Course Title/ Course #: 06 Mathematics / 1560

Start day: 1

Meetings: 180 days

Course Description

The sixth-grade standards are a transition from the emphasis placed on whole number arithmetic in the elementary grades to foundations of algebra. The standards emphasize rational numbers. Students will use ratios to compare data sets; recognize decimals, fractions, and percents as ratios; solve single-step and multistep problems, using rational numbers; and gain a foundation in the understanding of integers. Students will solve linear equations and use algebraic terminology. Students will solve problems involving area, perimeter, and surface area, work with \( \pi \) (pi), and focus on the relationships among the properties of quadrilaterals. In addition, students will focus on applications of probability and statistics.

While learning mathematics, students will be actively engaged, using concrete materials and appropriate technology such as calculators, computers, and spreadsheets.

Pacing Resources Assessments MP1

<table>
<thead>
<tr>
<th>Time Frame (days)</th>
<th>Standards of Learning</th>
<th>Units/ Topics/ Concepts</th>
<th>Resources</th>
<th>Assessments</th>
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<td>Gizmo – <strong>Coordinates</strong> - interactive instructional resource</td>
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<td>Flocabulary – <strong>The Coordinate Plane</strong> - instructional video</td>
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<td>Compass – <strong>Finding Points on a Coordinate Plane</strong> - interactive skill practice</td>
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<td>Smart Exchange - interactive skill practice</td>
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<td><strong>Coordinate Plane</strong> [SMART Notebook lesson]</td>
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<td>Brain Pop – <strong>Coordinate Plane</strong> – interactive skill practice</td>
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<td><strong>Working With Integers</strong></td>
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**Compass Learning**
6.3a - MA6512
6.3b - MA6522
6.3c - QZM6081

**Formative Assessment**
Whip Around

**Prentice Hall**
Web Codes:
ayp-0003 and ayp-0790

**Integer Quiz**

**Interactive Achievement**

Mulligan Checkpoint
6.11

Compass Learning
6.11 a-b - QZM6069
QZM6090

Formative Assessment
Response Cards

**Coordinate Plane Quiz**
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<td>page(s) 270 – 273 (Order of Operations)</td>
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<p>| | | Interactive Achievement |
| | | Mulligan Checkpoint 6.5 and 6.8 |
| | | Compass Learning 6.8 - MA6222 |
| | | Formative Assessment Exit Ticket |
| | | Prentice Hall Web Codes: ayp-0142 and ayp-0743 |
| | | <strong>Order of Operations Quiz</strong> |
| | | <strong>Exponents/Perfect Squares Quiz</strong> |</p>
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<td><a href="http://mrnussbaum.com/sixth-grade-math/">http://mrnussbaum.com/sixth-grade-math/</a></td>
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<td><a href="http://www.explorelearning.com/index.cfm?method=cResourcedspDetail&amp;resourceid=109">Solving One-Step Equations</a> [SMART Notebook lesson]</td>
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<td><a href="http://www.explorelearning.com/index.cfm?method=cResourcedspDetail&amp;resourceid=109">Equations</a> [SMART Notebook lesson]</td>
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<td><a href="http://www.crctlessons.com/Perfect-Squares/perfect-squares-game.html">Balanced</a> – lesson plan</td>
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<td><a href="http://studyjams.scholastic.com/studyjams/jams/math/algebra/aorder-of-operations.htm">Equation Vocabulary</a> - lesson plan</td>
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| 6 | 6.1 | Ratios | **Text**  
Virginia Math Connects, Course 1, ©2012, Glencoe/McGraw-Hill  
page(s) 150 – 155 and 173 - 177  
Extra Practice page –EP 7 – 8  Lessons 3-1 and 3-3  
Coach book, 6th Grade Virginia Gold Edition  
page(s) – 20 - 25  
Mulligan Math in Minutes 6.1  

**Technology**  
Brain Pop – Ratios - interactive skill practice  
Gizmo – Part to Part and Part to Whole Ratios - interactive instructional resource  
RPS Tech - OBJ01  
Compass – Instruction Practice – Writing Ratios  6704 - interactive skill practice assessment  
Smart Exchange - interactive skill practice  
Ratio [SMART Notebook lesson]  

**Virginia Department of Education**  
SOL 6.1 – Lesson Plan, page 2  
Teaching Ratios – Instructional video  
Field Goals, Balls, and Nets - Lesson plan  

