The 2012 National Survey of Science and Mathematics Education

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Question

In order to meet the vision laid out in new college and career readiness standards (e.g., CCSS-M, NGSS), the K–12 STEM education system:

a. Needs a complete overhaul.
b. Needs to have a few parts replaced/updated.
c. Needs a minor tune up.

Where Have We Been?

- There is a great deal of talk about the need to improve STEM education in the nation:
  - Reports about the status of the system
    - A Nation at Risk
    - Rising Above the Gathering Storm
  - Large scale assessments
    - NAEP
    - TIMSS

Where Do We Want to Go?

- New standards documents set a new goal for what all students are expected to know and be able to do as a result of K–12 education…

- But they don't tell us how to get there.

Where are We Now?

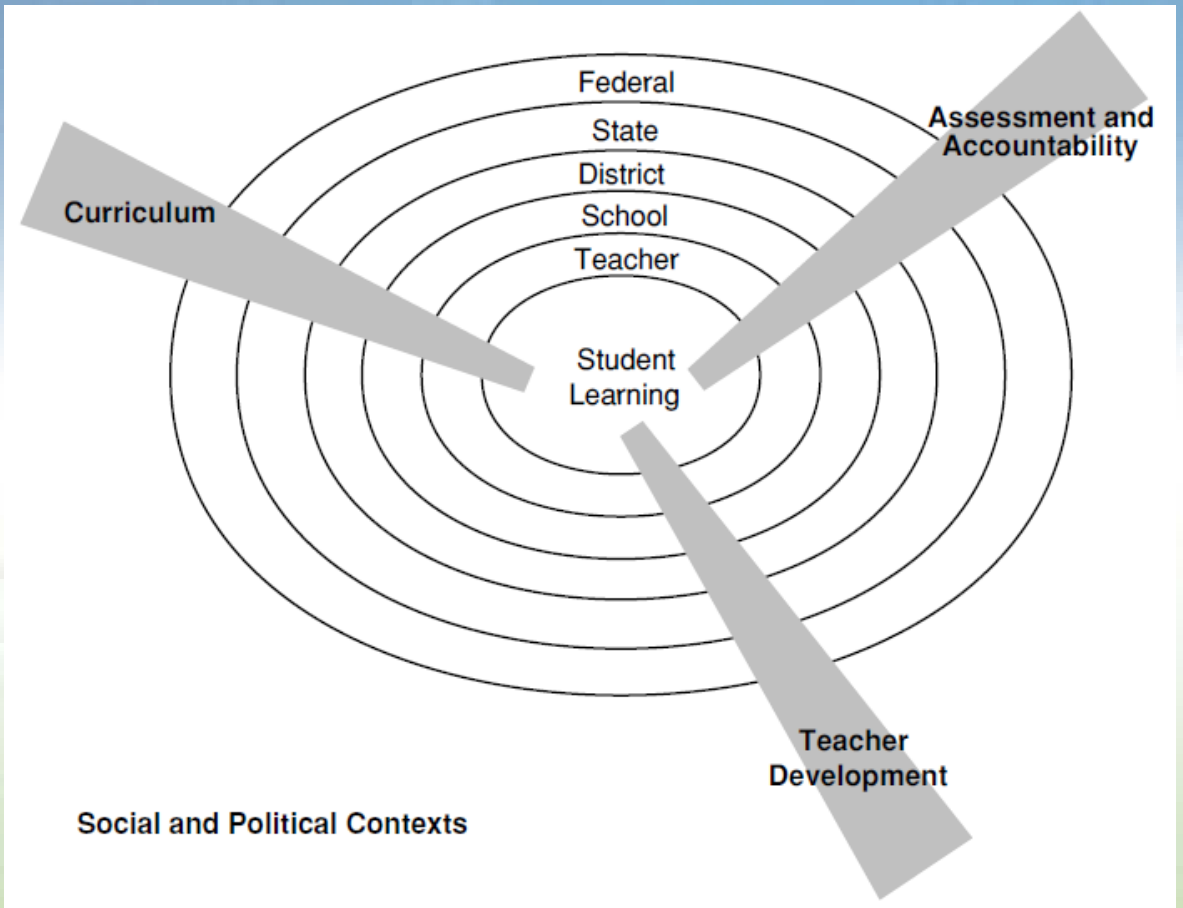
- There are both strengths and areas in need of improvement in the K–12 STEM education system.
- We can't develop a sensible plan for getting there if we don't know where we are now.
- Data from the 2012 National Survey of Science and Mathematics Education help answer this question.

Question

Which is the most important determinant of student outcomes in STEM?

a. Teacher preparation programs/professional development
b. Teachers' knowledge, skills, and beliefs
c. Quality of instructional materials
d. High-stakes assessments
e. Parent/community expectations and engagement
f. Classroom practice

Factors Influencing Student Outcomes



National Research Council. (2002). *Investigating the influence of standards: A framework for research in mathematics, science, and technology education*. I.R. Weiss, M.S. Knapp, K.S. Hollweg, and G. Burrill (Eds.), Committee on Understanding the Influence of Standards in K-12 Science, Mathematics, and Technology Education, Center for Education, Division of Behavioral and Social Sciences and Education. Washington, DC: National Academy Press.

Session Structure

- About the 2012 National Survey of Science and Mathematics Education
- Science and Mathematics Instruction
- The Science and Mathematics Teaching Force
- Professional Development
- Instructional Materials
- Implications for the Future

About the 2012 National Survey of Science and Mathematics Education

- The 2012 NSSME is the fifth in a series of surveys dating back to 1977.

- It is the only survey specific to science and mathematics education that provides nationally representative results.

Endorsing Organizations

- American Association of Physics Teachers
- American Chemical Society, Education Division
- American Federation of Teachers
- Association of Mathematics Teacher Educators
- Association of State Supervisors of Mathematics
- Center for the Study of Mathematics Curriculum
- Council of State Science Supervisors
- National Association of Biology Teachers
- National Association of Elementary School Principals
- National Association of Secondary School Principals
- National Catholic Education Association
- National Council of Supervisors of Mathematics
- National Council of Teachers of Mathematics
- National Earth Science Teachers Association
- National Education Association
- National School Boards Association
- National Science Education Leadership Association
- National Science Teachers Association

Topics Addressed

- Characteristics of the science/mathematics teaching force:
  - Demographics
  - content background
  - beliefs about teaching and learning
  - perceptions of preparedness
- Instructional practices
- Factors that shape teachers' decisions about content and pedagogy
- Use of instructional materials
- Opportunities teachers have for professional growth
- How instructional resources are distributed

Who's In the Sample

- Two-stage sample that targeted:
  - 2,000 schools (public and private)
  - Over 10,000 K–12 teachers

- Excellent response rate:
  - 1,504 schools agreed to participate
  - Over 80 percent of program representatives
  - Over 75 percent of sampled teachers

- As we go through the data, jot down anything that:
  1. Surprises you
  2. Pleases you
  3. Dismays you

- In addition, make note of anything that might have implications for your work.

Science and Mathematics Instruction

Question

On average, how many minutes per day in elementary classes are devoted to instruction in:

