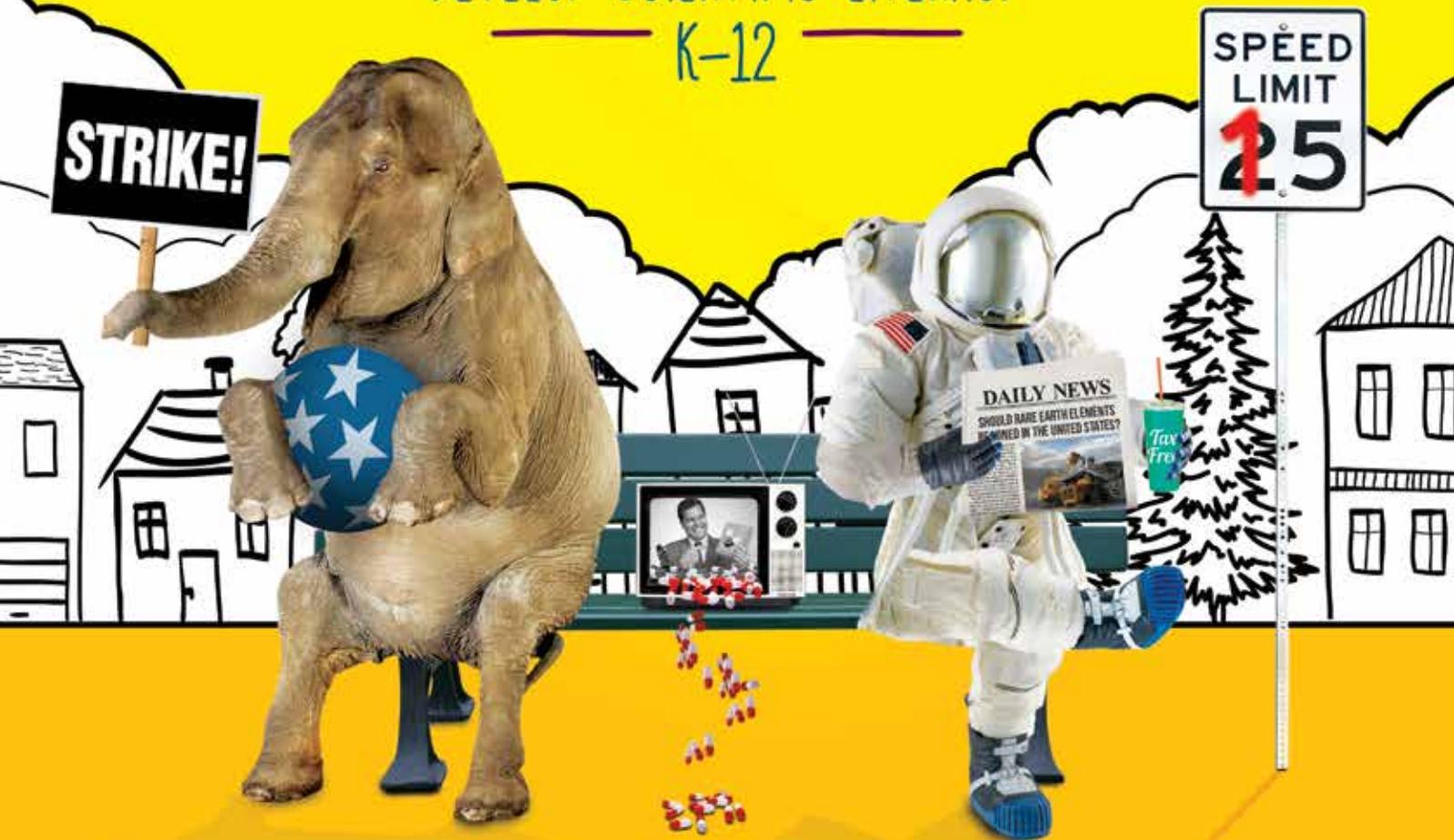


# IT'S DEBATABLE!



USING SOCIOSCIENTIFIC ISSUES TO  
DEVELOP SCIENTIFIC LITERACY

K-12



Dana L. Zeidler and Sami Kahn

**NSTA**press  
National Science Teachers Association

# IT'S DEBATABLE!

---

USING SOCIOSCIENTIFIC ISSUES TO  
DEVELOP SCIENTIFIC LITERACY

— K-12 —



# IT'S DEBATABLE!



USING SOCIOSCIENTIFIC ISSUES TO  
DEVELOP SCIENTIFIC LITERACY

— K-12 —



Dana L. Zeidler and Sami Kahn

**NSTA**press

National Science Teachers Association

Arlington, Virginia



Claire Reinburg, Director  
Wendy Rubin, Managing Editor  
Andrew Cooke, Senior Editor  
Amanda O'Brien, Associate Editor  
Amy America, Book Acquisitions Coordinator

**ART AND DESIGN**  
Will Thomas Jr., Director  
Joe Butera, Senior Graphic Designer, cover and  
interior design

**PRINTING AND PRODUCTION**  
Catherine Lorrain, Director

#### **NATIONAL SCIENCE TEACHERS ASSOCIATION**

David L. Evans, Executive Director  
David Beacom, Publisher

1840 Wilson Blvd., Arlington, VA 22201  
[www.nsta.org/store](http://www.nsta.org/store)  
For customer service inquiries, please call 800-277-5300.

Copyright © 2014 by the National Science Teachers Association.  
All rights reserved. Printed in the United States of America.  
17 16 15 14 4 3 2 1

*NSTA is committed to publishing material that promotes the best in inquiry-based science education. However, conditions of actual use may vary, and the safety procedures and practices described in this book are intended to serve only as a guide. Additional precautionary measures may be required. NSTA and the authors do not warrant or represent that the procedures and practices in this book meet any safety code or standard of federal, state, or local regulations. NSTA and the authors disclaim any liability for personal injury or damage to property arising out of or relating to the use of this book, including any of the recommendations, instructions, or materials contained therein.*

#### **PERMISSIONS**

Book purchasers may photocopy, print, or e-mail up to five copies of an NSTA book chapter for personal use only; this does not include display or promotional use. Elementary, middle, and high school teachers may reproduce forms, sample documents, and single NSTA book chapters needed for classroom or noncommercial, professional-development use only. E-book buyers may download files to multiple personal devices but are prohibited from posting the files to third-party servers or websites, or from passing files to non-buyers. For additional permission to photocopy or use material electronically from this NSTA Press book, please contact the Copyright Clearance Center (CCC) ([www.copyright.com](http://www.copyright.com); 978-750-8400). Please access [www.nsta.org/permissions](http://www.nsta.org/permissions) for further information about NSTA's rights and permissions policies.

#### **Library of Congress Cataloging-in-Publication Data**

Zeidler, Dana L. (Lewis) author.

It's debatable! : using socioscientific issues to develop scientific literacy, K-12 / Dana L. Zeidler and Sami Kahn.

pages cm

Includes index.

ISBN 978-1-938946-00-4

1. Science—Social aspects—Study and teaching—United States. 2. Technology—Social aspects—Study and teaching—United States. 3. Curriculum planning—United States. I. Kahn, Sami, author. II. Title.

Q175.5.Z38 2014

507.1'173—dc23

2013042407

Cataloging-in-Publication data are also available from the Library of Congress for the e-book.  
e-LCCN: 2013044019

# CONTENTS

Contributors

xi

About the Authors

xiii

A Prelude: “Monday Morning”

xv

## Part 1

### **Introduction and Background on Socioscientific Issues**

#### **Why Socioscientific Issues?**

1

*Distinction From Science, Technology, and Society*

*SSI and Scientific Literacy*

*Integrating Science Content*

*Cross-Curricular Connections*

*SSI and Character*

#### **SSI and the Next Generation Science Standards (NGSS)**

8

#### **The SSI Teacher and Classroom**

13

*SSI and Pedagogy*

*SSI and Classroom Discourse*

#### **Voices From the Field: What Practicing Teachers Can Tell Us About SSI Classrooms**

16

## Part 2

### **Implementing SSI in the K–12 Classroom**

#### **Developing Your Own SSI Curriculum**

31

#### **Key Classroom Strategies for SSI Implementation**

34

*Argumentation*

*Assessment*

*Evaluating Sources of Information*

*Cooperative Learning*

#### **Guide to Sample Units**

46

#### **List of Sample Units**

48



## Unit 1

### Food Fight

Should schools charge a “fat tax” for unhealthy foods?