**Other Sites**  
Henrico 6-1  
Study Jams – Ratio – Instructional review  
Suffolk 6.1 (6.1 activity section)  

Interactive Achievement  
Mulligan Checkpoint 6.1  
Compass Learning 6.1 - QZM6008  
Formative Assessment Foldable  
Prentice Hall  
Web Code: ayp-0053  
Ratio Quiz |
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**Benchmark Assessment Blueprint - 25 questions**

**SOL Objective(s)**

- 6.3
- 6.5
- 6.8
- 6.18
- 6.1
- 6.11

**Number of Questions**

- 4
- 3
- 4
- 6
- 5
- 3

**VDOE - Performance Analysis**

- Interactive Achievement
- Allen Teachers
- Math SOL Resources - Henrico Public Schools
<table>
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<tr>
<th>Time Frame (days)</th>
<th>Standard s of Learning</th>
<th>Units/ Topics/ Concepts</th>
<th>Resources</th>
<th>Assessments</th>
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| 6                 | 6.2 a-d                | Fractions, Decimals, and Percents | **Text**
Virginia Math Connects, Course 1, ©2012, Glencoe/McGraw-Hill
page(s) 210-213 (Percents as Fractions)
214 – 217 (Fractions as Percents)
218 – 221 (Percents and Decimals)
227 – 241 (Compare and Order Fractions, Decimals, and Percents)
Extra Practice page – EP 9 – 11 Lessons 4-1, 4-2, and 4-3
Coach book, 6th Grade Virginia Gold Edition
6.2a – page(s) 20 – 25 (also includes ratios)
6.2b and 6.2c 12 - 19
6.2d - page(s) 26 – 32  
**Technology**
Smart Exchange - interactive skill practice
Fractions, Decimals, and Percents [SMART Notebook lesson]
Percent Jeopardy Game [SMART Notebook lesson]
Compass – Converting decimals, fractions, and percents - interactive skill practice assessment
Compass – Comparing and Ordering - interactive skill practice assessment
Compass – Fractions, Decimals, Percents - interactive skill practice assessment
Compass – Fractions as Decimals - interactive skill practice assessment
Gizmo – Part, Part, Whole - interactive instructional resource
Gizmo – Fraction, Decimal, Percent - interactive instructional resource
Brain Pop – Converting fractions and decimals - interactive skill practice
**Virginia Department of Education**
Rational Speed Matching – lesson plan
SOL 6.2 a –c – lesson plan
SOL 6.2a, 7.4 - lesson plan
SOL 5.2b, 6.2d, 7.1c, 8.1b - lesson plan  
**Other Sites**
Henrico 6-2ab
Henrico 6-2cd

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| Interactive Achievement
Mulligan Checkpoint 6.2
Compass 6.2d - MA64102
Percents – MA5342
Fractions - MA5432
Conversion – MA6854
Prentice Hall Web Codes:
ayp-0745, ayp-0832, ayp-0896, ayp-0757
Formative Assessment Graphic Organizer
FDP Compare and Order Quiz
FDP Representation Quiz |
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<th>Models for Multiplication and Division of Fractions Computation of Fractions</th>
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**Text**
- Virginia Math Connects, Course 1, ©2012, Glencoe/McGraw-Hill
  - page(s) 96 - 101 and 104 - 115 - Multiplication
  - page(s) 117 – 133 – Division
  - Extra Practice page – EP5 - 7 Lessons 2-1, 2-2, and 2-3
- Coach book, 6th Grade Virginia Gold Edition
  - 6.4 and 6.6a – page(s) 69 – 75 (multiplication) 76 – 82 (division)
  - 6.6b – page(s) 62 – 68 and 83 – 89

**Technology**
- Smart Exchange - interactive skill practice
  - Introduction to Multiplying Mixed Numbers [SMART Notebook lesson]
  - Multiplication of Fractions [SMART Notebook lesson]
  - Dividing fractions [SMART Notebook lesson]
- Compass – Multiplication of Fractions and Mixed Numbers - interactive skill practice assessment
- Compass - Dividing Fractions and Mixed Numbers - interactive skill practice
- Gizmos – Dividing Fractions - interactive instructional resource
- Gizmos – Multiplying Fractions - interactive instructional resource
- Gizmos – Dividing Mixed Numbers - interactive instructional resource
- Gizmos – Multiplying Mixed Numbers - interactive instructional resource
- Brain Pop – Multiplying and Dividing Fractions - interactive skill practice