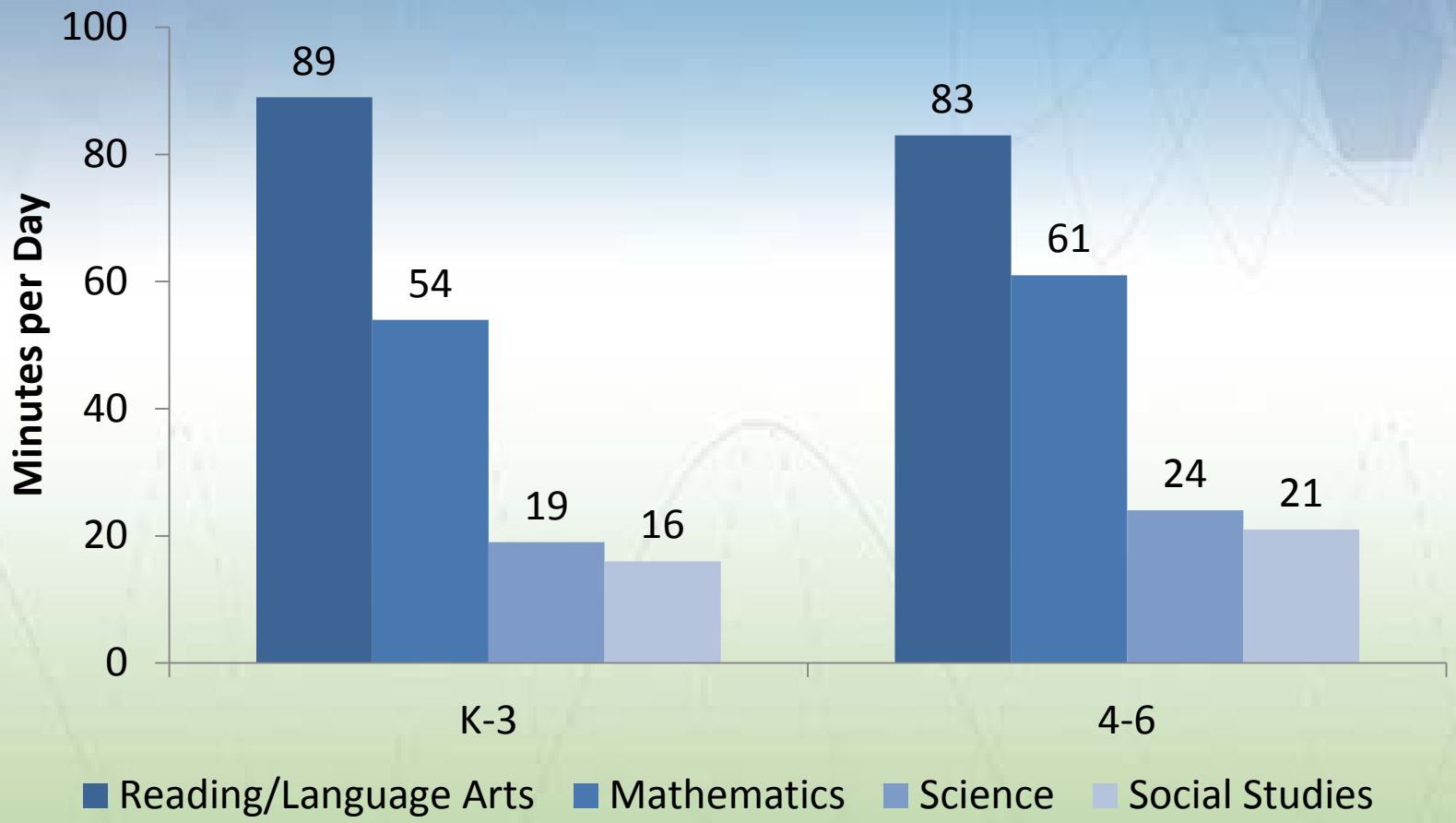
I. Reading/language arts? _____

II. Mathematics? _____

III. Science? _____

IV. Social Studies? _____

Instructional Time: Elementary Classes

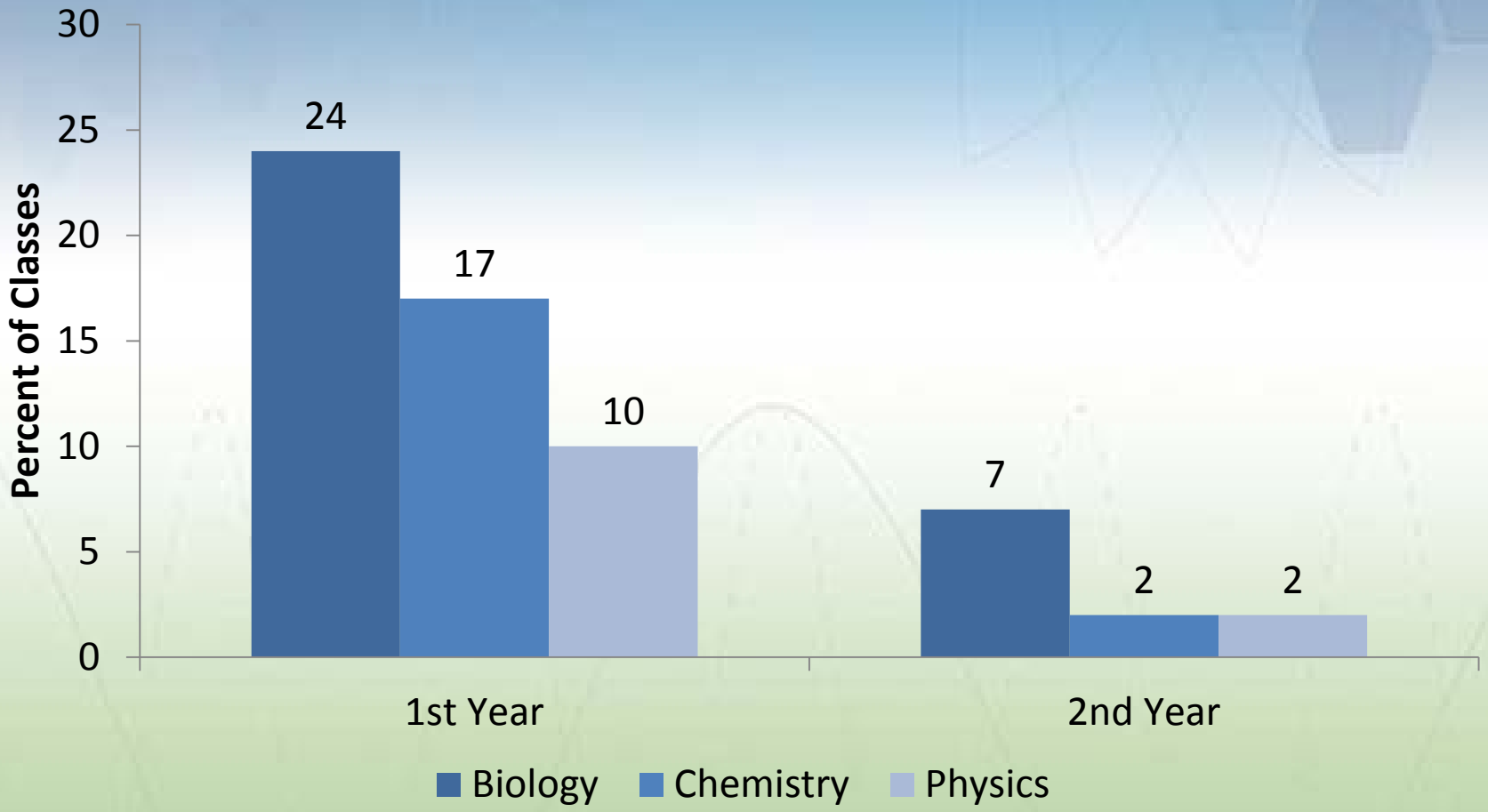


Elementary Science and Mathematics

- Nearly all elementary teachers teach mathematics every day of every week.
- Science is a different story:

	Percent of Classes	
	K-3	4-6
All/Most Days, every week	20	35
Three or fewer days, every week	39	33
Some weeks, but not every week	41	32

High School Science Courses Offered



High School Mathematics Courses Offered

Question

Compared to lower-level high school courses, students in advanced science and mathematics courses are:

a. Less diverse.
b. Just as diverse.
c. More diverse.

Student Enrollment: HS Science

	Percent Female
• Non-College Prep	46
• 1st Year Biology	49
• 1st Year Chemistry	51
• 1st Year Physics	49
• Advanced Courses	54

Student Enrollment: HS Science

	Percent HUS
• Non-College Prep	36
• 1st Year Biology	33
• 1st Year Chemistry	30
• 1st Year Physics	23
• Advanced Courses	21

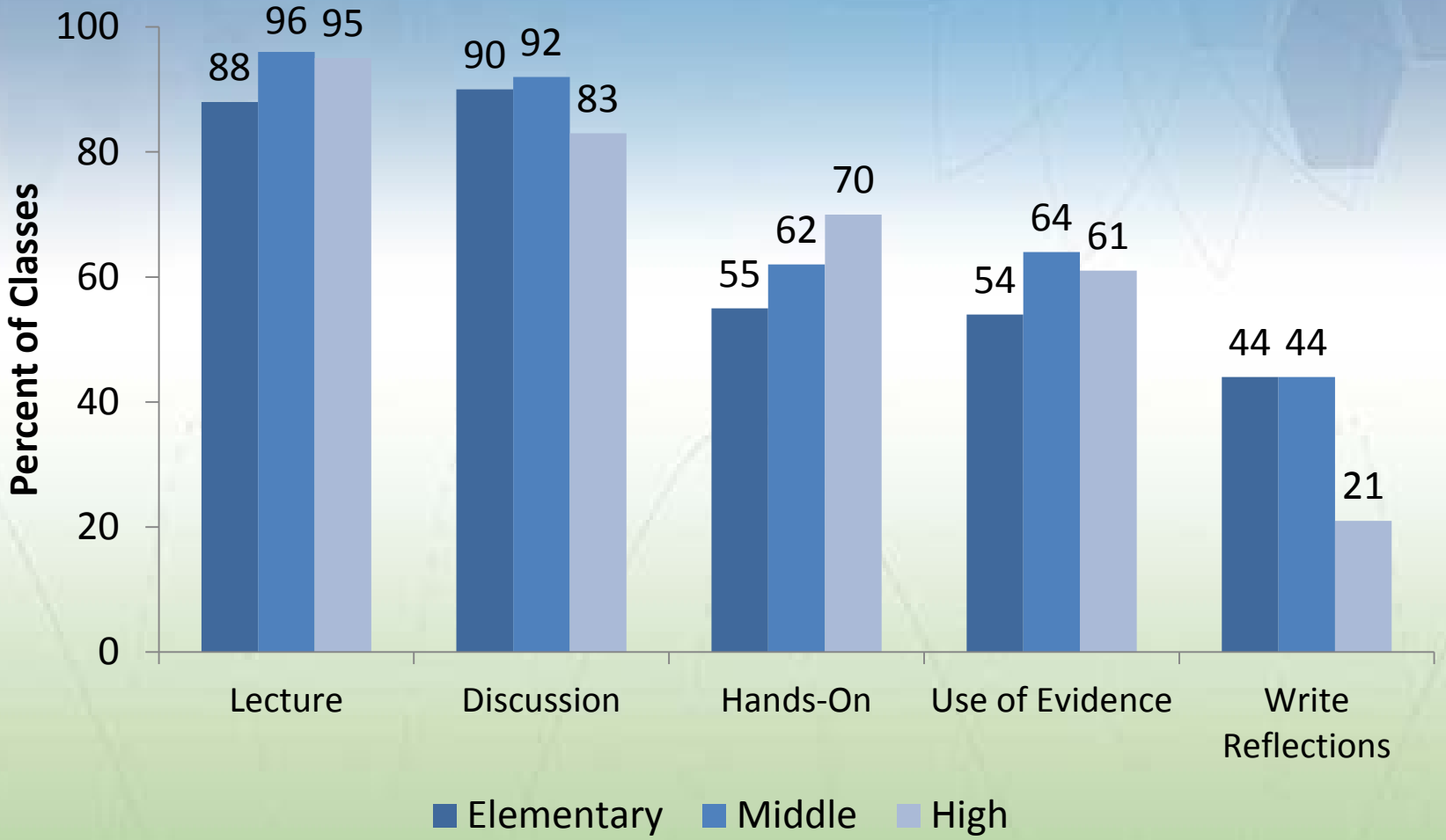
Student Enrollment: HS Mathematics

	Percent Female
• Non-College Prep	42
• Formal Level 1	48
• Formal Level 2	50
• Formal Level 3	51
• Formal Level 4	48
• College-Credit Courses	48