51

#### Lesson 1

Initial Debate  
*Should Schools Charge More Money  
for “Unhealthy” Foods?*

56

#### Lesson 2

Introduction to the Food Groups  
*My Healthy Plate*

60

#### Lesson 3

How Fresh Is Your Food?  
*The Effects of Preservatives*

65

#### Lesson 4

The Six Nutrients Mystery Matching  
Game and Reading Labels Carousel

69

#### Lesson 5

Digestion  
*The Path to Good Nutrition*

75

#### Lesson 6

Find the Fat ... and  
Cheeseburgers on Trial!

80

#### Lesson 7

Kids as Consumers  
*Evaluating and Creating Food  
Commercials*

86

#### Lesson 8

Final Debate and Letter Writing  
*Should Schools Charge More Money  
for “Unhealthy” Foods?*

91

#### Optional Lesson

Field Trip to Supermarket and  
“Eat This, Not That” Slide Show

94





## Unit 2

### Animals at Work

Should animals perform in circuses?

97

#### Lesson 1

All Sorts of Working Animals

101

#### Lesson 2

Putting the Horse Before the Cart

105

#### Lesson 3

Follow Your Nose

108

#### Lesson 4

Dolphins With a “Porpoise”

111

#### Lesson 5

Meet Some Animal Helpers

114

#### Lesson 6

How Do YOU Feel About Working Animals?

118

#### Lesson 7

Circus Animals

121

#### Lesson 8

Under the Big Top

129

#### Lesson 9

Where Do You Stand?

136

#### Lesson 10

Culminating Whole Class Project

140





## Unit 3

### A Need for Speed?

Should speed limits be lowered to reduce traffic fatalities?

143

#### Lesson 1

Slippery When Wet

147

#### Lesson 2

Data Driven

150

#### Lesson 3

Speed Kills?

153

#### Lesson 4

Town Hall Meeting

*Should We Reduce Speed Limits?*

160



## Unit 4

### Space Case

Do humans have the right to colonize and use resources on extraterrestrial planets?

165

#### Lesson 1

Who Owns Outer Space?

170

#### Lesson 2

Space Players

173

#### Lesson 3

Planetary Particulars

179

#### Lesson 4

United Nations Vote

186





## Unit 5

### A Fair Shot?

Should the Gardasil vaccines be mandatory for all 11–17-year-olds?

**189**

#### Lesson 1

Introduction

*Should the Gardasil Vaccination Be Required for All  
11–17-Year-Olds? An Immune System Research Project*

**194**

#### Lesson 2

The Biology of Cancer

**201**

#### Lesson 3

It Can't Happen to Me!

*Sexually Transmitted Infections and Diseases*

**209**

#### Lesson 4

The Art of Argument  
*Research and Debate*

**214**

#### Lesson 5

Rethinking Positions and Relating the Gardasil Debate to  
the Nature of Science (NOS)

**217**



## Unit 6

### “Mined” Over Matter

Should rare Earth elements be mined in the United States?

**221**

#### Lesson 1

Introduction to Rare Earth Elements

**225**

#### Lesson 2

Rock and Roll

*Plate Tectonics and the Rock Cycle*

**235**

#### Lesson 3

Elements, Rocks, and Minerals

**240**

#### Lesson 4

Cake Mining

*Identification and Reclamation of Mineral Resources*

**244**

#### Lesson 5

Digging Deeper

**249**

#### Lesson 6

The Decision-Making Process

**252**

#### Lesson 7

Debate: Should the United States Mine  
Rare Earth Elements?

**257**





## Unit 7

### “Pharma’s” Market

Should prescription drugs be advertised directly to consumers?

261

#### Lesson 1

We Are Family  
*Prevalence of Prescription Drug Use  
in the United States*

266

#### Lesson 2

What’s in the Bottle?  
*Research on Pharmaceutical Composition*

271

#### Lesson 3

How Do Drugs Work?  
*Molecular Models and Drug-Target Interactions*

274

#### Lesson 4

How Are Pharmaceuticals Made?  
*Creating a Synthetic Drug*

278

#### Lesson 5

Vioxx  
*A Case Study*

283

#### Lesson 6

Congressional Subcommittee Hearing  
*Should Prescription Drugs Be Banned From TV?*

287

---

A Final Word (for Now)

293

Index

295





# Contributors

The authors are grateful for the expert contributions  
of the following outstanding educators:

## “Voices From the Field”: Teacher Perspectives

**Scott Applebaum**  
*Palm Harbor  
University High  
School*  
**Palm Harbor, FL**

**Hyunsook Chang**  
*Kuksabong  
Middle School*  
**Seoul, South Korea**

**Thomas Dolan**  
*Pride Elementary  
School*  
**Tampa, FL**

**Kisoon Lee**  
*Sinam Middle  
School*  
**Seoul, South Korea**

## Unit Plan Contributors

**Brian Brooks**  
*University of  
South Florida*  
**Tampa, FL**

**Christina Cullen**  
*University of  
South Florida*  
**Tampa, FL**

**Daniel Majchrzak**  
*University of  
South Florida*  
**Tampa, FL**

**Tammy Modica**  
*University of  
South Florida*  
**Tampa, FL**

**Michael Caponaro**  
*University of  
South Florida*  
**Tampa, FL**

**Thomas Dolan**  
*Pride Elementary  
School*  
**Tampa, FL**

**Andrea Churco  
Marshall**  
*Hillsborough County  
School District*  
**Florida**

**Crystal Nance**  
*University of  
South Florida*  
**Tampa, FL**

**Kory Bennett**  
*University of  
South Florida*  
**Tampa, FL**

**Katie Frost**  
*University of  
South Florida*  
**Tampa, FL**

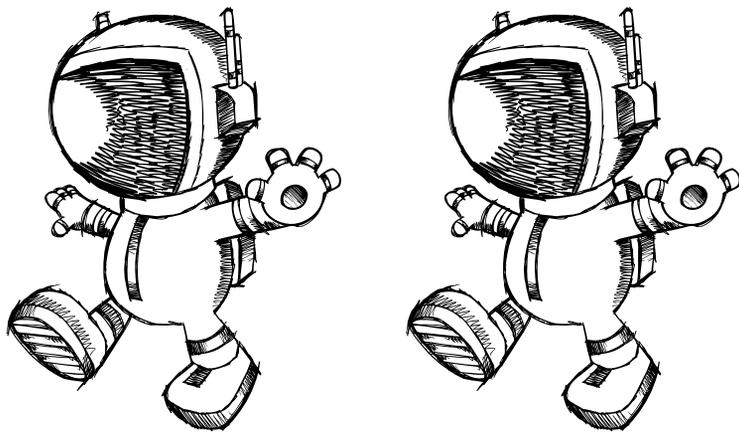
**Lisa Clautti  
Mistovich**  
*University of  
South Florida*  
**Tampa, FL**

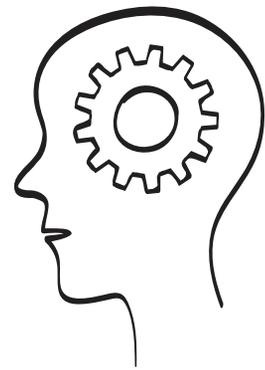
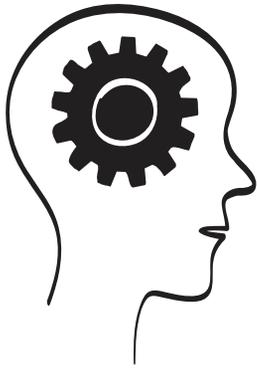
**Ashley  
Schumacher**  
*University of  
South Florida*  
**Tampa, FL**