**Virginia Department of Education**
- Modeling Multiplication of Fractions - lesson plan
- Modeling Division of Fractions – lesson plan

**Other Sites**
- Henrico 6-4
- Henrico 6-6a
- Henrico 6-6b
- Suffolk 6-6, (6.6 section)
- Interactivesites weebly - Fractions

**Interactive Achievement**
- Mulligan Checkpoint 6.4/6.6

**Compass Learning**
- MA64162
- MA64152
  (Compass program must be open for link to work)

**Prentice Hall**
- http://www.phschool.com/
- Web Codes: ayp-0812, ayp-0813, ayp-0806, ayp-0807

**Formative Assessment**
- Fraction Operations Quiz
- Multiply and Divide Fractions

**Model Multiplication and Division with Fractions**
| 6 | **6.16 a-b** | **Probability** | **Text** | Virginia Math Connects, Course 1, ©2012, Glencoe/McGraw-Hill  
page(s) – 702 -712  
Coach book, 6th Grade Virginia Gold Edition  
page(s) 217 – 223  
**Technology**  
Smart Exchange - interactive skill practice  
**Probability** [SMART Notebook lesson]  
**Possible Outcomes** [SMART Notebook lesson]  
Compass – **Dependent and Independent Events** - interactive skill practice  
Compass – **Probable Outcomes** - interactive skill practice assessment  
Gizmos – **Spin the Big Wheel** - interactive instructional resource  
Brain Pop – **Independent and Dependent** - interactive skill practice  
**Virginia Department of Education**  
**It Could Happen** – lesson plan  
**SOL 5.14, 6.16a,b** – lesson plan  
**Other Sites**  
Henrico 6-16  
Suffolk 6.16 – (6.16 section)  
Interactive sites weebly - **Probability** | Interactive Achievement  
**Probability Quiz**  
Mulligan Checkpoint 6.16  
Compass Learning  
MA61072  
M7255  
**Prentice Hall**  
Web Codes:  
ayp-0121 and  
ayp-0122  
Formative Assessment  
Muddiest Point |
|---|---|---|---|---|
| 7 | **6.14 a-c** | **Circle Graphs** | **Text** | Virginia Math Connects, Course 1, ©2012, Glencoe/McGraw-Hill  
page(s) – 644 -650 and 651 – 655  
Extra Practice page –EP31-32 Lessons 11-3 and 11-4  
Coach book, 6th Grade Virginia Gold Edition  
6.14a and 6.14b - page(s) 182 - 188  
6.14c – page(s) 202 – 208  
**Technology**  
Smart Exchange - interactive skill practice  
**Graphs, Charts, and Analysis of Data Part 1** [SMART Notebook lesson]  
Compass – **The Star Report** (Circle Graphs) - interactive skill practice  
Compass – **Read and Make Circle Graphs** - interactive skill practice  
Brain Pop – **Circles** - interactive skill practice  
**Virginia Department of Education**  
**May I Have Fries with That?** – lesson plan  
**SOL 6.14a** – lesson plan page 49 -59  
**Other Sites** | Interactive Achievement  
Mulligan Checkpoint 6.14  
Compass Learning  
MA59114  
**Prentice Hall**  
Web Code: ayp-0758  
Formative Assessment  
Modeling |
|   | 6.20 | Graphing Inequalities | **Text**  
Virginia Math Connects, Course 1, ©2012, Glencoe/McGraw-Hill  
page(s) – 387 – 395  
Extra Practice page –EP18 Lesson 7-2  
Coach book, 6th Grade Virginia Gold Edition  
page(s) 249 – 255  
**Technology**  
Smart Exchange (use slides 1-8) - interactive skill practice  
[Graphing Inequalities [SMART Notebook Math Tools lesson]]  
Compass – [Graph Sentences 1](#) - interactive skill practice assessment  
Brain Pop – [Inequalities](#) – interactive skill practice  
**Virginia Department of Education**  
[Give or Take a Few](#) – lesson plan  
**Other Sites**  
Henrico 6-20 | **Graph Quiz**  
Interactive Achievement  
Mulligan Checkpoint 6.20  
Formative Assessment  
Think-Pair-Share  
**Inequalities Quiz** |
|---|---|---|---|---|
|   | 6.17 | Geometric and Arithmetic Sequences | **Text**  
Virginia Math Connects, Course 1, ©2012, Glencoe/McGraw-Hill  
page(s) – 378 – 383  
Extra Practice page –EP 16-17 Lesson 7-1  
Coach book, 6th Grade Virginia Gold Edition  
page(s) 230 – 237  
**Technology**  
Compass – [Arithmetic Sequence](#) - interactive skill practice assessment  
**Virginia Department of Education**  
[Growing Patterns and Sequences](#) – lesson plan  
[SOL 6.17](#) - lesson plan page 32-37  
**Other Sites**  
Henrico 6-17  
Suffolk 6-17 (6.17 section)  
Interactivesites weebly - [Patterns](#) | **Sequences Quiz**  
Interactive Achievement  
Mulligan Checkpoint 6.17  
Compass Learning [MA6254](#)  
(Compass must be open for link to work)  
Formative Assessment  
Visual Display  
**Sequences Quiz** |
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**Review**