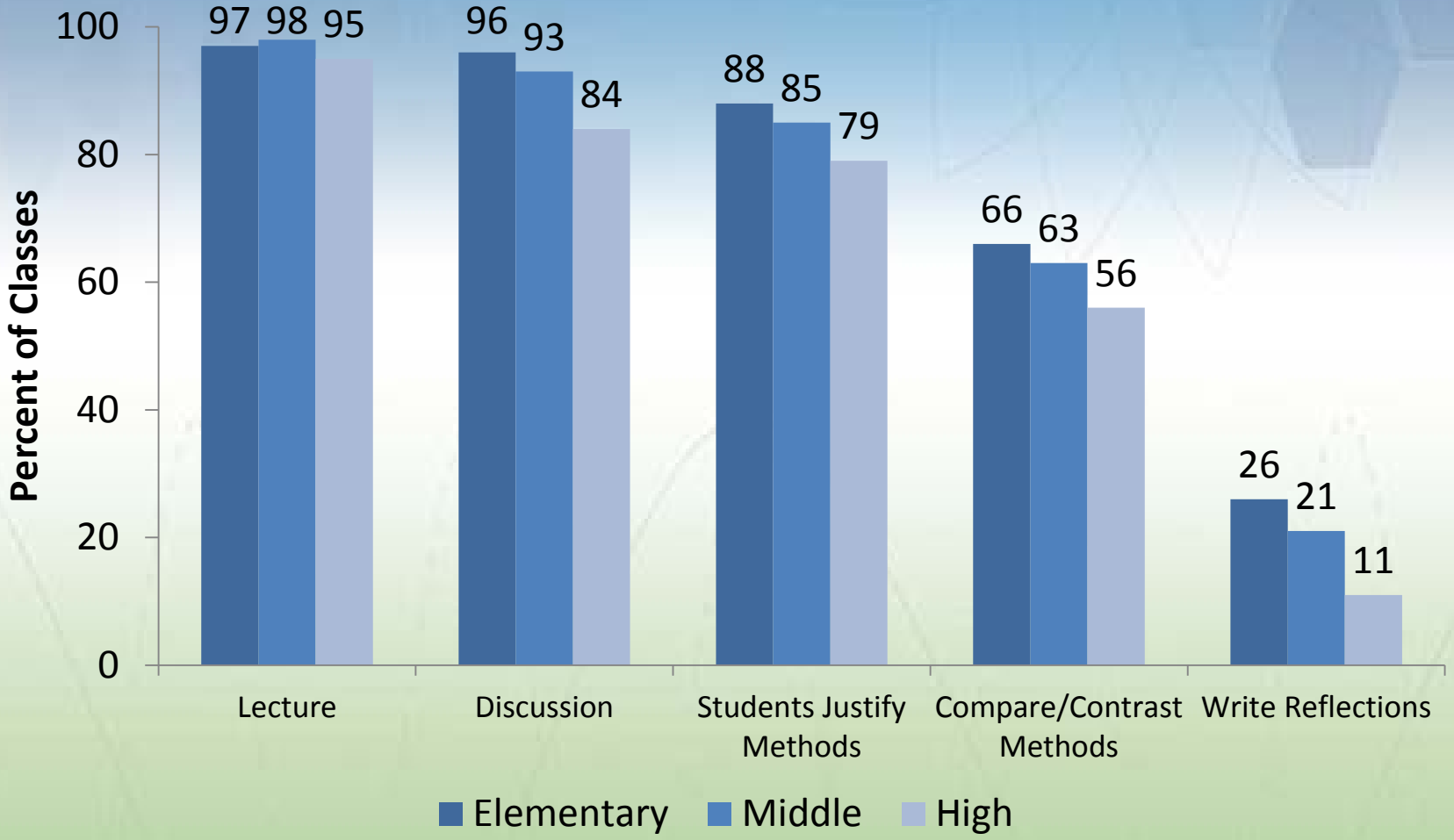
Student Enrollment: HS Mathematics

	Percent HUS
• Non-College Prep	45
• Formal Level 1	39
• Formal Level 2	31
• Formal Level 3	27
• Formal Level 4	22
• College-Credit Courses	17

Weekly Instructional Practices: Science



Weekly Instructional Practices: Math



The Science and Mathematics Teaching Force

Question

About what percentage of elementary teachers feel very well prepared to teach:

