

**STUDENT EDITION**

**CHEWING ON PLASTIC?!, p. 9**  
**INVESTIGATE IT!**

1. Most chewing gum contains plastic and other synthetic ingredients. Proschan wanted to create a gum that doesn't use these ingredients but that still has the same properties of gum.
2. Criteria included that the chewing gum should have flavors similar to conventional gum, should have the same texture as conventional gum, and should be able to be made in large batches.
3. Constraints included that the gum could include only natural substances.
4. Answers will vary.

**ARE YOU BEING WATCHED?, p. 27**  
**WEIGHING THE EVIDENCE**

Answers will vary but should include facts to support students' opinions. For example, an answer may include that facial recognition technology is not yet completely accurate or that the technology could be used to identify people who may pose a danger to others at places like schools.

**WHAT IN THE WORLD?, p. 32**

A photographer captured this bird's-eye view of a road near the city of Dubai, in the United Arab Emirates. A sandstorm in the surrounding desert had swept piles of sand onto the road, blocking parts of it. Because of its location near the Arabian Desert, Dubai frequently experiences large sandstorms. Soon after the storms, city workers clear the sand from the roads with bulldozers. For more information, visit [scholastic.com/scienceworld](http://scholastic.com/scienceworld).

**SCIENCE NEWS QUIZ, T9**

1. B 2. B 3. C 4. A 5. D 6. B 7. C 8. A 9. C 10. A

**VIDEO CAMPAIGN, T10**

Research Your Topic: Answers to the graphic organizer will vary depending on the topics student groups choose to cover. Plan Your Video: Videos will vary, but students should present the facts in an interesting way and have a clear introduction, middle, and conclusion. Record Your Video: Final videos will vary, but all students should have worked collaboratively, and each should have taken on a particular role.

**ONLINE EDITION**

**CHEWING ON PLASTIC?!  
 STEP BY STEP**

1. An inventor would research ways other people have tried to address the problem to learn what has or hasn't worked in the past. This step is important to define the problem and identify criteria and constraints for attaining a successful solution.
2. Skipping the Plan step may result in building a less successful first design. Creating diagrams and running computer simulations can reveal problems with the design before the first version is built.
3. The engineer might research current automobile and airplane designs. They would determine criteria, such as the height the vehicle must be able to fly, where it could land, etc. and constraints such as cost. They would then use that information to brainstorm possible designs before choosing one to focus on.
4. A person would build a prototype, or model, and use it to test their design. Data would be gathered during the tests to determine whether the design successfully met the desired requirements and restrictions.

5. Once a prototype is built and tested, it may need to be improved and changed. As a result, the engineer will go back to the earlier stages of brainstorming, planning, building, and testing to alter and optimize the design.

**CHEWING ON PLASTIC?! INVESTIGATE IT!**

**Note:** These answers are the same as in the Student Edition.

1. Most chewing gum contains plastic and other synthetic ingredients. Proschan wanted to create a gum that doesn't use these ingredients but that still has the same properties of gum.
2. Criteria included that the chewing gum should have flavors similar to conventional gum, should have the same texture as conventional gum, and should be able to be made in large batches.
3. Constraints included that the gum could include only natural substances.
4. Answers will vary.

**STRETCH OUT**

**Part 1: Conclusions**

1. The cold gum was stiffer and less flexible. When warmed, the gum was softer and more pliable.
2. Warm chewing gum stretches farther than cold chewing gum.

**Part 2: Claim, Evidence, Reasoning**

Answers may include the following:

3. Claim: The elasticity of chewing gum increases with increased temperature.
4. Evidence: When chewing gum was warm, it could be stretched farther without breaking. Cold chewing gum broke or tore at shorter distances. Warm chewing gum could be more easily squeezed than cold chewing gum.
5. Reasoning: The elasticity of a material is its ability to be stretched and return to its original state. Chewing gum can be squeezed and stretched farther without breaking when it is warm, so its elasticity is greater at higher temperatures.

**OPERATION IGUANA**

**SPECIES SEPARATION**

1. Diet and whether the bird lives on the ground or in the trees are the major factors that influence bill shape.
2. Finches with grasping bills live in trees.
3. The medium ground finch has a bill that is shaped for crushing. That way, the finch can crush seeds to get at the nutritious material inside.
4. Answers may include that the bird's beak has a similar shape to those of finches with probing bills. So, like those finches, it may eat insects or cactuses.
5. Answers may include that the large ground finch's large bill likely means it eats large seeds. The sharp-beaked ground finch has a narrower pointy bill more likely suited to picking up and crushing small seeds.