**Jessica Croghan-  
Ingraham**  
*University of  
South Florida*  
**Tampa, FL**

**Bryan Kelly**  
*University of  
South Florida*  
**Tampa, FL**

**Hayley Sweet**  
*Florida College  
Academy*  
**Tampa, FL**



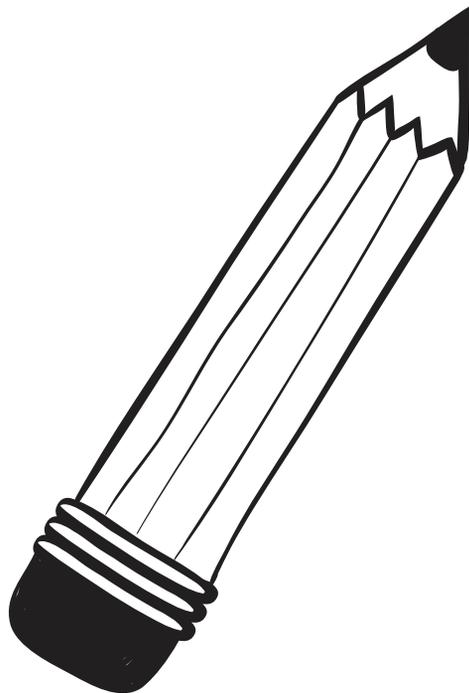


## About the Authors

**Dana L. Zeidler** (first author) earned his PhD from Syracuse University. His research program incorporates aspects of socioscientific issues as a means to facilitate scientific literacy. His work has attracted international attention and is cited widely both within and external to the field of science education. His line of extensive research can be found in numerous journal articles, book chapters, keynote addresses and international conference proceedings. He works closely with doctoral students and other leaders in the science education community. He is a Professor and Program Coordinator of Science Education at the University of South Florida, Tampa Bay. Dana has long-standing ties to the science education community including working closely with other leaders, faculty, and graduate students. Some of his most recent honors include:

- President of National Association for Research in Science Teaching (NARST): A worldwide organization for improving science teaching and learning through research, 2010–2011
- Recipient for the Outstanding Mentor Award (2008), Association for Science Teacher Education (ASTE)
- Executive Board of Directors, NARST, 2006–2009
- At Large Board of Directors, ASTE (2008–2011)
- Series Editor for *Contemporary Trends and Issues in Science Education*, Springer: Dordrecht, The Netherlands (2008 to present)
- Distinguished Visiting Professor of Science Education, Ewha Womans University, Seoul, South Korea (2012–2013)
- Honorary Professor of Science and Environmental Studies, The Hong Kong Institute of Education, The University of Hong Kong, China (2013–2016)
- Attained level of Master (7th-degree Black Belt) from the Okinawa Isshinryu Karate Association, Okinawa, Japan (1982 to present)

**Sami Kahn** (second author) is a 26-year veteran science educator with extensive experience in classroom teaching, professional development, and curriculum development. Currently serving as a Presidential Doctoral Fellow in Science Education at the University of South Florida, she has authored numerous journal articles, including several in *Science and Children*, and has coauthored three books on enhancing scientific inquiry experiences for children and adults. She has served as an invited and keynote speaker at several state and national conferences, and most recently at an international STEM conference in Thailand. She is particularly known for her work in ensuring quality science opportunities for all children, including those with disabilities. In that capacity, she has served as president of Science Education for Students with Disabilities (SESD), an NSTA Associated Group dedicated to inclusive science practices, chair of the National Science Teachers Association's Special Needs Advisory Board, and chair of the national awards committee for the Scadden Science Teaching Award. She also had the honor of serving as a delegate to the National Congress on Science Education, from which she was elected to represent the Congress as an NSTA national convention planning committee member. Ms. Kahn has successfully taught grades Kindergarten through college, as well as inservice professionals, and has won numerous awards for outstanding science teaching. She holds an MS in ecology and evolutionary biology and a JD with an emphasis in environmental law from Rutgers University. Prior to coming to University of South Florida, she most recently served as lower school science coordinator/teacher and K–12 science department chair at Collegiate School in New York City.



# A Prelude



## “Monday Morning”



**M**s. C. left the school office in a hurry, hastily grabbing her mail before heading to her first period biology class. Mondays were always a challenge, but today seemed especially so. It wasn't even 8:00 and she had already been involved in a heated discussion of the new accountability measures being implemented in her school district; more tests, more requirements to meet Common Core, and more pressure to make sure her students made Adequate Yearly Progress or her performance evaluations would be on the line. “When did teaching become so stressful?” she thought. It was never an easy job, but the last few years felt especially weighty ... less focused on the subject and students she loved, less creative, and definitely more stressful.

She took a deep breath as she entered her classroom. “Good morning!” she said with a somewhat forced smile. Almost immediately, she sensed something was different today... her ninth graders, usually sleepy on Monday mornings, were talkative and animated. The energy in the room was palpable.

“Hey, Ms. C, we were just arguing about the vaccine question from last week. I still think it's wrong to make teenagers take vaccines!” said Alex.

“But they protect us!” exclaimed Janelle.

“That's what the drug companies want you to think. What's your evidence?” asked Vincent.

Ms. C's ears pricked up as she was shocked to hear her students suddenly engaged in an impromptu discussion of ... science!

“My group read an article about how the vaccine protects against cervical cancer, so it's a good thing!” Janelle retorted.

“Yeah, but what was the source? Did you evaluate the source?” pressed Vincent.

Ms. C. smiled in awe. She didn't know if the discussion on evaluating sources of evidence would sink in. It didn't sound like the most exciting topic when she read about it, and yet, the students really enjoyed evaluating different websites and articles using the rubric she had provided. Maybe this new curricular approach was working.

“But our group found an article that said that vaccines were bad for you. There are side effects ... even death!” replied Alex.

“Yeah, that's the problem with science. There are always different reports. You never know what to trust!” added Crystal, in an exasperated tone.

## A Prelude

“But that doesn’t mean you can’t trust it. Remember the whole nature of science thing? There’s always new information,” added Miguel.

Ms. C. felt a tingling feeling she hadn’t felt in years: that combination of pride and excitement that comes with knowing you’ve impacted your students’ lives.

“I don’t think it matters whether the vaccine helps or not. No one has the right to make me take a vaccine if I don’t want it. It’s my body! And I talked about this with my parents this weekend and they agree!” exclaimed Karla.

Ms. C. couldn’t believe her ears. She had never heard a peep from Karla, her quietest student. Yet today Karla was taking a stand, and she had clearly been talking (and thinking) about it over the weekend.

“Maybe this new SSI approach I’m trying is making a difference,” Ms. C. thought. In fact, her friend Mr. Alvarez, a Language Arts teacher, did mention that he heard some of Ms. C’s students discussing the vaccine argument in his class last Friday ... science seemed to be spilling over into other parts of the day. And yet, Ms. C. really hadn’t made a huge change in her teaching. She had just decided to tweak her already-existing curriculum to include a few extra lessons that put the science content into a personal context that really motivated and challenged her students ... and her.

Ms. C. hated to interrupt the students, who at this point were engaged in a full debate. “Let’s take a look at what we’ve learned so far and see what we still need to discover!” she said.

It was going to be a good day ... and a good year!





# Unit 3

---

## A Need for Speed?

Should speed limits be lowered to reduce traffic fatalities?

### Unit Overview

During this unit, students will investigate physical science concepts related to forces and motion. They will then synthesize and apply their learning to grapple with the question of whether speed limits should be lowered to reduce traffic accidents. Through engagement in several hands-on activities, as well as the development of research-based arguments, students relate physical concepts to their everyday lives and to the functioning of society.

### Key Science Concepts

Forces, Friction, Motion, Momentum, Mass, Gravity, Velocity

### Ethical Issues

Personal Freedom, Government Regulation, Individual vs. Societal Interests

### Science Skills

Predicting, Observing, Measuring, Analyzing Data, Understanding Cause and Effect, Communicating Results, Forming Arguments From Evidence.

### Grade Levels

Upper Elementary and Middle School

# 3

## Time Needed

The unit is comprised of four lessons over five class periods. Time can be adjusted depending on student content background.

## Lesson Sequence

**Lesson 1.** Slippery When Wet (Momentum and Friction on the Slip 'n Slide)

**Lesson 2.** Data Driven (Analyzing and Interpreting Slip 'n Slide Data)

**Lesson 3.** Speed Kills? (Research on Speed and Automobile Safety: 2 periods)

**Lesson 4.** Town Hall Meeting: Should We Reduce Speed Limits?

## Background on the Issue

Speed limits are part of everyday life in societies that rely on motor vehicles for transportation. Yet questions about whether speed limits really do save lives, and if so, what speeds are “ideal” remain controversial. Speed limits are generally imposed for safety reasons, but also have been used to reduce fuel consumption and reduce air and noise pollution. U.S. federal highway speeds have changed over the years, in response to research on road safety as well as fuel prices. Those who favor reduced speed limits generally cite research suggesting fewer road fatalities, improved fuel efficiency, and cleaner environments. Those who oppose speed limit reductions generally cite research suggesting that speed limits do not substantially improve safety or reduce air pollution, and that they are irrelevant since many people don't obey them anyway. Furthermore, opponents suggest that speed limits make commerce more difficult as they slow the movement of goods for businesses, yet create a large source of revenue for city, state, and local government through ticketing. In this unit, students will explore how velocity and mass affect momentum and will use their knowledge to analyze and interpret readings on speed limits and road safety. Students will then debate the proposed reduction of speed limits in a town hall meeting using evidence informed by their research.