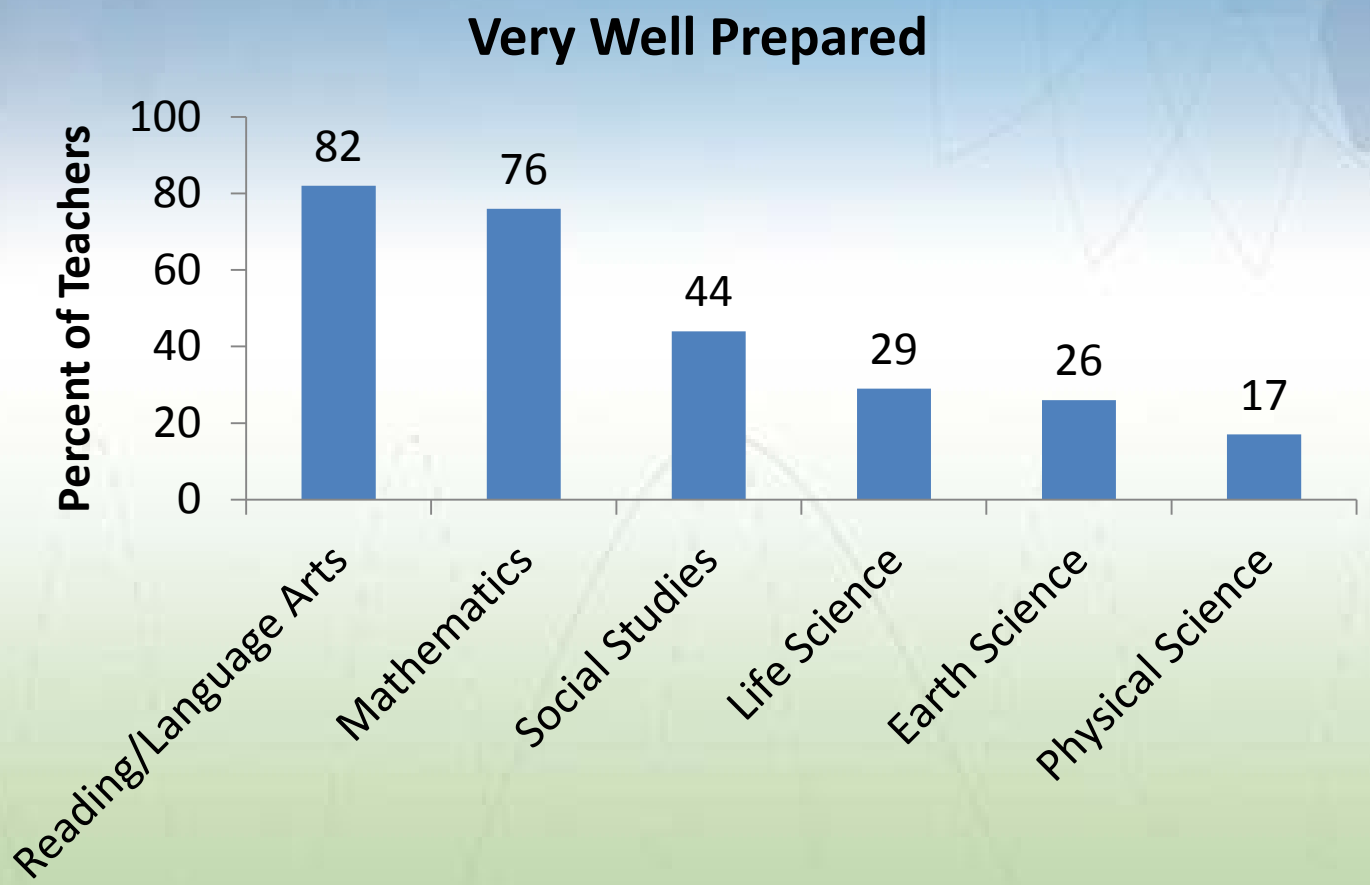
I. Reading/language arts? _____

II. Mathematics? _____

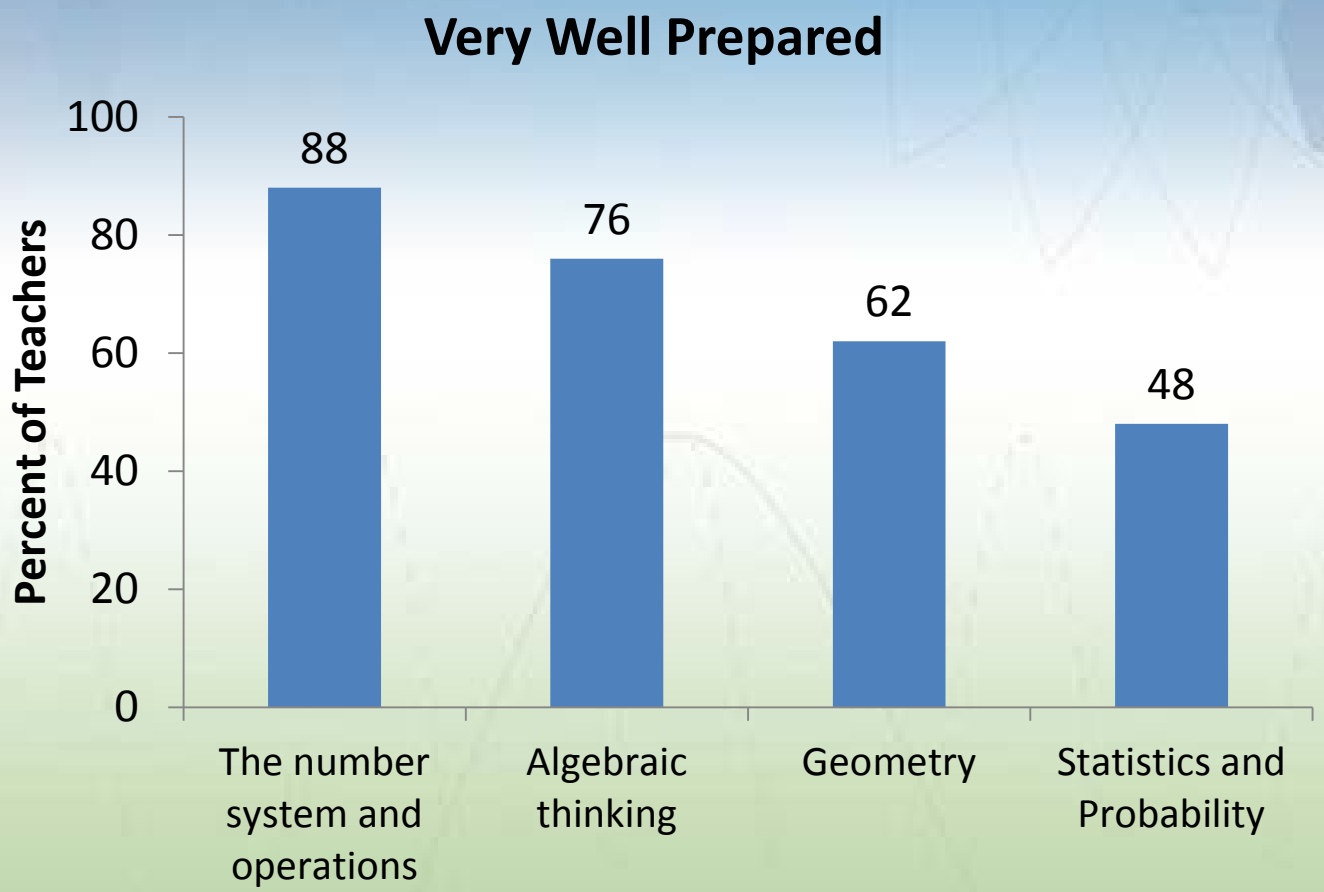
III. Science? _____

IV. Social Studies? _____

Perceptions of Preparedness: Elementary



Perceptions of Preparedness: Middle Grades



Question

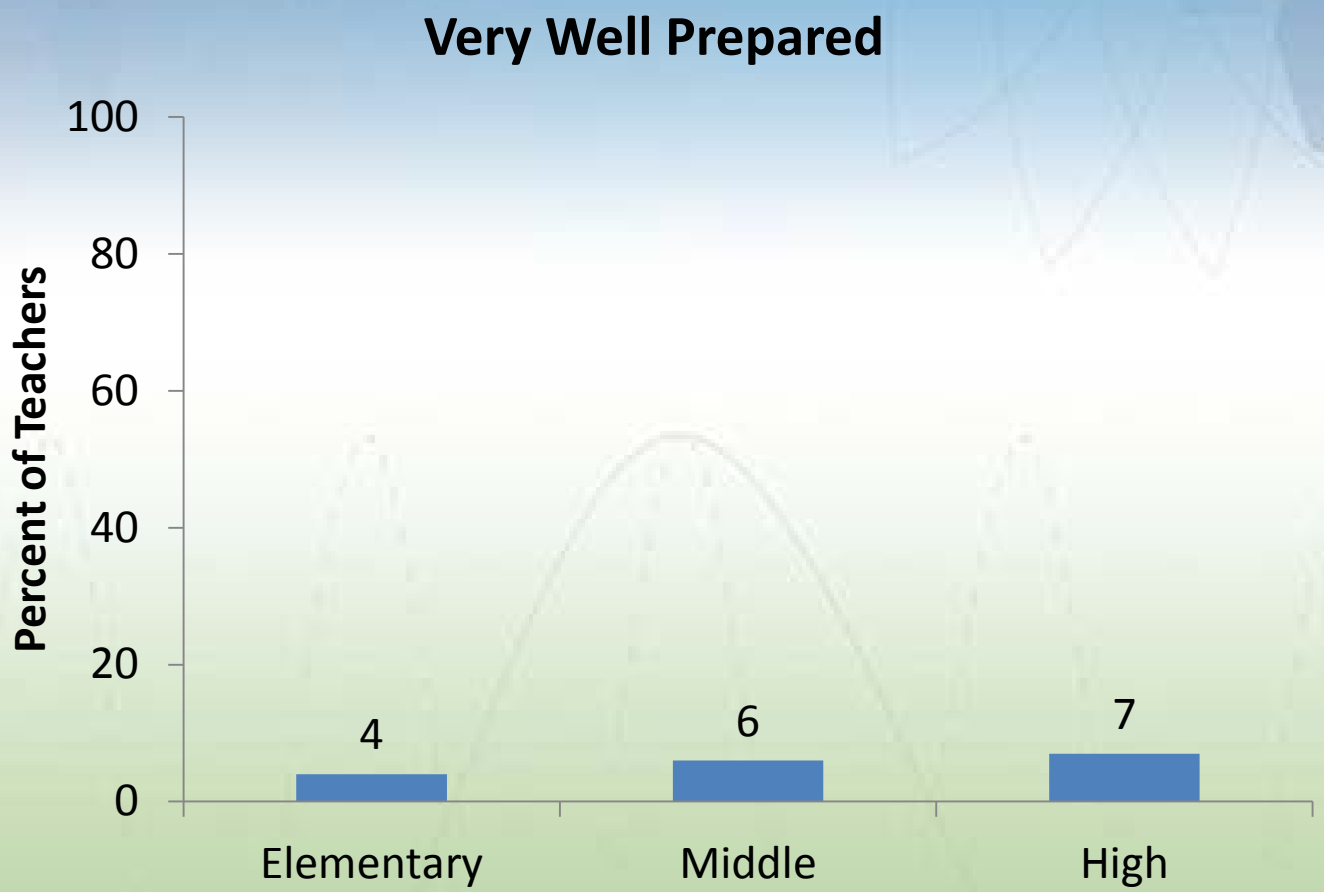
About what percentage of teachers at each grade level feel very well prepared to teach engineering?

