CHOICE, CONTROL, AND CHANGE

For the past few weeks, my class has been studying human body systems and learning about how food is digested, metabolized, and used to help their bodies function and grow. Now, students are ready to look at what happens when something goes wrong, by modeling the flow of blood through arteries that have become clogged with plaque. This demonstration sets up students for further exploration of how lifestyle choices can impact the cardiovascular system. (See www.tc.edu/efe/choice.html for the full lesson plan.)

Each pair of students gets two sections of clear plastic tubing (about three-fourths of an inch in diameter), a chunk of yellow modeling dough, and a cup of water that's been dyed red. Students stuff the modeling dough into one of the tubes, push a pencil through to make a narrow hole, and have a model of a clogged artery. One student, holding the clogged tube in front of his eye like a telescope, says, “Whoa, that blood is going to get all stuck up in here!”

After making predictions about what they think will happen when the “blood” travels through each tube, students set about their investigations. As they pour the “blood” through each of the tubes, it’s easy to see that the flow is much smoother and faster through the healthy artery. Students use their observations to generate new questions: How much blood can travel through each artery in the same amount of time? What happens if the artery gets completely blocked?

Two students push more modeling clay into one end of their clogged artery until the hole is the size of a pencil point. As one
student pours the blood into the artery, her partner observes the trickle falling into the bowl underneath. “It’s not getting through—the heart will have to work extra hard to get blood to go through a clogged vessel.”

After cleaning up, students discuss how the clogged artery could cause a heart attack or a stroke, depending on its location in the body. One student observes that “high cholesterol is more serious than just being fat.” Students are particularly concerned about whether there is a way to unclog a vessel, because, as another student says, “I do not want that stuff in my blood!”

Students refer to a reading on heart-healthy eating habits. One student is dismayed to learn that most donuts can contribute to high cholesterol, but another student is pleased to find that oatmeal, as long as not too much butter and sugar are added, is a heart-friendly food. “My grandma likes oatmeal too,” she says. “I’ll ask if we could have that at home sometimes.”

Childhood obesity and its long-term health implications should be of major concern to science educators. Our team of science educators, nutrition educators, and classroom teachers has been working in this area for several years in support of teachers and youth learning more about this phenomenon and what they can do to support healthy food and activity choices. Prior to this lesson, students had collected data on what kinds of foods are typically available in their neighborhood stores, investigated how humans have a universal liking for fat and sugar, experimented with measuring how much fat and sugar are in food, studied energy balance in the body, and collected data on their own eating and physical activity. All of these activities are part of a larger five-unit, 19-lesson module developed at Teachers College Columbia University called Choice, Control, and Change (C3) (see Resources). C3 is a standards-driven and inquiry-based curriculum that is framed around the driving question, “How can we use scientific evidence to help us make healthy food and activity choices?”

C3 teaches life science through investigating how the human body works; why a state of dynamic equilibrium—balancing energy in and energy out—is important in order for our bodies to function well; how conditions such as high blood cholesterol and high blood sugar develop and what we can do to prevent them; and how to make food and exercise choices that will promote health and decrease the risk of many lifestyle-related diseases such as heart disease, type 2 diabetes, and some cancers. The curriculum provides teachers and students with rigorous, yet relevant investigations into how an understanding of biology, the environment, and personal behaviors impacts weight and health. Classroom activities provide opportunities for students to explore their experiences and feelings and to reflect on them through self-assessment of eating and activity patterns and learning about consequences. Use of our inquiry-based approach provides students the opportunity and skills to learn about making choices and taking control.

**Childhood obesity: Preventing an epidemic**

The issue of childhood obesity has become a national phenomenon. The rates have been increasing over the past two decades. In fact, the research on childhood obesity indicates that over 50% of the population in the United States is considered to be overweight or obese, with the number of overweight children doubling in the
past two decades. Health workers, nutritionists, and social scientists have also shed new light on the long-term health implications of overweight children having increased risk for elevated blood lipids, increased cholesterol levels, type 2 diabetes, and social discrimination that could lead to obesity later in life.

Yet, prevention of childhood obesity is a complex phenomenon, bringing together human biology, environmental factors, and personal choices. The time for this kind of education is now as the social, physical, and economic environment have dramatically changed our food consumption and exercise habits—energy in and energy out—over the past 25 years. The amount of energy consumed from low nutrient-density snacks and sweetened beverages has doubled, while screen time (watching TV and playing video games) has increased, and physical activities have decreased about 40%. Clearly, youth have to make choices in an environment in which food is ubiquitous, tasty, cheap, and heavily advertised; being sedentary is easily setting them up for a lifetime of being in positive energy balance.