## Connecting to NGSS

**3-PS2-1.** Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

**3-PS2-2.** Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

**MS-PS2-2.** Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.

## Accommodations for Students With Disabilities

**Visual Impairments:** Allow student to tactilely examine the Slip 'n Slide in advance of the lesson; have student count the number of paces back from the Slip 'n Slide so that she or he knows when to slide; allow student to feel the difference between one pound and one kilogram.

**Hearing Impairments:** Outdoor activities can be tricky as wind can increase "noise" for students who use hearing aids or cochlear implants; if possible, use an FM system or interpreter, or try to give directions either inside the school or in a wind-protected area if it happens to be windy; provide visual cues for vocabulary words such as *velocity*, *momentum*, and *mass*.

**Learning Disabilities:** Show students several examples of pound to kilogram conversions; separate the velocity and momentum portions of the data sheet into two pages to allow for greater white space on the page; use a T-chart to keep track of arguments for and against reduced speed limits.

**Motor-Orthopedic Impairments:** Accommodations will depend on the student's particular impairment and comfort level; speak with the student to discuss options for the Slip 'n Slide portion of the unit; the student could be seated on the Slip 'n Slide and have partners gently pull the student so that he or she can feel the difference in movement on a dry, wet, or soapy surface; if the student uses a wheelchair, the same calculations for velocity and momentum can be done using the wheelchair motion rather than the Slip 'n Slide; a whole-class alternative activity could consist of all students testing their speed using a spare wheelchair so that all students are using the same apparatus.

**Emotional Disabilities:** Assign numbers to students in advance of approaching the Slip 'n Slide to minimize arguments over the order of sliding; anticipate an outdoor "time out" spot that a student could move to if she or he requires a break from the excitement; if a student has difficulty listening or becomes disruptive during the debate, consider providing her or him with a Town Hall Meeting Participation Sheet and allow student to serve as an assistant to you; this may help student to focus on the conversation and provide a sense of autonomy.

# 3

## Resources for Teachers

- The Physics Classroom on Momentum  
([www.physicsclassroom.com/Class/momentum/u4l1a.cfm](http://www.physicsclassroom.com/Class/momentum/u4l1a.cfm))
- Insurance Institute for Highway Safety's Speed Limits Q&A Page:  
([www.iihs.org/research/qanda/speed\\_limits.aspx](http://www.iihs.org/research/qanda/speed_limits.aspx))

*Note:* This unit is based on a project submitted by Thomas Dolan.

An alternative to the "Slip 'n Slide" lesson that uses a skateboard can be found at:

Dolan, T. J., and D. L. Zeidler. 2009. Speed kills! (Or does it?). *Science and Children* 47 (3): 20–23.

# Lesson 1

## Slippery When Wet

### To the Teacher

In this lesson, students will participate in a Slip 'n Slide activity to examine concepts of velocity, mass, momentum, and friction. They will record their time sliding on water with and without dish soap, calculate their momentum based on their weight, and examine the effects of a reduction of friction on their velocity.

### Objective

Students will demonstrate their understanding of the impact of friction on velocity.

### Time Needed

One class period

### Materials

Slip 'n Slide, hose, stopwatch, bottle of dish soap, pencil, list (with the names of all students and 6 columns for each student), bathing suits, towels, goggles (1 pair per student).

*Note:* You may wish to have an extra adult on hand in order to assist with the data collection.

### Procedure

1. In advance of the class, set up the Slip 'n Slide outdoors.
2. Bring students outside to the Slip 'n Slide and ask for a volunteer to slide down the track without water turned on. (Students will either refuse because they know they won't slide, or will sit on the Slip 'n Slide without moving.)

# 3

3. Probe students about friction. "Why can't we slide well on the dry Slip 'n Slide?" "What is friction?" "How can we reduce the friction on the track?"
4. Have students line up and spray them with the hose. Students will then line up and run a distance of 5 meters before proceeding headfirst down the Slip 'n Slide track. The Slip 'n Slide track is approximately 6.1 meters in length.
5. Have a parent or another adult time students on the track with a stopwatch and record student times on the data sheet.
6. Allow each student to slide three times with the water running.
7. After each child has gone three times, apply dish soap to the Slip 'n Slide. (This is used to further demonstrate the lessening of friction.) Have students wear goggles and allow them to take another three turns down the slide with the soap added. Record times.
8. After all students have gone a total of 6 times, students will rinse off and proceed to change back into their school clothes.



# 3

## Lesson 2

### Data Driven



Topic: Momentum  
Go to: [www.scilinks.org](http://www.scilinks.org)  
Code: SSI005

#### To the Teacher

During this lesson, students analyze and interpret their results from the Slip 'n Slide activity to draw conclusions about the relationship between velocity and mass to momentum, as well as the impact of friction on velocity.

#### Objective

Students will demonstrate that both mass and velocity are related to momentum, and that friction reduces velocity.

#### Time Needed

One class period

#### Materials

Slip 'n Slide handout, timesheet (recorded from the previous day's activity for each student), pencil, paper, calculator.

#### Procedure

1. Begin by reviewing the events of the previous class. Can we slide on the Slip 'n Slide without water? (no, because too much friction) What is friction? (a force that slows things down) How did the water help us slide? (reduced friction). What effect do you think the soap had? (made it more slippery and reduced friction) Is it easier to stop with or without soap? (without)
2. Explain to students that in order to be certain about our results, we need to calculate our velocity, which is a function of time and distance. Have students examine their data sheets.

3. Students complete their data sheets by entering their mass (converted to kg as per the directions on the sheet) and then calculate their velocities both with and without soap. Students also calculate their momentum, which is a function of velocity and mass.
4. Have students compare and contrast the data in order to determine the effects of mass and velocity on momentum with regard to variances in friction due to the water and soap (soap decreases friction which then increases velocity; increased velocity increases momentum). Also note that velocity is inversely proportional to time for a given distance; in other words, it takes less time to get to a destination when traveling faster.

## Closure

Pool the class data so students can compare their results with the class to look at the effect of mass on momentum (increased mass increases momentum). Students should observe that increasing both mass and velocity increase the momentum of an object. Note that an object with greater momentum takes longer to stop.

## Assessment

Ask students to determine what factors would make a vehicle more or less likely to come to a quick stop, based on our results. (a fast, heavy vehicle will have more momentum than a slow, lighter vehicle, and will therefore stop more slowly; wet or oily roads reduce friction so velocity and momentum are increased)

Name: \_\_\_\_\_ Date: \_\_\_\_\_

# Slip 'n Slide

**Mass Conversion** (Round answer to the nearest hundredths)

Your Weight (lbs.)  $\times$  0.454 = Your Mass (kg)

\_\_\_\_\_  $\times$  0.454 = \_\_\_\_\_

**Time Trials** (Round time to the nearest tenth of a second)

Without Soap Trials

Trial	Time
1	
2	
3	

With Soap Trials

Trial	Time
1	
2	
3	

**Velocity Calculation** (Round answers to the nearest hundredths)

Trial	Distance (m) $\div$	Time (sec) =	Velocity (m/sec)
1			
2			
3			
4			
5			
6			

**Momentum Calculation** (Round answers to the nearest hundredths)

Trial	Mass (kg) $\times$	Velocity (m/sec) =	Momentum (kg m/sec)
1			
2			
3			
4			
5			
6			

# Lesson 3

## Speed Kills?

### To the Teacher

In this lesson, students will research various sources of data to grapple with the question of whether speed limits in the fictional city of Driversburg should be reduced in order to cut down on the number of vehicle fatalities.



Topic: Speed Limits  
Go to: [www.scilinks.org](http://www.scilinks.org)  
Code: SSI006

### Objective

Students will analyze a series of articles to become familiar with statistics and information regarding speed and the effect it has on vehicular accidents.