I. Elementary _____

II. Middle _____

III. High _____

Preparedness to Teach Engineering

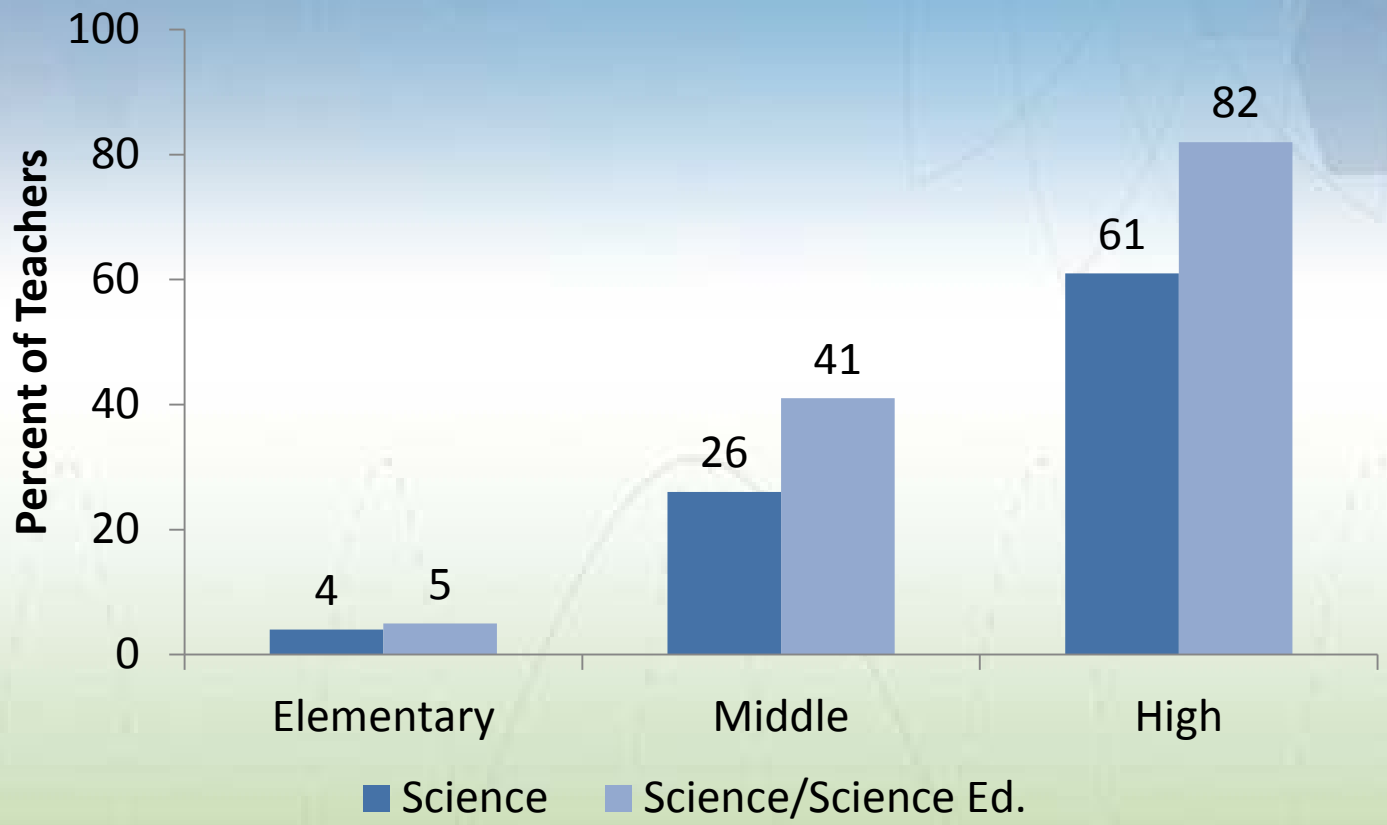


Question

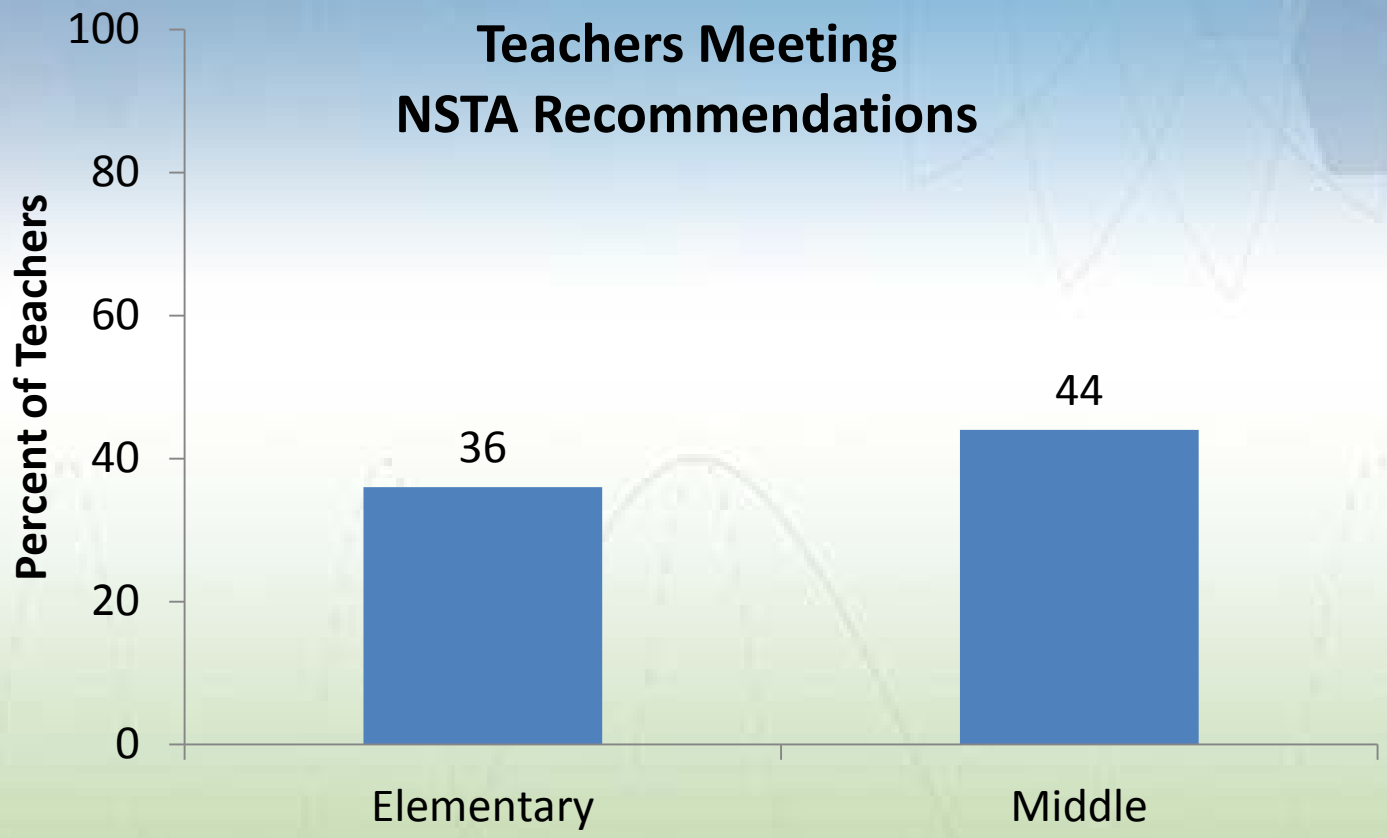
About what percentage of high school science teachers has a college degree in a science discipline?

