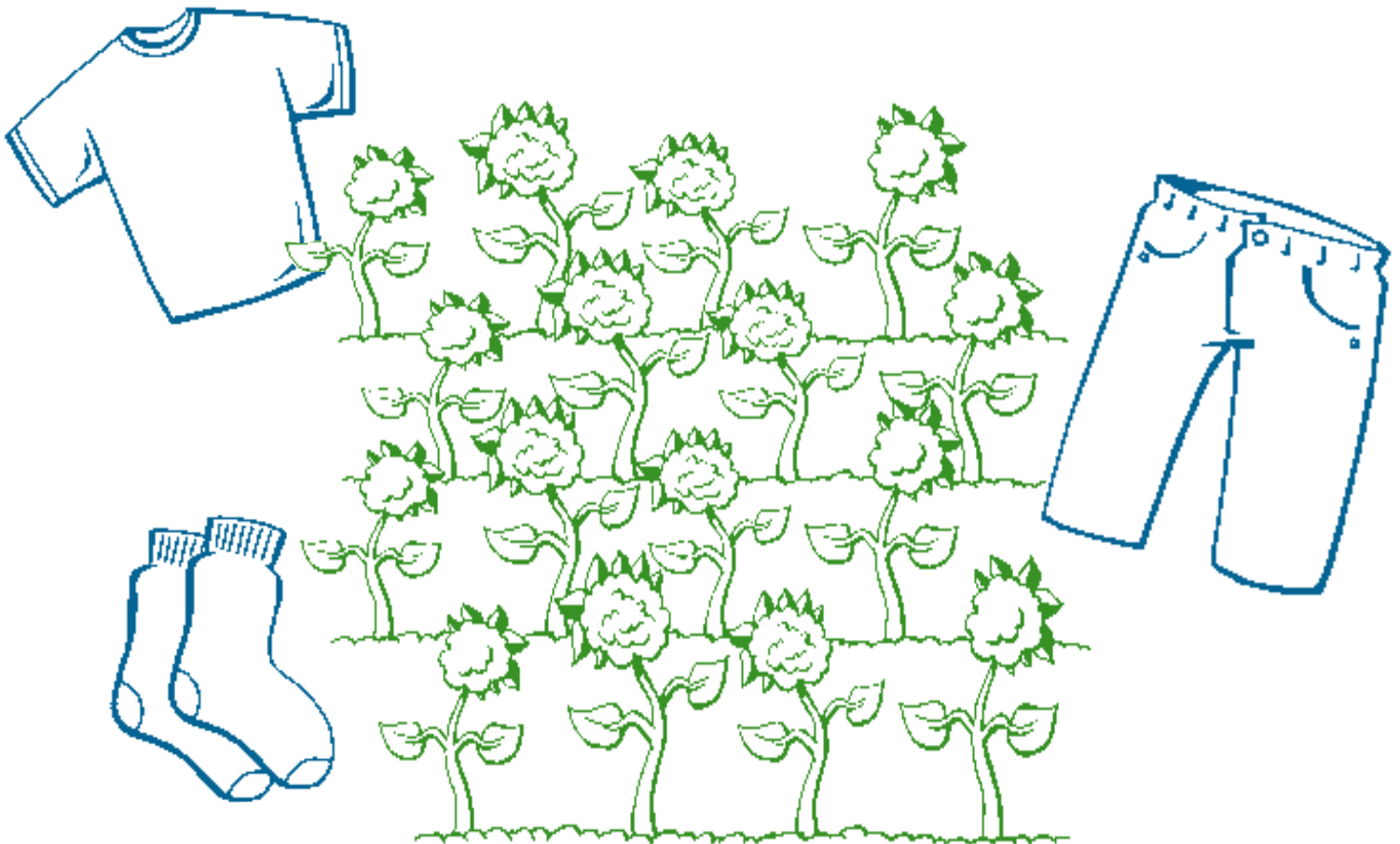
B _ _ L L

S _ _ C K S

T _ _ W _ _ L S

Most T-shirts are made of cotton. It takes eight cotton plants to make one T-shirt.