### Time Needed

Two class periods

### Materials

Article packet (containing 4 articles), Article Evaluation Sheets, highlighters, pencils

### Procedure

#### Day 1

1. After reviewing some of the major concepts from the prior lessons (momentum, velocity, mass), ask students whether they think that there should be speed limits on motor vehicles? (accept all answers) Ask, "If you think there should be limits, how can we decide what those limits should be? Should cars just go as slowly as they can?" (accept all answers)
2. Inform students that they are going to investigate research that has been done on vehicle safety to determine whether speed limits should be reduced.

## 3

3. In groups of four, have students read the articles and highlight important information within each article. After all students have finished reading the articles, each group will individually discuss the effects of lowering the speed limit and complete the Article Evaluation Sheets.

**Day 2**

1. Ask students to imagine that they are citizens of the city of Driversburg. After a series of recent fatal vehicular accidents, a law was proposed to reduce the speed limits on city streets by half. They have been charged with debating the law and ultimately, voting on its outcome.
2. Place students in new groups (different than their research groups) that represent various stakeholders on the issue of speed limit reduction. The new groups are: truck drivers, parents, business leaders, and police officers.
3. Challenge students to use the information in the articles and the knowledge gained in the hands-on experiments to formulate arguments for their particular stakeholder group. Allow students to access additional resources, if necessary, to enhance their arguments.

**Closure**

Inform students that they will be debating the issue in the next class period. “What are our ground rules for our debates?” (raising hands to speak, listening respectfully, no personal attacks or criticisms, using evidence to justify claims, and so on)

**Assessment**

Review student article summaries for accuracy and completeness.

**Articles for Packets**

**Article 1:** Witzenburg, G. (2003, January 23). Seven major myths of speed and speed enforcement. *Consumer Guide*. [www.motorists.org/ma/myths.html](http://www.motorists.org/ma/myths.html)

**Article 2:** U.S. Department of Transportation Research, Development, and Technology. 1992. Fact Sheet: Effects of raising and lowering speed limits. [www.fhwa.dot.gov/publications/research/safety/humanfac/rd97002.cfm](http://www.fhwa.dot.gov/publications/research/safety/humanfac/rd97002.cfm)

**Article 3:** Nagourney, E. 2009. Safety: As speed limits rise, so do death tolls. *The New York Times*. July 20. [www.nytimes.com/2009/07/21/health/research/21safe.html?scp=3&sq=highway&st=cse&\\_r=0](http://www.nytimes.com/2009/07/21/health/research/21safe.html?scp=3&sq=highway&st=cse&_r=0)

**Article 4:** Reinberg, S. 2009. Deaths, injuries increase with higher speed limits. *U.S. News and World Reports* (online version). July 16. <http://health.usnews.com/health-news/managing-your-healthcare/articles/2009/07/16/deaths-injuries-increase-with-higher-speed-limits>

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Article 1

# “Seven Major Myths of Speed and Speed Enforcement”

Summarize the main argument of the article:

---

---

---

---

Identify key points used in this article:

1. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
2. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
3. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
4. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
5. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Name: \_\_\_\_\_ Date: \_\_\_\_\_

## Article 2

# “Fact Sheet: Effects of Raising and Lowering Speed Limits”

Summarize the main argument of the article:

---

---

---

---

Identify key points used in this article:

1. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
2. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
3. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
4. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
5. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Name: \_\_\_\_\_ Date: \_\_\_\_\_

### Article 3

# “Safety: As Speed Limits Rise, So Do Death Tolls”

Summarize the main argument of the article:

---

---

---

---

Identify key points used in this article:

1. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
2. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
3. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
4. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
5. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Name: \_\_\_\_\_ Date: \_\_\_\_\_

## Article 4

# “Deaths, Injuries Increase With Higher Speed Limits”

Summarize the main argument of the article:

---

---

---

---

Identify key points used in this article:

1. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
2. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
3. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
4. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
5. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

# 3

## Lesson 4

# Town Hall Meeting

## Should We Reduce Speed Limits?

### To the Teacher

In this lesson, students will use the evidence they have collected from their hands-on investigations and their article research to debate whether speed limits should be reduced in the fictitious city of Driversburg.

### Objectives

Students will use evidence-based argumentation while engaging in respectful discourse on the controversial issue of whether speed limits should be lowered to reduce traffic accidents.

### Time Needed

One class period

### Materials

Completed article evaluation sheets and Slip 'n Slide data sheets from prior lessons, pencils.

### Procedure

1. Organize students to participate in a town hall meeting to determine if the speed limit should be lowered to help reduce traffic fatalities in Driversburg. Truck drivers and business leaders will argue against the reduction in speed limit, while parents and police officers will argue in favor of the speed limit reduction. The final decision regarding the speed limit will be determined by a secret ballot at the conclusion of the debate.

2. Begin a semistructured debate whereby all groups make an opening statement comprised of one or two claims using evidence to persuade others of their viewpoint. After all four groups have made their statements, allow students to ask questions of other groups' evidence, refute their claims, or bolster their own claims with additional evidence. Students must raise their hands to participate.
3. At the end of the meeting, review your impressions with the students and clear up any misconceptions that may have surfaced during the discussion. Have students now assume the role of the governing body and vote using a secret ballot to determine whether the speed limit should be reduced in Driversburg. Students should vote what they believe, not their stakeholder positions (although these might be the same). Announce the results to the class.

## Closure

Discuss the outcome with the students. "Were you surprised by the group's decision?" "Do you still have questions about the relationship between speed and vehicle safety?" "Could we have negotiated a different outcome?" "How does it feel to use evidence to inform decision making?" "Did you change your mind about this issue during the debate?"

## Assessment

Students write a letter to their town, county, or state department of transportation describing their research results and expressing their opinions on speed limits. Letters can contain additional research on local speed limits and speed-related accident statistics. Letters are assessed on accuracy of data, clarity of expression, persuasiveness of arguments, and format/grammar. Students can also be assessed on participation in all phases of Town Hall Meeting activities (See Town Hall Meeting Participation Sheet).

Name: \_\_\_\_\_ Date: \_\_\_\_\_

# Town Hall Meeting Participation Sheet

(Place a check “√” in each box as task is completed.)

Student Names	Completed Article Research Sheets	Participated in Stakeholder Group Discussions	Made Evidence-Based Contribution to Town Hall Meeting	Developed a Thoughtful Letter to Department of Transportation	Total (4 “√” Max)
<b>Truck Drivers</b>					
<b>Parents</b>					
<b>Business Leaders</b>					

Name: \_\_\_\_\_ Date: \_\_\_\_\_

<b>Student Names</b>	<b>Completed Article Research Sheets</b>	<b>Participated in Stakeholder Group Discussions</b>	<b>Made Evidence-Based Contribution to Town Hall Meeting</b>	<b>Developed a Thoughtful Letter to Department of Transportation</b>	<b>Total (4 “√” Max)</b>
<b>Police Officers</b>					



### Letter Scoring Rubric

Did the letter state the student's opinion on the issue of speed limits?	____ 5 pts.
Did the letter provide at least five specific facts and/or statistics learned from this unit?	____ 15 pts.
Was the letter accurate?	____ 5 pts.
Was the letter clear?	____ 5 pts.
Was the letter persuasive?	____ 5 pts.
Does the letter contain proper grammar and structure?	____ 5 pts.

**Total Pts. \_\_\_\_ / 40**

# Index

Page numbers printed in **boldface** type refer to tables or figures.