a. 50 percent
b. 60 percent
c. 70 percent
d. 80 percent

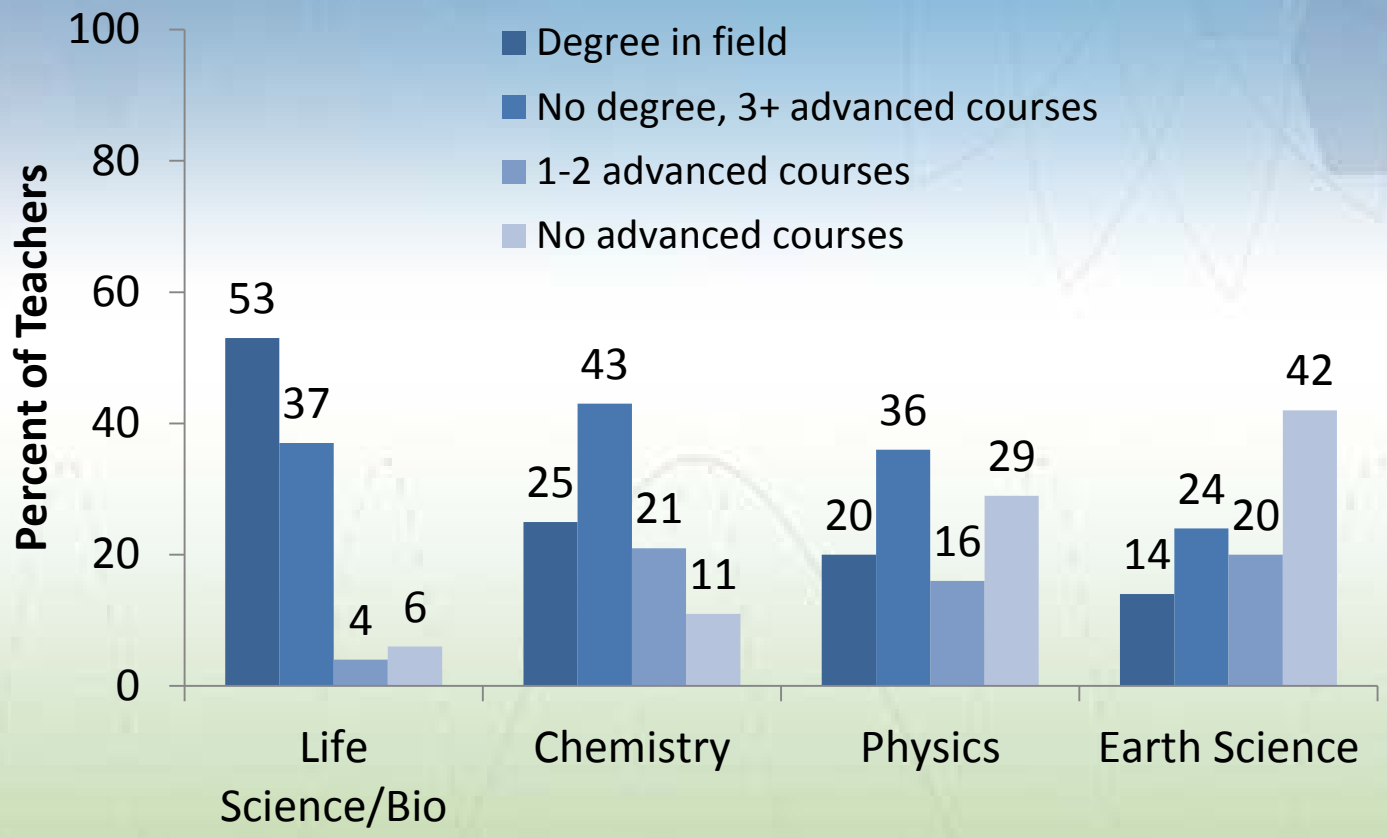
Science Teacher Degrees



Science Coursework



High School Science Teachers

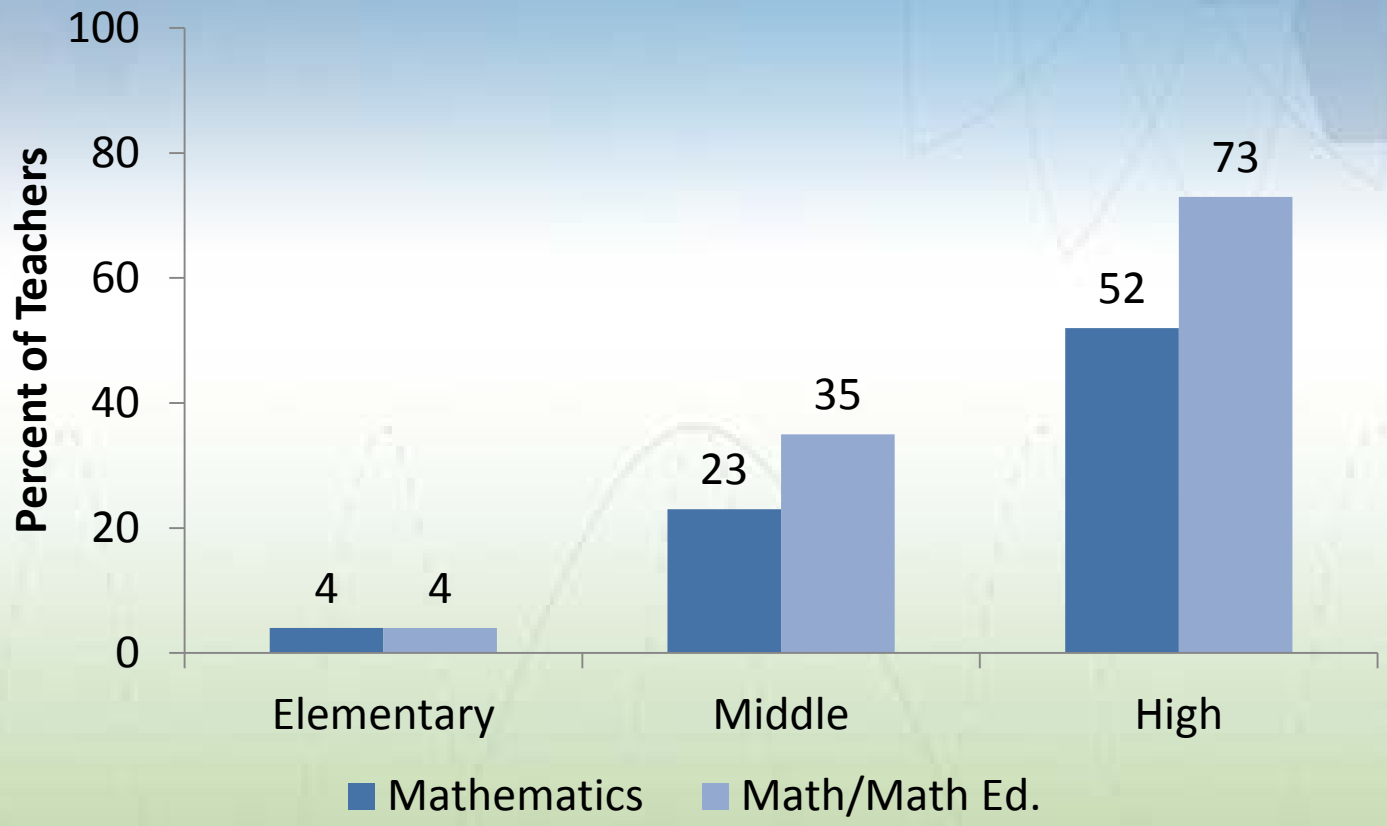


Question

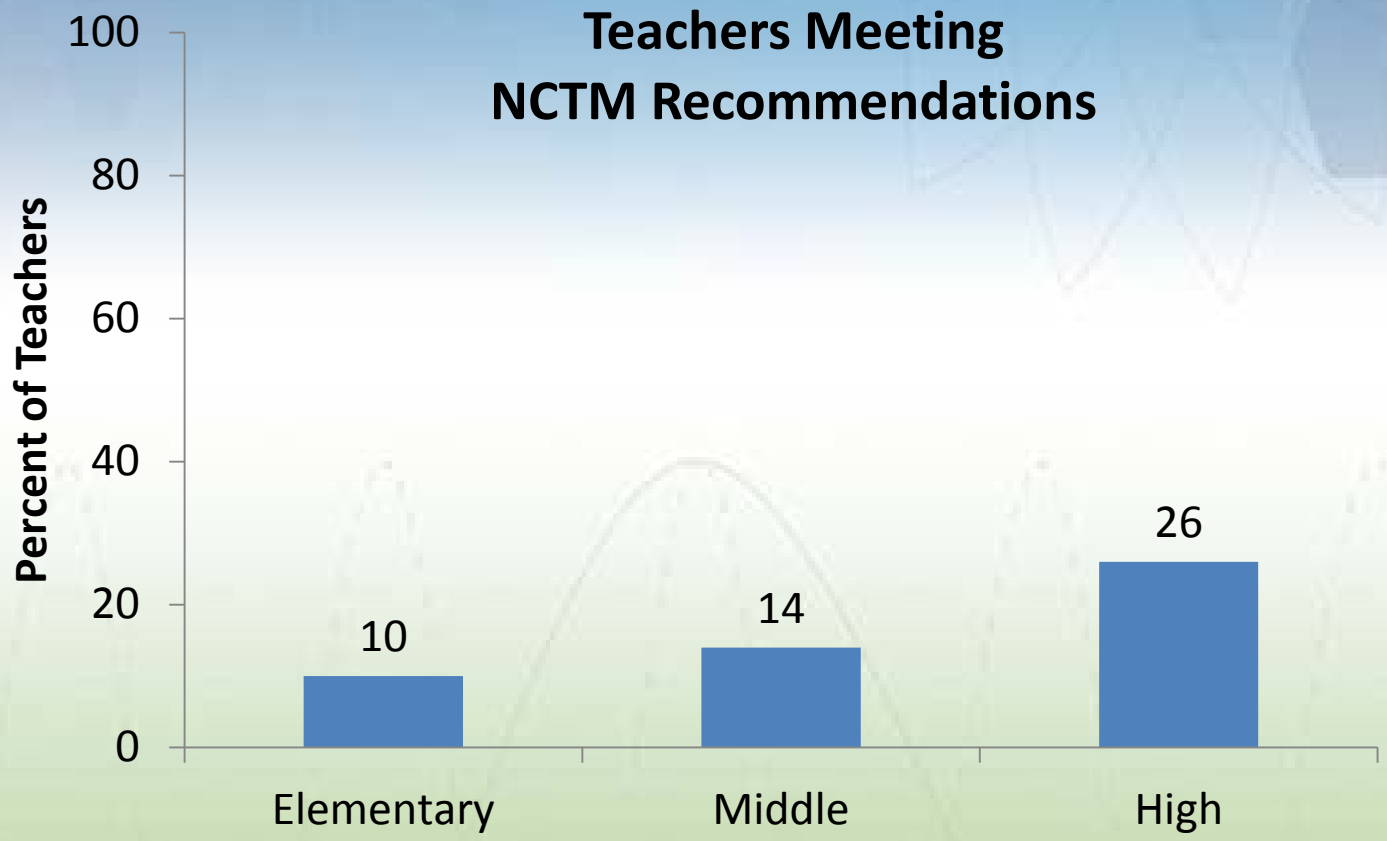
About what percentage of high school mathematics teachers have a college degree in mathematics?

a. 50 percent
b. 60 percent
c. 70 percent
d. 80 percent

Mathematics Teacher Degrees



Mathematics Coursework



Question

About what percentage of science and mathematics teachers believe students should be given definitions for new vocabulary **at the beginning of instruction** on an idea?

a. 20 percent
b. 40 percent
c. 60 percent
d. 80 percent

Beliefs about Teaching and Learning

- Over three-quarters of science and mathematics teachers at each grade level agree that inadequacies in students' background can be overcome by effective teaching.
- A large proportion believe that students learn best in classes of similar abilities:

	Science	Mathematics
Elementary	32	51
Middle	48	69
High	65	77

Views about Effective Instruction Vary: Science

- Three-quarters at each grade range agree that it is better to focus on ideas in depth, even if it means covering fewer topics.
- About 40 percent think teachers should explain ideas to students before having them consider evidence for it.
- More than half think hands-on/laboratory activities should be used primarily to reinforce ideas students have already learned.
- Over 70 percent think students should be given definitions for new vocabulary at the beginning of instruction.

Views about Effective Instruction Vary: Mathematics

- Over three-quarters at each grade range agree that it is better to focus on ideas in depth, even if it means covering fewer topics.
- 37-48 percent think teachers should explain ideas to students before having them investigate the idea.
- 39-52 percent think hands-on activities/manipulatives should be used primarily to reinforce ideas already learned.
- 81-90 think students should be given definitions of new vocabulary at the beginning of instruction

Professional Development

Features of High Quality PD

- Focuses on content knowledge;
- Emphasizes active learning;
- Promotes coherence;
- Provides a large amount of training sustained over time; and
- Encourages collaboration among teachers.

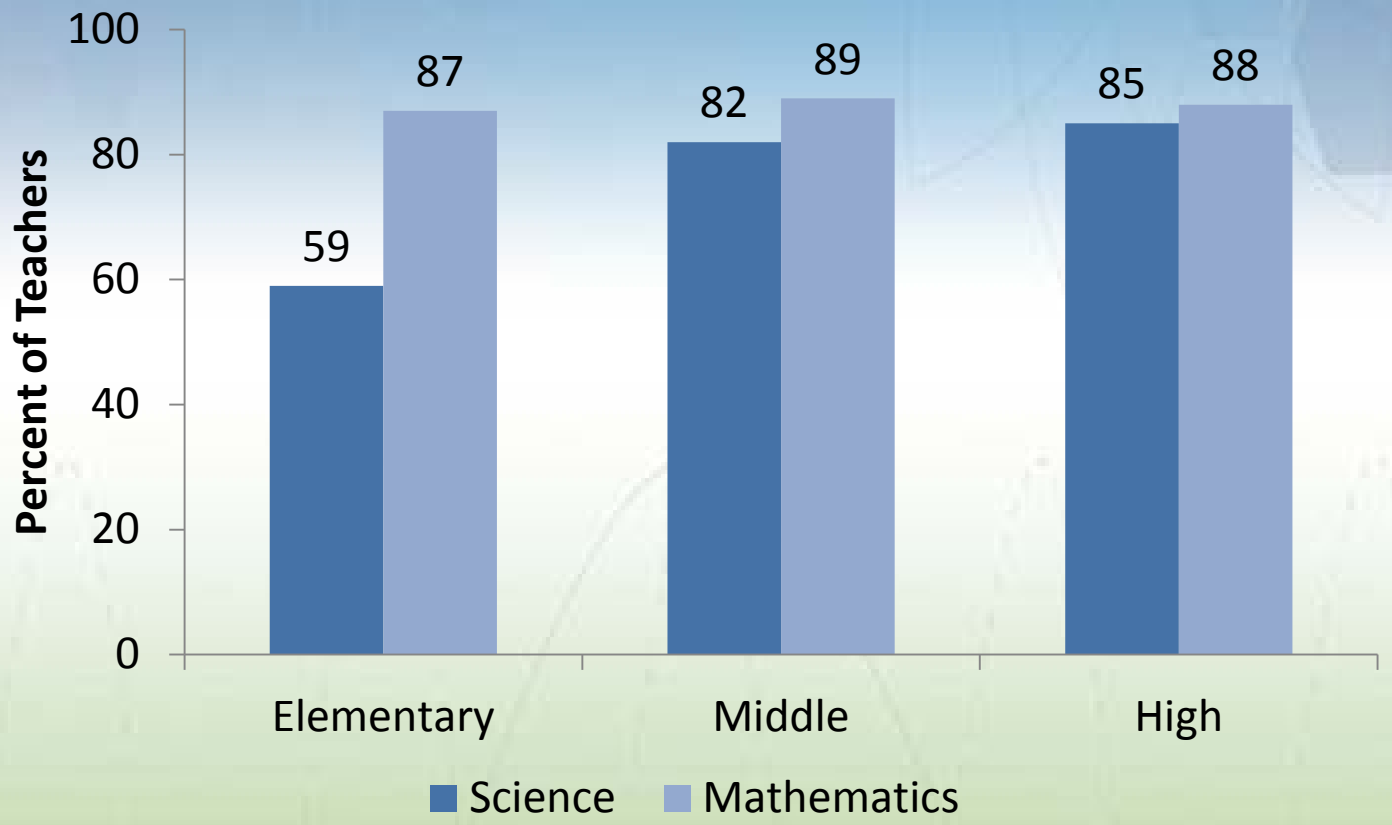
Garet, M. S., Porter, A. C., Desimone, L., Birman, B. F., & Yoon, K. S. (2001). What makes professional development effective? Results from a national sample of teachers. American educational research journal, 38(4), 915–945.