**Blueprint for Assessment**

**Benchmark Assessment Blueprint - 35 questions**

**VDOE** - Performance Analysis

Interactive Achievement

**Allen Teachers**

**Math SOL Resources**

Henrico Public Schools
## Course Title/ Course #: Grade 6 Mathematics

### Pacing Resources Assessments MP3

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| 6          | 6.15 a-b              | Balance Point and Measure of Center | **Text**  
Virginia Math Connects, Course 1, ©2012, Glencoe/McGraw-Hill  
page(s) 613 – 618 (mean)  
page(s) 620 – 624 (median, mode, and range)  
page(s) 627 – 630 (appropriate measures)  
Extra Practice page –EP30  Lesson 11-1  
Coach book, 6th Grade Virginia Gold Edition  
page(s) 209 – 216  
**Technology**  
Smart Exchange - interactive skill practice  
Measures of Central Tendency [SMART Notebook lesson]  
Graphs, Charts, and Analysis of Data Part 2 [SMART Notebook lesson]  
Discovering the Mean [SMART Notebook lesson]  
Compass – Central Tendency - interactive skill practice assessment  
Compass – Data Analysis - interactive skill practice assessment  
Gizmo – Mean, Median, Mode - interactive instructional resource  
Gizmo – Reaction Time - interactive instructional resource  
Brain Pop – Mean, Median, Mode – interactive skill practice  
**Virginia Department of Education**  
Balancing Act – lesson plan  
**Other Sites**  
Henrico 6-15  
Suffolk 6-15 (6.15 section)  
Interactivesites weebly – Mean, Median, and Mode | **Interactive Achievement**  
Mulligan Checkpoint 6.15  
Compass Learning MA6682 MA6684  
**Formative Assessment Vocabulary**  
Measure of Center Quiz |
| 10         | 6.10 a-d              | Circumference, Area, Perimeter, Volume, and Surface Area | **Text**  
Virginia Math Connects, Course 1, ©2012, Glencoe/McGraw-Hill  
Circumference – page(s) 507 - 512  
Area - page(s) 495 – 500 (triangles) 513 – 518 (circles)  
Perimeter – page(s) 520 – 524  
Volume – page(s) 534 – 540  
Surface Area – page(s) 541 – 547  
Extra Practice page –EP 24 -27 Lessons 9-1, 9-2, 9-3, and 9-4 | **Interactive Achievement**  
Mulligan Checkpoint 6.10  
Compass Learning 6.10d - MA5648 |
### Technology

**Smart Exchange** - interactive skill practice
- Circumference [SMART Notebook lesson]
- The Area of Circles [SMART Notebook lesson]
- Volume of Rectangular Prisms [SMART Notebook lesson]

**Compass** – *Relationship between Circumference, Pi, and Diameter* - interactive skill practice assessment

**Compass** – *Area and Circumference* - interactive skill practice assessment

**Compass** – *Area of Triangles* - interactive skill practice assessment (need triangle section only)

**Compass** – *Area of Rectangles* - interactive skill practice assessment

**Compass** – *Surface Area* - interactive skill practice assessment (need prism section only)

**Compass** – *Volume* - interactive skill practice assessment

**Gizmos** – *Circumference and Area of Circles* - interactive instructional resource

**Gizmos** – *Balancing Blocks* - interactive instructional resource

**Gizmos** – *Finding Fido’s Flower Bed* - interactive instructional resource

**Brain Pop** – *Pi* – interactive skills practice

### Virginia Department of Education

**Going the Distance** – lesson plan
- SOL 6.10 a, b – lesson plan page 10-21

**Out of the Box** – lesson plan
- SOL 6.10d, 7.5a – lesson plan page 13-52

### Other Sites

- Henrico 6-10ab
- Henrico 6-10cd
- Suffolk 6-10 (6.10 section)