Look at the field of cotton drawn below. Circle the cotton plants in groups of eight.
How many T-shirts can be made from this field of cotton? _____



How can biotechnology help us to grow food that can improve our health and is more nutritious?

Scientists are using biotechnology to grow foods that could help make people healthier. Here are a few examples:

Rice will one day have extra beta-carotene, which is a source of Vitamin A. They call it "Golden Rice." It could help fight diseases and blindness.

In the future, bananas could be grown with medicines inside them. This means people could grow their own banana trees to provide the essential medicines to protect against illness and disease.

Someday, potatoes could be grown that absorb less oil when they are made into potato chips or french fries. Healthier snacks does not mean that you should eat too much of them; but when you do eat them, they could be better for you.

Here are pictures showing foods that can help us be healthier. Can you match the food with the benefit?



● Potatoes

● Reduces Blindness



● Rice

● Edible Medicines



● Bananas

● Great Taste, Reduced Fat





Biotechnology is one of many tools farmers can use to improve their crops. It could have tremendous potential for improving the environment and the food supply for people around the world. While farmers have been breeding plants to create better crops for centuries, biotechnology takes the process a giant step further. Agricultural biotechnology is a precise way to make seeds with special qualities. These seeds could allow farmers to grow plants that are more nutritious, more resistant to pests and more productive.

Search this puzzle to find 20 words related to biotechnology and farming. You can form the words forward, backward, upside down or diagonally. Circle the words you find.

BIOLOGY	DAIRY	MICROSCOPE	SOYBEAN
BIOTECHNOLOGY	ENVIRONMENT	POTATO	TECHNOLOGY
CORN	FOOD	RICE	TRAIT
COTTON	GENE	SCIENTIST	WATER
CROP	INSECT	SOIL	WHEAT

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



As you can guess, there are many scientists involved in studying biotechnology to help people and the Earth.

One day you may want to become a scientist. Each of these people has a special name based on what they study. These scientists are experts in plants, food, insects, chemicals and genes, and they all work together to help find the solutions to tough problems. Can you figure out what each of these scientists study?

Draw a line between the picture of the scientist and the name of the scientist.