Question

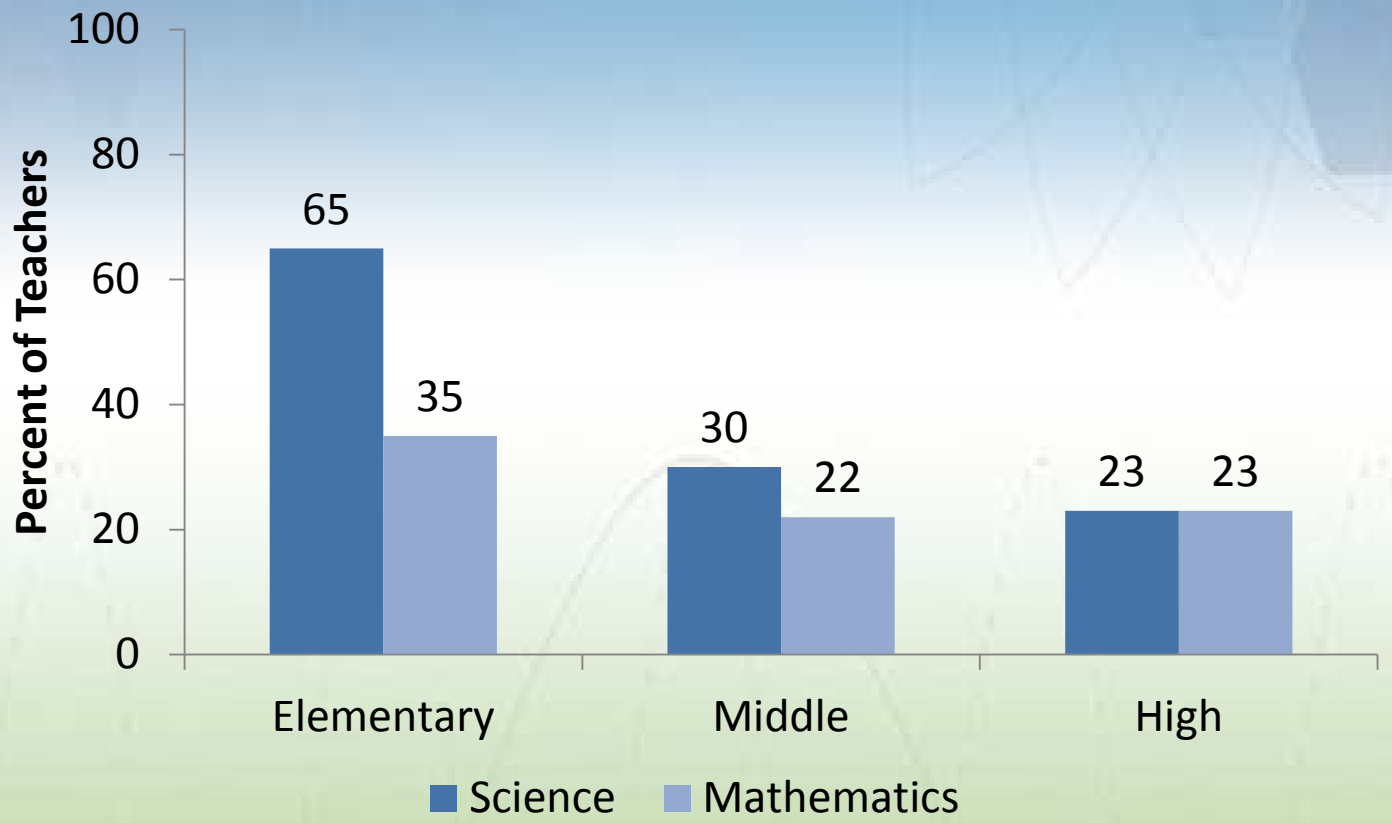
About what percentage of elementary teachers have participated in science-specific PD in the last three years?

a. 20 percent
b. 40 percent
c. 60 percent
d. 80 percent

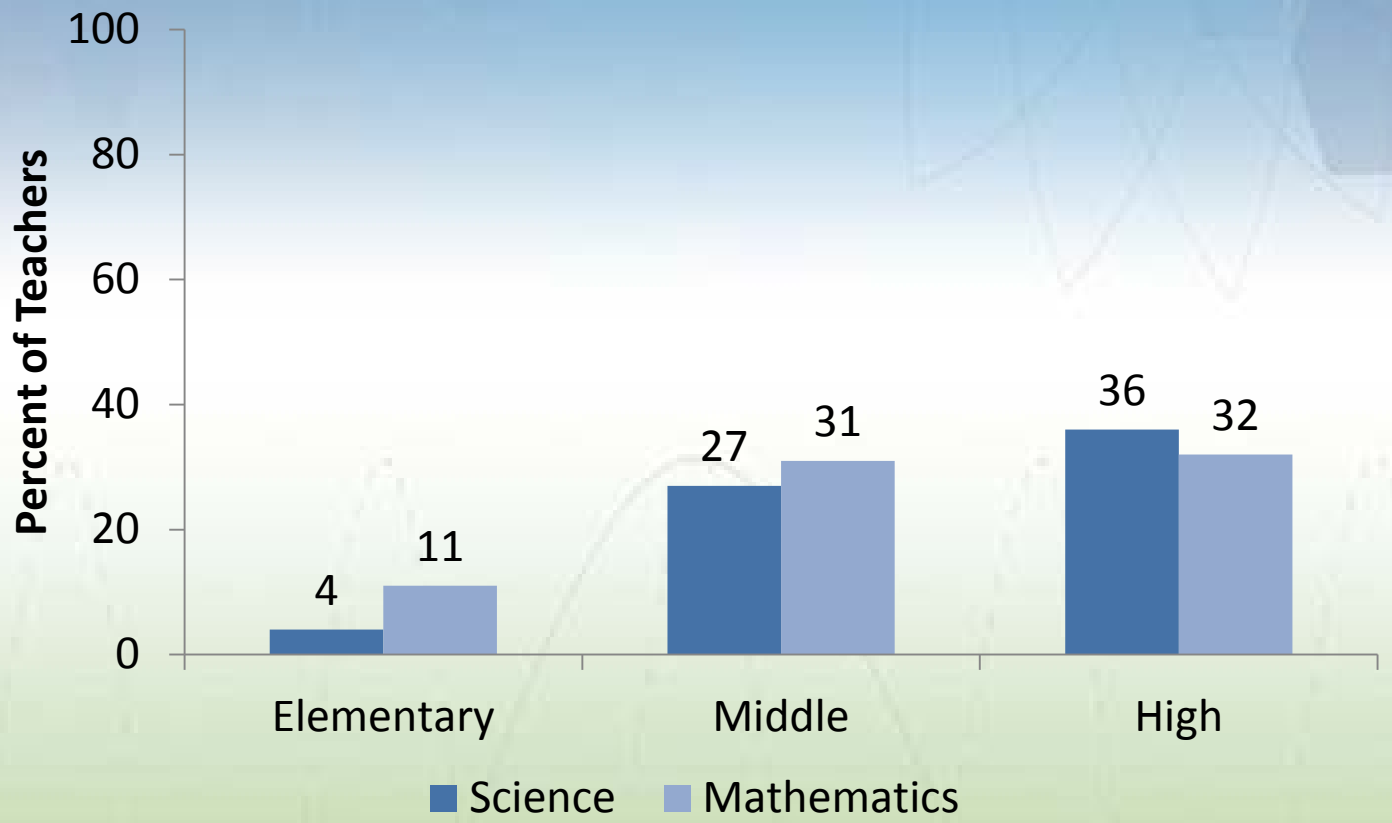
Teachers Participating in PD in Last 3 Years