Despite the complexity of the childhood obesity phenomenon, we know that prevention of weight gain is easier, less expensive, and more effective than treatment. The Surgeon General’s 2001 Call to Action includes a specific call for obesity prevention activities focused on healthy eating and physical activity in schools. Yet, to date, few projects exist that offer models for schools, and there is little consensus about how to teach kids the challenges associated with childhood obesity, or at what grade levels such an intervention would be most effective. There are also questions about how any intervention program might balance between helping youth understand the problem and act on the problem, or what role science education might play in reversing the epidemic.

The importance of focusing on the middle grades

While young children mainly make their food choices based on what they like, by middle school, cognitive-motivational processes also become important influences on food choice as well. Youth become more able to link cause and effect and to perceive the consequences of their actions. Thus, they can make food choices in light of their perceptions, health and weight concerns, taste, and convenience. In terms of opportunity, adolescents in the United States receive close to $6 billion annually from caretakers in discretionary funds, and spend half of it on snacks. Middle school youth have both the capacity and opportunity to practice personal control and mastery in the area of food choices and physical activity.

Behavior, however, is motivated not only by the anticipation that the behavior will bring about desired outcomes, but also by a strong sense of being able to exert personal control over their environment. Youth do have choices and need to learn to take control to create for themselves personal food and activity environments that are conducive to health and body-size regulation. It is important to provide youth the opportunity to achieve a sense of personal control and mastery through understanding the complex systems of biology, the environment, and their behaviors, and by learning how to take action based on their understandings. We call this personal control and mastery over their own behavior, and the ability to create personal food and activity environments “competence.” Thus, youth will be able to experience self-determination and to gain personal satisfaction in achieving personal control. With such training, students are creating personal environments that are healthful and reduce the risk of obesity.

A science-education approach to childhood obesity

In the past, childhood obesity interventions in schools have focused primarily on specific diet-related behavior, such as fat reduction or fruit and vegetable consumption. While these interventions play an important role, students can also benefit from having skills to analyze food and exercise and to understand the dramatic changes they have undergone in a short time period. This will give students the knowledge and skills they need to be able to maintain a balance of their energy in and energy out despite our current environment. In our work, we have proposed going beyond teaching students which behaviors to enact and the strategies to enact them, to include how to think about food and their behaviors in ways that help them feel competent in navigating today’s food and activity environment. Any program focused on childhood obesity should teach youth about human biology and why they have innate preferences for certain kinds of foods, their ability to learn to eat in particular ways, and how that ability is influenced by social context.

Why focus on energy in and energy out?

Understanding the body’s dynamic equilibrium is central to being able to make smart, scientifically grounded decisions about eating and activity. It is important for students in the middle grades to begin to understand why life depends on an organism’s abil-
ity to regulate its internal environment (National Science Education Standards, Standard C: Regulation and Behavior). Students need to understand that the amount of food energy (calories) a person requires varies with body weight, age, sex, activity level, and natural body efficiency. Regular exercise is important to maintain a healthy heart and lung system, good muscle tone, and bone strength. It is also important for students to understand how the body uses food for energy and building materials: The food must first be digested into molecules that are absorbed and transported to cells. To burn food for the release of energy stored in it, oxygen must be supplied to cells, and carbon dioxide removed. Lungs take in oxygen for the combustion of food and they eliminate the carbon dioxide produced. The urinary system disposes of dissolved waste molecules, the intestinal tract removes solid wastes, and the skin and lungs rid the body of heat energy. The circulatory system moves all these substances to or from cells where they are needed or produced, responding to changing demands (National Science Education Standards, Standard C).

These ideas and others are covered in C3 in a systematic, rigorous exploration of students’ personal food and activity choices. Drawing upon Science as Inquiry and Science in Personal and Social Perspectives, in addition to the Content Standards, students explore how they can use scientific evidence to make healthy food and activity choices. To delve into this larger question, students take up smaller investigations into five key questions:

- What influences our food and activity choices?
- How can we make sure we get the right amount of energy to help our bodies do what we want them to do?
- How can we use personal data to help us make healthful food and activity choices?
- Why are healthful food and activity choices important for our body?
- How can I maintain my skills as a competent eater and mover?

As Figure 1 shows, these ideas fit together to help students build a solid understanding of why a state of dynamic equilibrium—balancing energy in and energy out—is important in order for our bodies to function well.

**Conclusion**

In order to prevent childhood obesity, a combined approach must be taken. Youth must have opportunities to investigate and develop deep conceptual understandings of the complex relationships between their biology, the environment, and personal behaviors. They also need adequate scaffold opportunities to develop the scientific skills they need to become competent eaters and exercisers. Whatever one’s approach is, one thing is clear: Youth will continue to be bombarded with opportunities to increase their fat and sugar intake cheaply and easily, while remaining sedentary. This is not acceptable. We must find ways to work with individuals both inside and outside of school to help youth gain the understandings and skills they need to competently navigate their worlds to make better and healthier choices.

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**Resource**


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