## **A**

- A Fair Shot? unit, 49, 189–219
  - accommodations for students with disabilities, 191–192
  - background on issue for, 190–191
  - connecting to NGSS, 191
  - ethical issues for, 189
  - grade levels for, 190
  - key science concepts for, 189
  - lesson sequence for, 190
    - lesson 1: Introduction, 194–200
    - lesson 2: The biology of cancer, 201–208
    - lesson 3: It can't happen to me!, 209–213
    - lesson 4: The art of argument, 214–216
    - lesson 5: Rethinking positions and relating the Gardasil debate to the nature of science, 217–219
  - overview of, 189
  - resources for teachers, 192–193
  - science skills for, 189
  - time needed for, 190
- A Need for Speed? unit, 49, 143–164
  - accommodations for students with disabilities, 145
  - background on issue for, 144
  - connecting to NGSS, 144–145
  - ethical issues in, 143
  - grade levels for, 143
  - key science concepts for, 143
  - lesson sequence for, 144
    - lesson 1: Slippery when wet, 147–149
    - lesson 2: Data driven, 150–152
    - lesson 3: Speed kills?, 153–159
    - lesson 4: Town hall meeting, 160–164
  - overview of, 143
  - resources for teachers, 146
  - science skills for, 143
  - time needed for, 144
- Accommodations for students with disabilities. *See also specific lessons*
  - for Animals at Work unit, 100
  - for A Fair Shot? unit, 191–192
  - for Food Fight unit, 53–54
  - for “Mined Over Matter” unit, 223–224
  - for A Need for Speed? unit, 145
  - for “Pharma’s” Market unit, 264

- for Space Case unit, 168–169
- Advertising of foods. *See* Food Fight unit, lesson 7
- Advertising of pharmaceuticals. *See* “Pharma’s” Market unit
- Animal rights. *See* Animals at Work unit, lesson 8
- Animals at Work unit, 48, 97–141
  - accommodations for students with disabilities, 100
  - background on issue for, 98–99
  - connecting to NGSS, 99
  - ethical issues in, 97
  - grade level for, 97
  - key science concepts in, 97
  - lesson sequence for, 98
    - lesson 1: All sorts of working animals, 101–104
    - lesson 2: Putting the horse before the cart, 105–107
    - lesson 3: Follow your nose, 108–110
    - lesson 4: Dolphins with a “porpoise,” 111–113
    - lesson 5: Meet some animal helpers, 114–117
    - lesson 6: How do you feel about working animals?, 118–120
    - lesson 7: Circus animals, 121–128
    - lesson 8: Under the big top, 129–135
    - lesson 9: Where do you stand?, 136–139
    - lesson 10: Culminating project, 140–141
  - overview of, 97
  - science skills for, 97
  - time needed for, 98
- Applebaum, Scott, 17, 19, 20, 21–22, 23–24, 25, 27
- Argumentation, 3–4, 15, 16, 34–36, 219
  - counterarguments, 36
  - creating a safe student-centered classroom environment for, 16–17, 34–35
  - creative modes of expressing, 36
  - definition of, 34
  - evidence-based, 11, 12
  - in NGSS, 34
  - providing activities for practicing, 36
  - teaching skills for, 34–36
- Assessment(s), 33, 37–42. *See also specific lessons*
  - criteria for, 37
  - debate rubric, **40–41**
  - designing for SSI, 37
  - of evidence-based reasoning, 37–38
    - scoring rubric for, **38**
  - formative, 37
  - impact of SSI on, 22–24
  - Programme for International Student Assessment (PISA), 11
  - standardized tests, 2, 22–24, 25
  - student products for, 33, 38–39, **39**
  - summative, 37, 259
- Authentic learning, 5, 16, 22, 23, 42

**B**

Benefits of SSI curriculum, 20–21

**C**

- Cake mining activity. See “Mined Over Matter” unit, lesson 4
- Cancer biology. See A Fair Shot? unit, lesson 2
- Caring for circus animals. See Animals at Work unit, lesson 7
- Challenges to SSI implementation, 17, 21–22
- Chang, Hyunsook, 17, 18, 20, 21, 23, 25, 26
- Character, 6–8, 7
- Circus animals. See Animals at Work unit
- Citizenship education, 2, 7, 8, 12
- Claims based on evidence, 11, 35
- Classroom discourse and SSI, 3, 14–16
  - argumentation and debate, 15
  - critical thinking, 15
  - discussion, 15
  - sociomoral discourse, 14, 22
- Classroom implementation of SSI, 16–27, 293
  - developing your own SSI curriculum, 31–33
  - guidelines for creating a safe student-centered environment, 16–17, 34–35
  - sample units for
    - Animals at Work, 97–141
    - A Fair Shot?, 189–219
    - Food Fight, 51–96
    - guide to, 46–47
    - list of, 48–50
    - “Mined” Over Matter, 221–260
    - A Need for Speed?, 143–164
    - “Pharma’s” Market, 261–292
    - Space Case, 165–187
  - strategies for, 34–45
    - argumentation, 34–36
    - assessment, 37–42
    - cooperative learning, 43–45
    - evaluating sources of information, 42–43
  - teachers’ perspectives on, 17–27
    - benefits of SSI, 20–21
    - controversial nature and parent/administrator problems, 24–26
    - handling implementation challenges, 21–22
    - impact on assessments, 22–24
    - reasons for beginning use of SSI, 18–20
    - tips for getting started, 26–27
- Colonizing space. See Space Case unit
- Commercials for food. See Food Fight unit, lesson 7
- Commercials for pharmaceuticals. See “Pharma’s” Market unit
- Common Core State Standards (CCSS)* in English language arts and mathematics, 2, 10–11
- Compassion, 7, 8
- Composition of drugs. See “Pharma’s” Market unit, lesson 2
- Concept maps, 54, 264
- Conscience, 6
- Contextualized science curricula, 3, 9
- Controversial issues, 1, 3, 4, 9

- argumentation and, 3–4, 15
  - critical thinking about, 15
  - discussion of, 15, 16
  - parent/administrator problems related to, 24–26
  - posing questions about, 33
  - willingness to discuss, 16
  - Cooperative learning, 18, 43–45. *See also* Sample SSI units
    - C-Points for, 44
    - techniques for, 45
    - tips for integrating elements of, 44–45
  - Critical thinking, 15, 20, 23, 257
  - Cross-curricular connections, 6
  - Cultural factors, 9, 17, 191
- D**
- Debate, 15
    - scoring rubric for, **40–41**
  - Development of SSI curriculum, 31–33, 293
    - adding lessons to existing units, 31
    - assessing knowledge and reasoning, 33
    - collecting resources, 32
    - having fun, 33
    - identifying topics, 31–32
    - incorporating group activities, 33
    - introducing topics, 32
    - posing controversial questions, 33
    - preparing students for discussions, 32–33
    - providing formal instruction, 33
    - providing guidance in evaluating primary and secondary sources, 33
  - Digestion. *See* Food Fight unit, lesson 5
  - Direct to consumer marketing of pharmaceuticals. *See* “Pharma’s” Market unit
  - Discussions, 15, 35
    - preparing students for, 32–33
  - Dolan, Tom, 17–18, 20, 21, 22–23, 24, 26
  - Dolphins’ echolocation abilities. *See* Animals at Work unit, lesson 4
  - Draught animals. *See* Animals at Work unit, lesson 2
  - Drug development and approval. *See* “Pharma’s” Market unit, lesson 4
  - Drug profile. *See* “Pharma’s” Market unit, lesson 2
- E**
- Echolocation abilities of dolphins. *See* Animals at Work unit, lesson 4
  - Elementary school units
    - Animals at Work, 48, 97–141
    - Food Fight, 48, 51–96
  - Elements, rocks, and minerals. *See* “Mined Over Matter” unit, lesson 3
  - Emotional disabilities, students with. *See* Accommodations for students with disabilities
  - Engineering practices, 9, 10, **12**
  - Evaluating sources of information, 33, 42–43
    - C.A.R.S. framework for, 42–43
    - nature of scientific information, 43
  - Evidence-based explanations, 11

Extraterrestrial settlements. *See* Space Case unit

## F

Fat content of foods. *See* Food Fight unit, lesson 6

“Fat tax” for unhealthy foods, 1, 33, 53, 56, 57, 92, 93

Feeding circus animals. *See* Animals at Work unit, lesson 7

Food Fight unit, 48, 51–96

accommodations for students with disabilities, 53–54

background on issue for, 52–53

connecting to NGSS, 53

ethical issues in, 51

grade level for, 52

key science concepts in, 51

lesson sequence for, 52

lesson 1: Initial debate, 56–58

lesson 2: Introduction to food groups, 60–63, **61**

lesson 3: How fresh is your food?, 65–68, **67**

lesson 4: Six nutrients mystery matching game and reading labels carousel, 69–72

lesson 5: Digestion, 75–79

lesson 6: Find the fat...and cheeseburgers on trial!, 80–84

lesson 7: Kids as consumers, 86–90

lesson 8: Final debate and letter writing, 91–93

optional lesson: Field trip to supermarket and “eat this, not that” slide show, 94–96

overview of, 51

resources for teachers, 54

science skills for, 51

time needed for, 52

Food groups. *See* Food Fight unit, lesson 2

*Frameworks for Science Education*, 8

Friction and velocity. *See* A Need for Speed? unit

Functional scientific literacy, 2, 5, 8, 293

## G

Gardasil vaccine. *See* A Fair Shot? unit

Geology. *See* “Mined Over Matter” unit

Group activities, 33, 44. *See also* Cooperative learning

Guidelines for creating a safe student-centered classroom environment, 16–17, 34–35