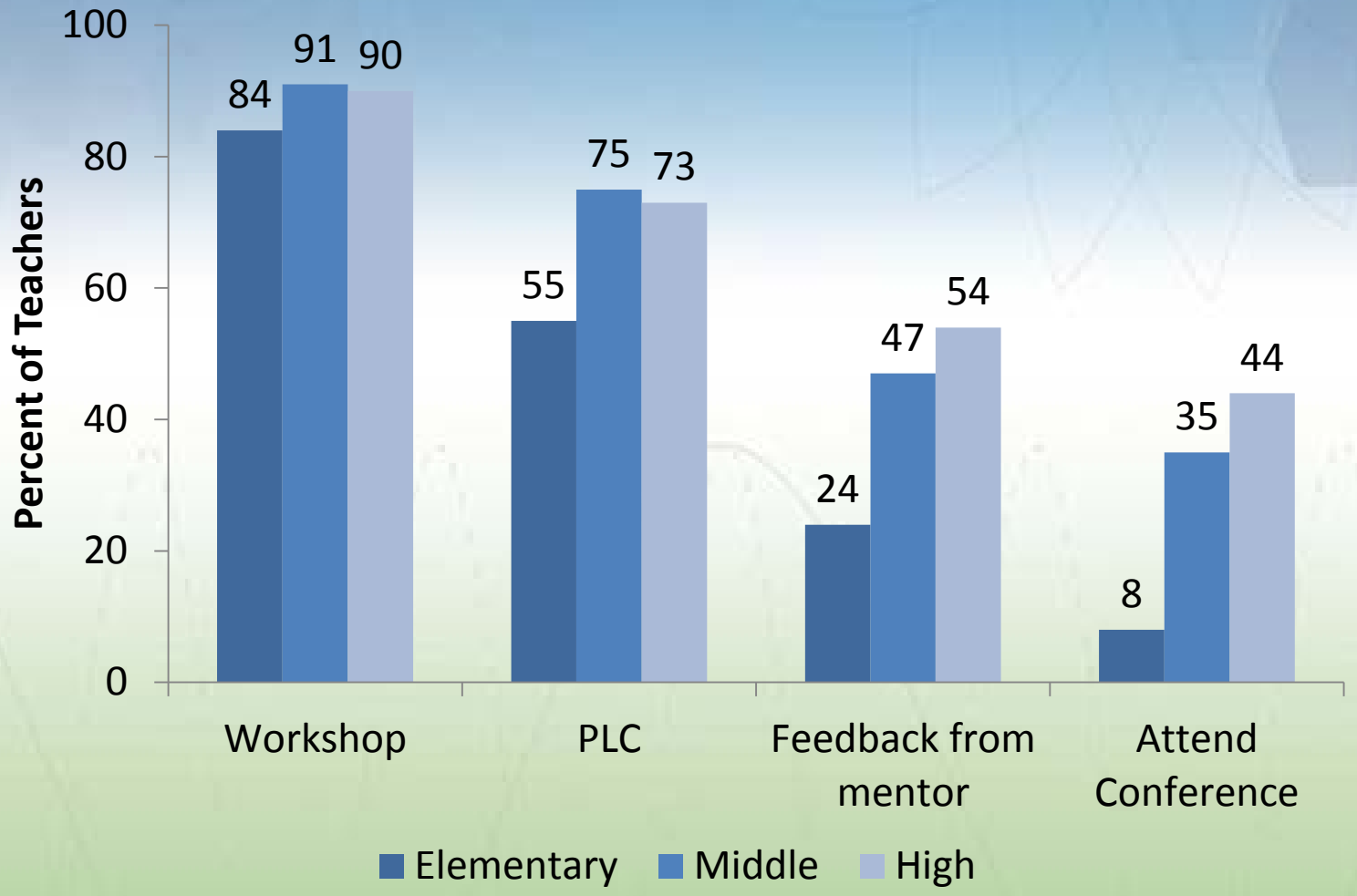
Less than 6 hours of PD in last 3 years



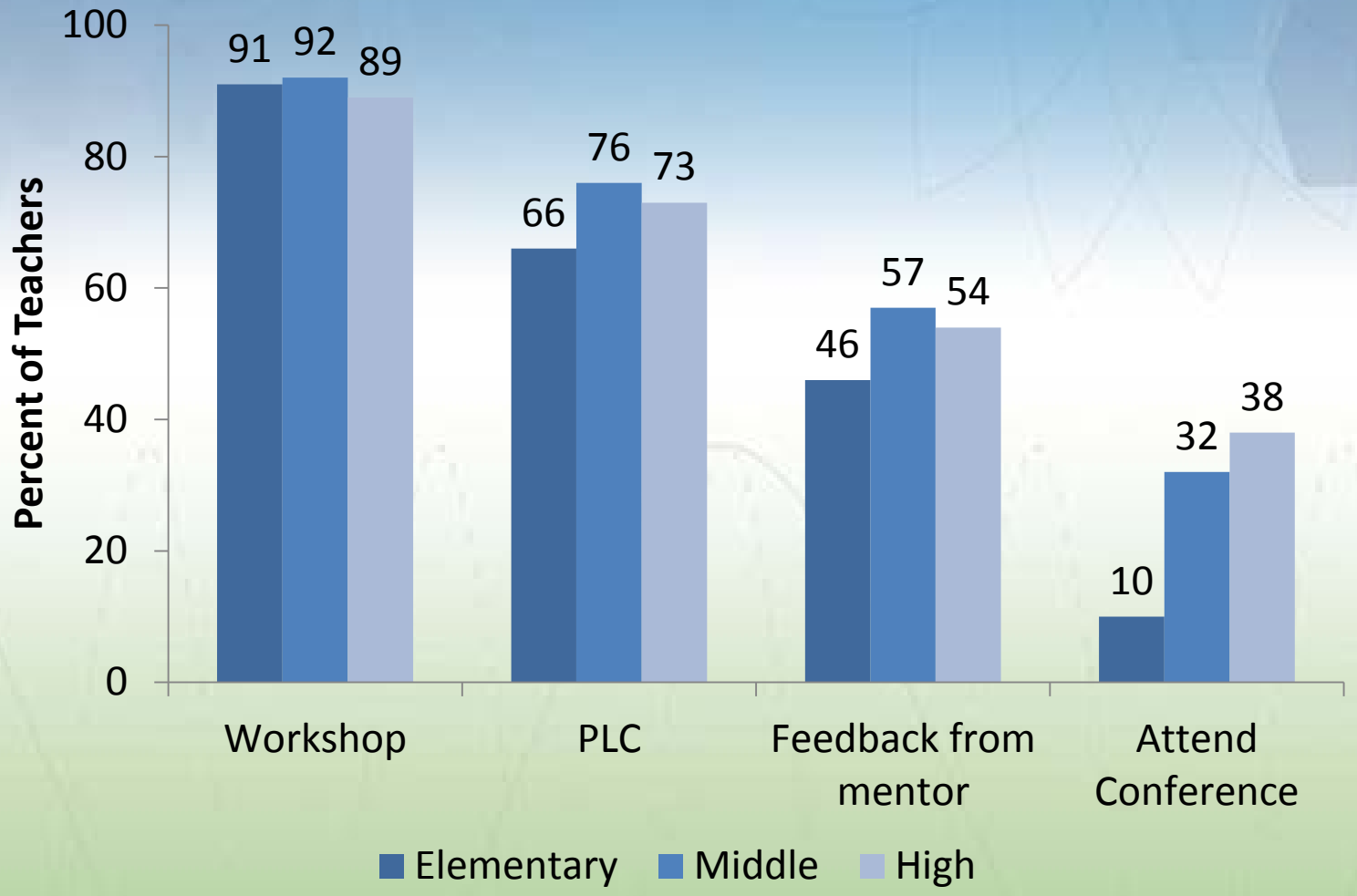
More than 35 hours of PD in last 3 years



Science Teacher PD in Last 3 Years



Math Teacher PD in Last 3 Years



The Typical PLC…

- Requires participation
- Meets for the entire year
- Meets at least twice a month
- Has a designated leader from within the school
- Limits participation to teachers from within school
- Includes teachers from multiple grade levels

Emphasis of PLCs

	Percent of Schools with PLCs	
	Science	**Mathematics**
Analyze student assessment results	73	83
Analyze instructional materials	65	65
Plan lessons together	67	62
Analyze classroom artifacts	37	34
Engage in science/mathematics investigations	25	30

Instructional Materials

Question

About what percentage of middle school science classes uses a published textbook or module as the primary instructional material?

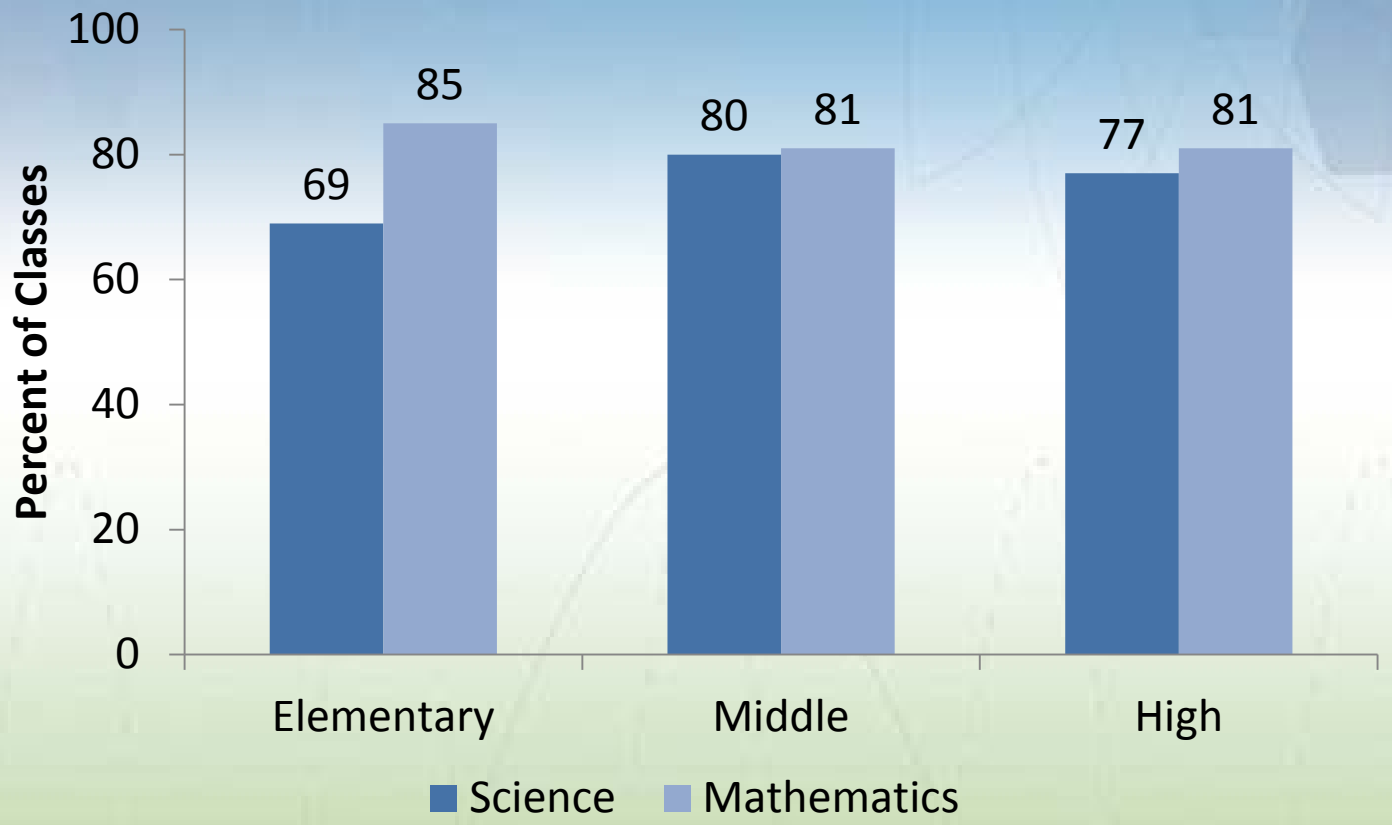
a. 40 percent

b. 60 percent

c. 80 percent

d. 100 percent

Classes Using a Published Text



How Teachers Use their Materials

- More than half use the textbook to guide both the overall and detailed structure of the unit.

- A large proportion also supplement and subset their textbook.

Recap

- The 2012 National Survey highlights both strengths and areas in need of improvement across the K–12 science and mathematics education system:
  - Instruction
  - Teacher preparation and support
  - Instructional materials

Implications for the Future

- The K–12 STEM education system will have to change if it is going to meet the goals of new science and mathematics standards

- The better the system components are aligned, the more likely we will be successful at meeting these goals

- There's a lot of work to do

Have to Consider the System

- "Every system is perfectly designed to get the results it gets." -- *Michael Patton*

- To change the results, you need to change the system, i.e., the guidance and/or incentives for teachers, administrators, students

Need to Address

- Pre-service teacher preparation and induction
- Professional development
- Instructional materials
- Assessments
- District and state policies
  - Curriculum
  - Accountability

Dilemma of System Reform

- You can't do everything at once
- But anything you don't attend to may come back to haunt you later
- You need to be strategic in deciding what to take on, when, and in what depth

For More Information on the 2012 NSSME

http://www.horizon-research.com/2012nssme/

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