**HISTORIC CRUISE**

1. An adaptation is a characteristic of an organism that helps it survive in its environment.
2. The type of vegetation in the environment influences the tortoises' shell type.
3. Answers may include that the tortoise may have a dome-shaped shell that allows its head to move forward but not upward. In a tropical, wet rainforest, the vegetation would be dense near the ground. This shell type would help the tortoise reach the food where it is most plentiful.
4. Answers may include that changing the vegetation in an area may cause animals to die out because they probably can't adapt to eating

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other plants. Over long periods of time, this could cause the traits of a population to change.

5. Answers may include that scientists need to consider the environment in which the replacement animals live and make sure it is similar to that into which they will be moved. Scientists need to make sure the animals are healthy so the population will survive, and that that they're not carrying any organisms that might introduce invasive species into the new area.

**WORLD TOUR**

- 11 months
- westward
- They visited the Galápagos in October 1835. The ship was in Callao in September 1835. It reached Tahiti by November of that year.
- the Atlantic Ocean
- The *Beagle* was sent to explore South America. The ship made many stops and stayed very close to the coast as it traveled around that continent.

**WATCH YOUR STEP!**

**SIGNAL STARTER**

- electrical impulse
- B
- Neurotransmitters are chemicals that help nerve signals travel from one neuron to another.
- Answers may include that the diagram above is a magnified view of the graphic in the article. It shows what occurs inside individual neurons as a signal travels through the network of nerves from the foot to the brain.
- Answers may include that when a person steps on a LEGO® brick, it triggers a signal in sensory neurons on the foot. These neurons send a pain signal that travels to the spinal cord and brain. In response, motor neurons in the central nervous system may send signals back to the muscles in the foot and leg to quickly step away.

**SAFER SOLES**

- Answers may include that the invention needs to protect people's feet so they can avoid the pain of stepping on a LEGO brick.
- Answers may include that the protective device needs to distribute the force of a LEGO brick across a larger area instead of just the sharp corners and needs to reduce the force felt on any given part of the foot.
- Answers may include the cost of materials so that it can be affordable to all LEGO builders and comfort to wearers.
- Answers will vary.

**PRESSURE POINT**

- $F = m \times a = 40 \text{ kg} \times 9.8 \text{ m/s}^2 = 392 \text{ N}$
- $P = F \div A = 392 \text{ N} \div 0.02 \text{ m}^2 = 19,600 \text{ Pa}$
- The force of the person's body pushing down on the floor is evenly distributed between the two feet, so one foot exerts a force of  $392 \text{ N} \div 2 = 196 \text{ N}$ . So, for one foot,  $P = F \div A = 196 \text{ N} \div 0.02 \text{ m}^2 = 9,800 \text{ Pa}$
- Assuming a 40 kg person stepped on the brick, they'd exert the following force:  $F = m \times a = 40 \text{ kg} \times 9.8 \text{ m/s}^2 = 392 \text{ N}$ . Since  $P = F \div A = 392 \text{ N} \div 0.00001 \text{ m}^2 = 39,200,000 \text{ Pa}$ . That's a huge amount of pressure concentrated in a small spot on the sole of the foot, making stepping on the brick quite painful.
- $P = F \div A$ , so  $24,500 \text{ Pa} = F \div 0.02 \text{ m}^2$  and  $F = 490 \text{ N}$ ;  $F = m \times a$ , so  $490 \text{ N} = m \times 9.8 \text{ m/s}^2$  and  $m = 50 \text{ kg}$

**A MOUNTAIN OF A PROBLEM**  
**INTEGRATING SOURCES**

Question	"A Mountain of a Problem"	"Life-Saving Invention"
Why does human waste pose a health hazard?	Human feces contain bacteria and viruses that can make people sick.	Waste can contain germs that, if ingested, cause potentially deadly infections, such as cholera or typhoid.
How have past waste disposal practices put people at risk?	Climbers often use glacier meltwater on Denali as drinking water. In the past, it was contaminated with poop, so it made people sick.	In cities such as London, human waste was once dumped into the streets and waterways, where it contaminated the water supply. Many people got sick.
How have waste disposal methods improved over time?	People stopped burying waste in shallow holes on the tops of glaciers because the waste would resurface when snow melted. Instead, they started dumping it deeper in crevasses. Now new devices allow climbers to carry their waste off the mountain so feces never enter the environment.	The flushing toilet was invented in 1851, but the waste from the toilets in places like London was still dumped into ditches. In 1858, a heatwave in London made the stench of waste become unbearable—a situation dubbed "The Great Stink." This motivated the city to build a sewage system to remove waste.
How can waste disposal be improved even more?	Now roughly three-quarters of climbers carry their waste off Denali. In the future it should be 100 percent.	Many people in developing countries don't have access to sanitation systems. Installation of modern waste disposal methods would help prevent illness in these parts of the world.