## H

Healthy, Hunger-Free Kids Act, 53

Healthy and unhealthy foods. *See* Food Fight unit

Hearing, animals’ sense of. *See* Animals at Work unit, lesson 4

Hearing impairments, students with. *See* Accommodations for students with disabilities

High school units

A Fair Shot?, 49, 189–219

“Mined” Over Matter, 50, 221–260

“Pharma’s” Market, 50, 261–292

How drugs work. *See* “Pharma’s” Market unit, lesson 3

Human papilloma virus vaccine. *See* A Fair Shot? unit

**I**

Immunity and vaccinations. *See* A Fair Shot? unit  
 Interdisciplinary connections, 2, 3, 4, 6, 9, 11, 12

**J**

Jigsaw strategy, 45, 130, 166, 170, 249, 263

**L**

Learning disabilities, students with. *See* Accommodations for students with disabilities  
 Lee, Kisoan, 17, 18–19, 20, 21, 23, 25, 26–27

**M**

Mandatory Gardasil vaccination. *See* A Fair Shot? unit, lesson 1  
 Manufacture of drugs. *See* “Pharma’s” Market unit, lesson 4  
 Marketing of foods to children. *See* Food Fight unit, optional lesson  
 Marketing of pharmaceuticals. *See* “Pharma’s” Market unit  
 Mechanism of drug action. *See* “Pharma’s” Market unit, lesson 3  
 Middle school units  
   A Need for Speed?, 49, 143–164  
   Space Case, 49, 165–187  
 “Mined” Over Matter unit, 50, 221–260  
   accommodations for students with disabilities, 223–224  
   background on issue for, 222–223  
   connecting to NGSS, 223  
   ethical issues for, 221  
   grade levels for, 222  
   key science concepts for, 221  
   lesson sequence for, 222  
     lesson 1: Introduction to rare earth elements, 225–234  
     lesson 2: Rock and roll, 235–239  
     lesson 3: Elements, rocks, and minerals, 240–243  
     lesson 4: Cake mining, 244–248  
     lesson 5: Digging deeper, 249–251  
     lesson 6: The decision-making process, 252–256  
     lesson 7: Debate: should the United States mine rare earth elements?, 257–260  
   overview of, 221  
   resources for teachers, 224  
   science skills for, 221  
   time needed for, 222  
 Minerals and rocks. *See* “Mined Over Matter” unit, lesson 3  
 Misconceptions of students, 14, 33, 161, 209  
 Momentum. *See* A Need for Speed? unit  
 Moral beliefs, 4, 14  
 Moral development, 8, 11, 12, 18, 23  
 Moral dilemmas, 4, 20, 21, 26, 46  
 Moral/ethical implications of decisions, 2, 5  
 Moral excellence, 7, 293  
 Moral implications of technological advancements, 10  
 Moral reasoning, 18, 22, 26, 170, 186, 194, 261  
 Motor/orthopedic impairments, students with. *See* Accommodations for students with disabilities

**N**

- National Science Teachers Association, 8
- National Social Studies Standards (NSSS), 11
- Nature of science (NOS), 2.4, 9, 12, **12**, 16, 17, 43, 217–219
- Next Generation Science Standards (NGSS)*, 2
  - alignment with *Common Core State Standards*, 10–11
  - conceptual shifts in, 9–12, **12**
- National Social Studies Standards and, 11
  - scientific and engineering practices in, 9, 10, **12**
- SSI and, 8–13, **12**
  - Animals at Work unit, 99
  - A Fair Shot? unit, 191
  - Food Fight unit, 53
  - “Mined Over Matter” unit, 223
  - A Need for Speed? unit, 144–145
  - “Pharma’s” Market unit, 263
  - Space Case unit, 167–168
  - three major dimensions of, 9
- No Child Left Behind Act, 2
- Numbered Heads Together technique, 45
- Nutrients. *See* Food Fight unit, lesson 4
- Nutritional labels. *See* Food Fight unit, lesson 4

**O**

- Obesity, 51, 52

**P**

- Pedagogy and SSI, 13–14
  - role of students, 14
  - role of teacher, 6, 13–14, 16
  - SSI context, 13
- Personal mineral consumption. *See* “Mined Over Matter” unit, lesson 1
- “Pharma’s” Market unit, 50, 261–292
  - accommodations for students with disabilities, 264
  - background on issue for, 262–263
  - connecting to NGSS, 263
  - ethical issues for, 261
  - grade level for, 262
  - key science concepts for, 261
  - lesson sequence for, 262
    - lesson 1: We are family, 266–270
    - lesson 2: What’s in the bottle?, 271–273
    - lesson 3: How do drugs work?, 274–277
    - lesson 4: How are pharmaceuticals made?, 278–282
    - lesson 5: Vioxx, 283–286
    - lesson 6: Congressional subcommittee hearing, 287–292
  - overview of, 261
  - resources for teachers, 265
  - science skills for, 261
  - time needed for, 262
- Planetary colonization. *See* Space Case unit

Plate tectonics. See “Mined Over Matter” unit, lesson 2  
 Prescription medication advertising. See “Pharma’s” Market unit  
 Preservatives in foods. See Food Fight unit, lesson 3  
 Prevalence of prescription drug use. See “Pharma’s” Market unit, lesson 1  
 Programme for International Student Assessment (PISA), 11  
 Progressivism in science education, 5  
 Pseudoscience, 3, 4, 209

**R**

Rare earth elements (REEs). See “Mined Over Matter” unit  
 Reading nutritional labels. See Food Fight unit, lesson 4  
 Reasoning  
   argumentation and, 15, 34, 35, 36, 219  
   critical thinking and, 15  
   emotive, 8  
   evidence-based, assessment of, 37–38  
     scoring rubric for, **38**  
   moral, 18, 22, 26, 170, 186, 194, 261  
   from multiple perspectives, 8, 16  
   nonoral expressions of, 36  
   reflective, 6  
   scientific, 3, 6, 8, 14  
     vs. non-scientific, 217  
   sociomoral discourse and, 14  
   socioscientific, 8, 20, 21  
 Removing a drug from the market. See “Pharma’s” Market unit, lesson 5  
 Rock cycle. See “Mined Over Matter” unit, lesson 2  
 Rocks and minerals. See “Mined Over Matter” unit, lesson 3

**S**

Sample SSI units, 46–50  
   Animals at Work, 97–141  
   A Fair Shot?, 189–219  
   Food Fight, 51–96  
   guide to, 46–47  
   list of, 48–50  
   “Mined” Over Matter, 221–260  
   A Need for Speed?, 143–164  
   “Pharma’s” Market, 261–292  
   Space Case, 165–187  
 School lunch nutritional guidelines. See Food Fight unit  
 Science, technology, and society (STS), 2, 5  
 Science, technology, engineering, and mathematics (STEM) teaching, 12  
 Scientific literacy, 2  
   functional, 2, 5, 8, 293  
   socioscientific issues and, 5–6  
   Vision I and Vision II, 5, 9  
*SciLinks*  
   animals in circuses, 97  
   digestive system, 75  
   mining minerals, 231