Nutritionist ●



● **Chemist**



● **Agronomist**



Geneticist ●



● **Entomologist**

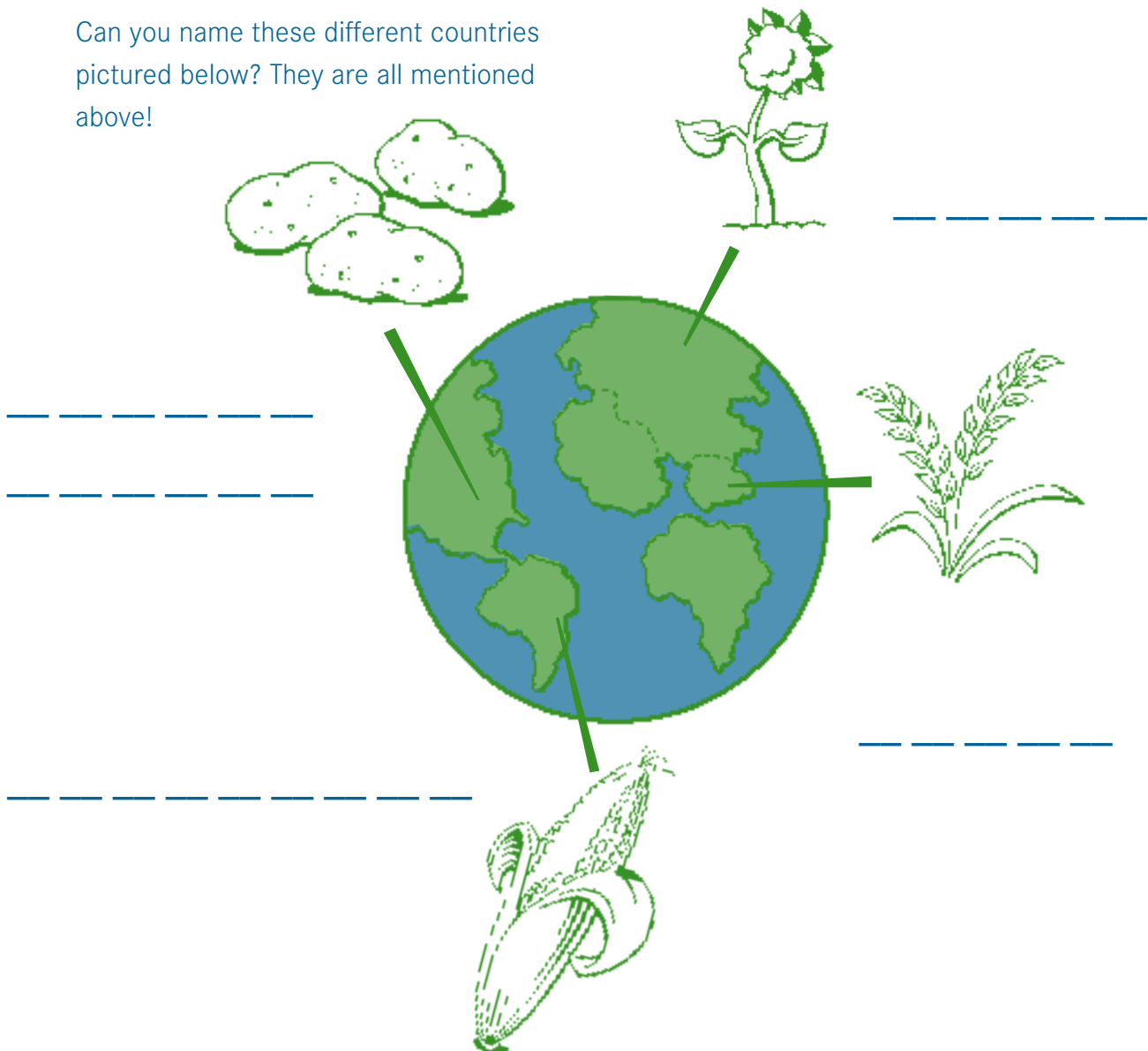
- This scientist studies insects.
- This scientist studies genes and how traits are inherited.
- This scientist studies the vitamins and minerals people need to be healthy.
- This scientist studies chemicals.
- This scientist studies agriculture.

Biotechnology helps farms of all sizes around the world.

Someday, farmers could produce more food, help the environment and produce more nutritious food.

For example, the farmer in China could grow cotton and use less insecticide. The farmer in India could grow healthier rice. The farmer in the United States could grow potatoes that protect themselves from harmful insects. The farmer in Argentina could grow corn that protects itself from insects.

Can you name these different countries pictured below? They are all mentioned above!



Answer Page

Page #2

biology technology

Page #3 — These are only some of the words to be found, did you find more?

lotion, honey, logic, bongo, boot, bone, bite, chin, cone, cool, hole, hoot, gone, logo, note, only, tool, tone, ton, toy, too, toe, tie, big, bet, bit, bog, beg, get, got, lot, hot, hit, log

Page #4 -5

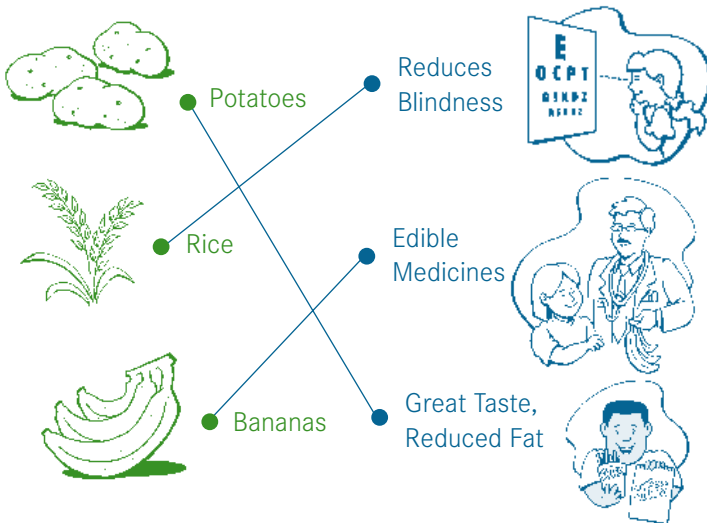
Biotechnology could help us: grow more food, protect the environment, grow more nutritious food.