**FROZEN IN TIME**

- If an object falls on the surface of a glacier, it can become trapped in the ice as new layers of snow fall on it. Or an object can become trapped in the ice if it falls into a crevasse.
- Climate change is causing glaciers to melt faster, which may expose more artifacts once trapped in the ice.
- Remains would decompose quickly in the heat and humidity of a tropical rainforest.
- Answers may include that there would have been more people living around the areas of the mountain glaciers than in the polar areas, where it's difficult to survive.
- Answers may include that even after 5,000 years trapped in the ice, Ötzi's remains were well-preserved. If the conditions in the ice prevent organic material from breaking down, then the pathogens in poop could still pose a health risk.

**MELTING MAP**

- Caucasus and Middle East

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2. 1, Alaska
3. The Russian Arctic dot is roughly half the size of that of Greenland. Therefore, it loses roughly 19 billion metric tons of ice per year.
4. No, how close an area is to the poles doesn't affect how much glacier ice is lost from the area each year. Supporting evidence may include that Greenland and the Arctic Canada north are both relatively close to the North Pole, and both have relatively high melting rates, compared to Antarctica and subantarctica near the South Pole, which lose little ice.
5. You would expect waste to resurface faster on Denali because the melting rates in Alaska are higher than in the Himalayas. Faster melting allows waste to resurface more quickly.

**ARE YOU BEING WATCHED?**

**ALTERNATE IDs**

Answers will vary depending on the chosen biometric but should include an explanation of how it works, how it compares with other biometrics, and how it is currently being used.

**COME TO A CONCLUSION**

Answers will vary but may include: (See chart below)

**WEIGHING THE EVIDENCE**

Answers will vary but should include facts to support a student's opinion. For example, it may include that facial recognition technology is not yet completely accurate or that the technology could be used to identify people who may pose a danger to others at places like schools.

**ANIMAL ADVOCATE**

**VIDEO CAMPAIGN**

Answers will vary.

**CHECK FOR UNDERSTANDING**

**CHEWING ON PLASTIC?!**

1. F 2. T 3. F 4. F 5. T

**IGUANA OPERATION**

1. archipelago 2. biodiversity 3. endemic 4. Darwin 5. hot spot
6. mantle 7. natural selection 8. invasive species 9. erosion
10. viability

**WATCH YOUR STEP!**

1. ABS plastic is extremely hard and durable, so it doesn't bend or break when you snap LEGO bricks together and pull them apart.
2. It would be more painful to step on a small rock. The pressure an object exerts on the sole of your foot depends on its surface area. The pressure is higher—and therefore more painful—if the force of your weight is concentrated over a small area versus a larger one.
3. Having many nerves on the foot causes people to be careful where they step to help avoid pain.
4. If you cut or damage your skin, nociceptors are activated. The cells send a signal that passes from nerve cell to nerve cell via chemical messengers called neurotransmitters until it reaches your spinal cord and then your brain, where the pain is registered.
5. The thalamus relays a pain signal to sections of the brain responsible for sensation, thinking, and emotion. That causes you to register, interpret, and react to the pain.

**A MOUNTAIN OF A PROBLEM**

1. c 2. i 3. a 4. h 5. g 6. j 7. b 8. f 9. d 10. e

**ARE YOU BEING WATCHED?**

1. A 2. C 3. C 4. B 5. A

Before Reading			After Reading		
Agree	Disagree	Statement	Agree	Disagree	Explanation
		Technology that uses people's physical characteristics to identify them is widely used today.	X		Facial recognition is used in some airports; some smartphones and other devices can identify you based on your fingerprint or facial recognition.
		Some schools are using cameras to track students' behavior in class.	X		Some schools in China are using facial recognition programs to monitor students.
		The use of facial recognition technology has raised concerns about protecting people's privacy.	X		Civil liberties groups worry that facial recognition technology is being used without people's permission.
		If you have a driver's license, your image could be in a facial recognition database.	X		Half of all Americans have their images, such as a driver's license photo, stored on at least one facial recognition database searchable by law enforcement agencies.
		Facial recognition programs can accurately determine a person's emotions from an image.	X	X	Answers will vary, but questions have arisen over the technology's accuracy.
		Facial recognition technology can accurately identify a person no matter his or her gender or race.		X	Facial recognition technology is not as accurate at identifying a woman of color compared with other groups.
		Using facial recognition technology will reduce crime.	X	X	Answers will vary but may include that it could help detectives identify subjects more quickly. On the other hand, it could lead police to pursue the wrong suspects or mistakenly arrest someone who's innocent.
		China is an example of a surveillance state, a country that closely monitors its citizens.	X		China routinely monitors its citizens to keep track of their behaviors.