- momentum, 150
- nutrition, 60
- nutritional disorders, 80
- plate tectonics, 235
- prescription drugs, 261
- rare earth elements, 225
- rock cycle, 245
- space ethics, 165
- speed limits, 153
- vaccines, 194
- Service animals. *See* Animals at Work unit, lesson 5
- Sexually transmitted diseases. *See* A Fair Shot? unit, lesson 3
- Skepticism, 4, 8, 16
- Slip 'n Slide activity. *See* A Need for Speed? unit
- Smell, animals' sense of. *See* Animals at Work unit, lesson 3
- Social conscience, 6
- Sociomoral discourse, 14, 22
- Socioscientific issues (SSI) curriculum, 1–27
  - argumentation and, 3–4
  - character and, 6–8, 7
  - classroom discourse and, 3, 14–16
    - argumentation and debate, 15
    - critical thinking, 15
    - discussion, 15
    - sociomoral discourse, 14, 22
  - classroom implementation of, 16–27, 293
  - collaborative nature of, 11
  - cross-curricular connections and, 6
  - definition of, 3
  - development of, 31–33
  - distinction from science, technology, and society, 5
  - features of, 4, 5
  - integrating science content in, 6
  - Next Generation Science Standards* and, 8–13, 12
  - pedagogy and, 13–14
    - role of students, 14
    - role of teacher, 6, 13–14, 16
    - SSI context, 13
  - sample units of, 46–50 (*See also* Sample SSI units)
  - scientific literacy and, 2, 5–6
- Space Case unit, 49, 165–187
  - accommodations for students with disabilities, 168–169
  - background on issue for, 166–167
  - connecting to NGSS, 167–168
  - ethical issues for, 165
  - grade levels for, 166
  - key science concepts for, 165
  - lesson sequence for, 166
    - lesson 1: Who owns outer space?, 170–172
    - lesson 2: Space players, 173–178
    - lesson 3: Planetary particulars, 179–185

- lesson 4: United Nations vote, 186–187
    - overview of, 165
    - resources and research materials for, 169
    - science skills for, 165
    - time needed for, 166
  - Speed limits. *See* A Need for Speed? unit
  - SSI. *See* Socioscientific issues curriculum
  - Stem cell research, 1, 25
  - Student-centered classroom, 16, 22, 25
  - Students
    - cooperative learning activities for, 18, 43–45
    - core beliefs of, 9, 14, 16, 21
    - with disabilities (*See* Accommodations for students with disabilities)
    - misconceptions of, 14, 33, 161, 209
    - role in SSI curriculum, 14
  - Synthetic drug manufacture. *See* “Pharma’s” Market unit, lesson 4
- T**
- T-Charts, 35, 54, 57, 59, 104, 145, 224, 264
  - Teachers. *See also* Classroom implementation of SSI
    - development of SSI curriculum by, 31–33
    - guidelines for creating a safe student-centered classroom environment, 16–17, 34–35
    - modeling by, 16, 35
    - perspectives on classroom implementation of SSI, 17–27
      - benefits of SSI, 20–21
      - controversial nature and parent/administrator problems, 24–26
      - handling implementation challenges, 21–22
      - impact on assessments, 22–24
      - reasons for beginning use of SSI, 18–20
      - tips for getting started, 26–27
    - reasons for beginning use of SSI, 17, 18–20
    - role in implementing SSI curriculum, 6, 13–14, 16
  - Television advertising of food. *See* Food Fight unit, lesson 7
  - Television advertising of prescription drugs. *See* “Pharma’s” Market unit, lesson 6
  - Therapy animals. *See* Animals at Work unit, lesson 5
  - Think-Pair-Share technique, 45
  - Topics for SSI curriculum, 31–32
  - Traffic fatalities and speed limits. *See* A Need for Speed? unit
- U**
- Unhealthy and healthy foods. *See* Food Fight unit
  - United States’ mining of rare earth elements. *See* “Mined Over Matter” unit, lesson 7
- V**
- Vaccines. *See* A Fair Shot? unit
  - Venn diagrams, 54, 66
  - Vioxx case study. *See* “Pharma’s” Market unit, lesson 5
  - Visual impairments, students with. *See* Accommodations for students with disabilities
- W**
- Working animals. *See* Animals at Work unit

# IT'S DEBATABLE!

USING SOCIOSCIENTIFIC ISSUES TO DEVELOP SCIENTIFIC LITERACY

K-12

This book encourages scientific literacy by showing you how to teach the understanding and thinking skills your students need to explore real-world questions like these:

- Should schools charge a “fat tax” to discourage kids from eating unhealthy foods?
- Should local governments lower speed limits to reduce traffic fatalities?
- Should pharmaceutical companies be allowed to advertise prescription drugs directly to consumers?

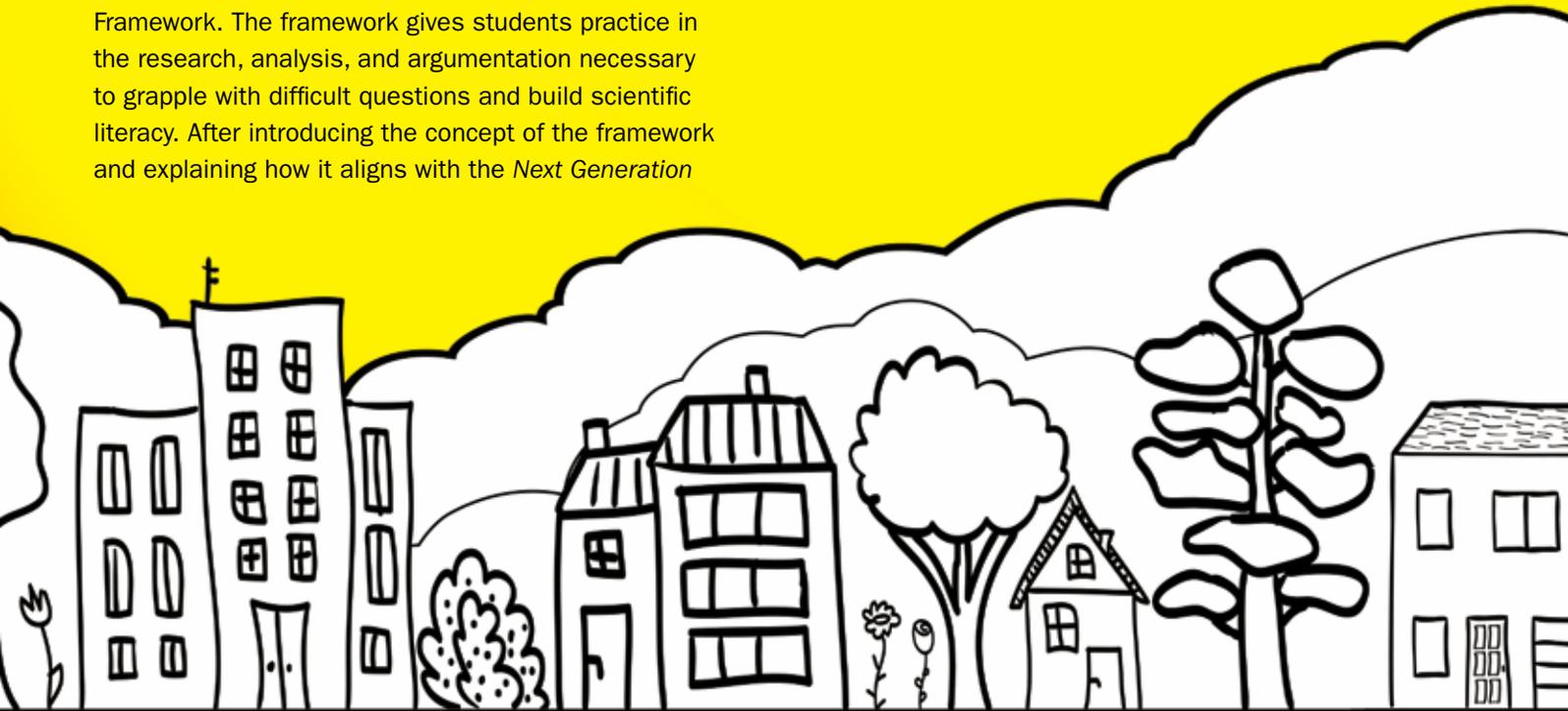
At the core of the exploration is the Socioscientific Issues Framework. The framework gives students practice in the research, analysis, and argumentation necessary to grapple with difficult questions and build scientific literacy. After introducing the concept of the framework and explaining how it aligns with the *Next Generation*

**“Functional scientific literacy requires an understanding of the nature of science and the skills necessary to think both scientifically and ethically about everyday issues.”**

—from the introduction to *It's Debatable!*

*Science Standards*, the book shows you how to implement it through seven units targeted to the elementary, middle, and high school levels. You even find out how to develop your own socioscientific issues curriculum.

Both practical and content-rich, *It's Debatable!* doesn't shy away from controversy. Instead, the authors encourage you and your students to confront just how messy the questions raised by science (and pseudoscience) can be. After all, as the authors note, “The only way for our students to be prepared for participation in societal discourse is to have practice in their school years, and what better place than the science classroom?”



Grades K-12

**NSTA**press  
National Science Teachers Association

PB347X  
ISBN: 978-1-938946-00-4