Page #9

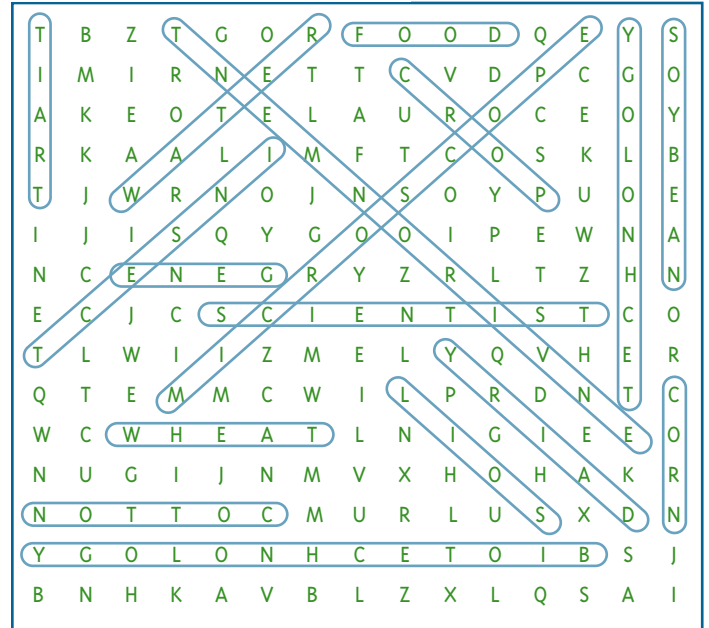
Shirt	Jeans	Sweater
Dollar Bill	Socks	Towels

2 shirts can be made from the cotton plants

Page #10



Page #11



Page #12

Entomologist: This scientist studies insects.

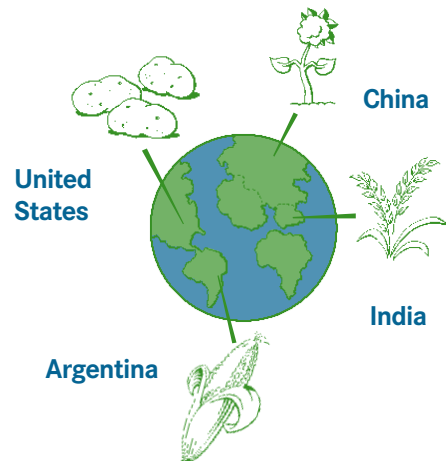
Geneticist: This scientist studies genes and how traits are inherited.

Nutritionist: This scientist studies the vitamins and minerals people need to be healthy.

Chemist: This scientist studies chemicals.

Agronomist: This scientist studies agriculture.

Page #13



AGRICULTURAL BIOTECHNOLOGY EDUCATIONAL MATERIALS

BIOTECHNOLOGY for Plants, Animals and the Environment

For Agriculture and Science Teachers

Developed by the National Council for Agricultural Education
as a special project of the National FFA Foundation

Ages: High School

Biotechnology affects everyone. Feeding this world's population and protecting the environment are two issues facing this nation and the world at large. In agriculture today, biotechnology is being applied to microbes, plants and animals to improve crops with resistance to disease or insects and to produce useful tools to clean up our soil and water. In recent years, Americans, and citizens of other countries, have become more conscious of the use of biotechnology. Educating students about biotechnology will insure its wise use and create informed consumers.

For more information, contact:

National Council for Agricultural Education
1410 King Street, Suite 400
Alexandria, VA 22314
(800)772-0939 or (703) 838-5881 phone
(703)838-5888 fax
PSA@TeamAgEd.org
<http://www.teamaged.or>

FIELD OF GENES: Making Sense of Biotechnology

A Leaders Guide Developed by the National 4-H Council

Ages: 5 to 18

Fields of Genes is a leader's guide that can help you teach children about the wonders of life. From the smallest one-celled protozoan to the multibillion-celled human, life moves and swirls and splits. Fields of Genes from National 4-H Council helps youth ages 5 to 18 examine their own and others' values and opinions about genetic engineering.

To learn more about biotechnology in agriculture, order the *Fields of Genes: Making Sense of Biotechnology in Agriculture* online at www.4hbookstore.org.

For a hard copy, please contact:

Marie Frohlich
National 4-H Council
7100 Connecticut Avenue
Chevy Chase, Maryland 20815

Or email: Marie Frohlich

frohlich@fourhcouncil.edu

An Introduction to Biotechnology

Developed by The Biotechnology Education Project,
St. Louis Mathematics and Science Education Center

Ages: Grades 5-6, 7-8, and 9-12

The biotechnology units begin with introductory lessons to give students a basic background in the technology. Biotechnology is important for the students simply because it affects their lives. The students therefore look at biotechnology and our society, current issues and the pros and cons of the rapid expansion of biotechnology.

Units are available by contacting:

Kendall/Hunt Publishing Company
4050 Westmark Drive
PO Box 1840
Dubuque, IA 52004-1840
(800)228-0810 Phone
(800)772-9165 Fax

Ask for: An Introduction to Biotechnology

Grade 5-6 ISBN Number 0-7872-1638-0

Grade 7-8 ISBN Number 0-7872-1639-9

Grade 9-12 ISBN Number 0-7872-1640-2

Other Educational Resources:

Council for Biotechnology Information

<http://www.whybiotech.com>

Biotech and You! web site

<http://www.biotechandyou.com>

The University of Nebraska, research/lessons site

<http://www.agbiosafety.unl.eduwww.whybiotech.com>

Teaching Science

<http://www.teachscience.org>

Teacher Helpful Hints

Have fun when you take a closer look at biotechnology. Below are some comments and creative ways other teachers have successfully used this book.

"We studied one type a day. I broke it down and the kids got a lot out of it."

"We read it through together and highlighted the important information. At the end we drew names and then asked questions. We all had fun!"

"At the end of the program the students were surprised at how much they knew when they took the quiz!"

"The book is very student friendly. The children could take the lead for learning without a lot of preparation."

"I brought apples into the classroom so that the students could work in pairs. They were able to get real perspective about how little land there is to grow food."

"It was a wonderful science lesson and a good tool for building reading and spelling skills."

Biotech Whiz Kidz Quiz

1. What is biotechnology? (How would you explain biotechnology to a friend?)

2. Biotechnology is about...

- Rocks and soil
- Plants
- Suns and stars

3. You can find genes...

- At any hardware store
- In most restaurants
- In garbage dumps
- In living things

4. What fractional part of the earth is available for growing food?

- 1/2 of the core
- 1/4 of the peel
- 1/8 of the apple
- 1/16 of the core
- 1/32 of the peel

5. Does biotechnology help people reduce their use of pesticides?

- True
- False

6. Does biotechnology help people produce more food on the same amount land?

- True
- False

7. Does biotechnology help the earth produce more nutritious food ?

- True
- False

8. Scientists using biotechnology have developed a type of cotton plant that...

- Produces taller cotton plants
- Protects itself from insect larvae
- Produces cotton in different colors

9. In the future, "Golden Rice" could help fight...

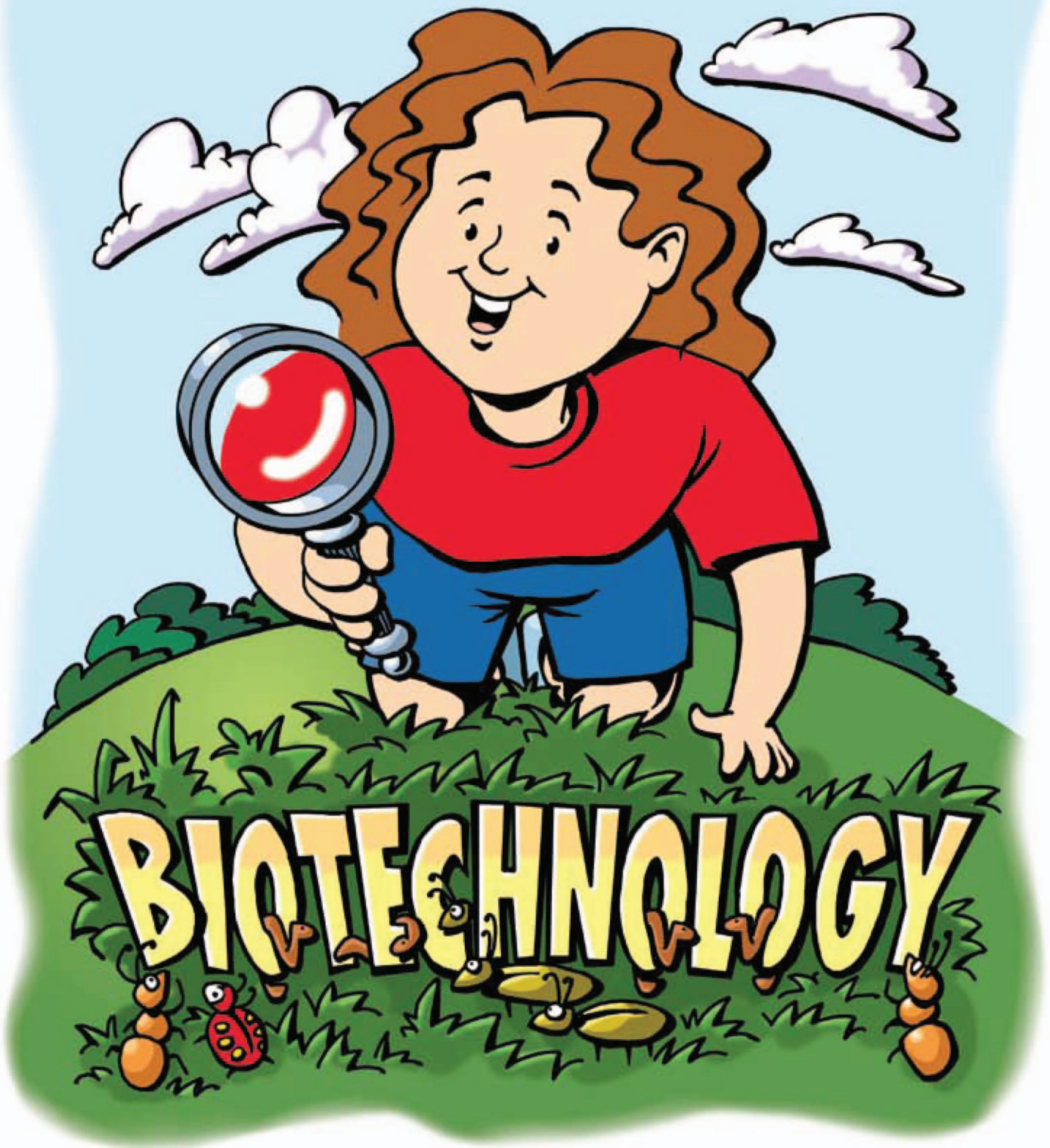
- Blindness
- Deafness
- Diabetes
- Arthritis

10. Which of these scientists studies genes and how traits are inherited?

- Nutritionist
- Agronomist
- Geneticist
- Chemist
- Entomologist

11. Describe three ways that biotechnology can help people live better lives in a healthier world. _____

Thanks for Taking a Closer Look at...



COUNCIL FOR
BIOTECHNOLOGY
INFORMATION
Good ideas are growing