Interactivesites weebly - *Circles*

Interactivesites weebly – *Area and Perimeter*

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### Quadrilaterals

6.13

**Text**

*Virginia Math Connects, Course 1, ©2012, Glencoe/McGraw-Hill*

- page(s) 456 – 461
- Extra Practice page –EP22 Lesson 8-3

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   page(s) 169 – 175  
**Technology**  
Smart Exchange - interactive skill practice  
**Polygons and Pattern Blocks** [SMART Notebook lesson]  
**Quadrilaterals** [SMART Notebook lesson]  
Compass – **On the Q** - interactive skill practice assessment  
Compass – **Classify Quadrilaterals** - interactive skill practice assessment  
Gizmos – **Classifying Quadrilaterals** - interactive instructional resource  
**Virginia Department of Education**  
**Exploring Quadrilaterals** – lesson plan  
**SOL 6.13, 7.7** – lesson plan page 74 -91  
**Other Sites**  
**Henrico 6-13**  
**Suffolk 6-13** (6.13 section)  
Coacht book, 6th Grade Virginia Gold Edition  
page(s) 90 – 95 (addition and subtraction)  
page(s) 96 – 103 (multiplication and division)  
**Technology**  
Compass - **Multiplication** - interactive skill practice assessment  
Compass – **Division** - interactive skill practice assessment  
Gizmos – **Sums and Differences with Decimals** - interactive instructional resource  
Brain Pop – **Multiplying Decimals** – interactive skills practice  
**Virginia Department of Education**  
**Practical Problems Involving Decimals** – lesson plan  
**SOL 5.5b, 6.7, 8.3a** - lesson plan  
**Other Sites**  
**Henrico 6-7**  
**Suffolk 6-7** (6.7 section)  
Interactivesites weebly - **Decimals**  
**Interactive Achievement**  
**Mulligan Checkpoint 6.7**  
**Compass Learning**  
**MA6342**  
**Lesson Quiz**  
**Prentice Hall**  
Web Code: ayp-0784, ayp-0785, ayp-0786, and ayp-0787  
**Formative Assessment**  
**Graphic Organizer**  
**Decimal Quiz**
| 7 | 6.9 | Ballpark Comparisons between U.S. Customary and Metric Measurement | **Text**  
Virginia Math Connects, Course 1, ©2012, Glencoe/McGraw-Hill  
page(s) 594-599  
Coach book, 6th Grade Virginia Gold Edition  
page(s) 116–120  
**Technology**  
Brain Pop – [Metric vs. Customary](#) – interactive skill practice  
**Virginia Department of Education**  
Measuring Mania - lesson plan  
SOL 5.8d, 6.9 – lesson plan  
**Other Sites**  
Henrico 6-9  
Suffolk 6-9 (6.9 section)  
Interactivesites weebly – [Measurement](#) (Review of basic measurements within the same system) | Interactive Achievement  
Mulligan Checkpoint 6.9  
**Prentice Hall**  
Web Code: ayp-0893  
**Measurement Quiz**  
Formative Assessment  
Discuss with a Partner |
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|  |  |  | VDOE – [Released Test](#)  
VDOE - [Performance Analysis](#)  
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| 5          | 6.19 a-c             | Properties           | **Text**
Virginia Math Connects, Course 1, ©2012, Glencoe/McGraw-Hill
page(s) 289 - 293
Extra Practice page –EP 13 Lesson 5-2
Coach book, 6th Grade Virginia Gold Edition
page(s) 244 – 248
**Technology**
Gizmo – Chomatic - interactive instructional resource
Smart Exchange - interactive skill practice
[Properties of Numbers](http://www.explorell.com/index.cfm?method=cResource.dspDetail&ResourceId=1014)
Compass – Properties and Operations - interactive skill practice assessment
Compass – Using Properties - interactive skill practice assessment
**Virginia Department of Education**
SOL 6.19, 7.16c,d,e – lesson plan page 14
**Other Sites**
[Henrico 6-19](http://www.harcourtschool.com/activity/similar_congruent/)
| Interactive Achievement
Mulligan Checkpoint 6.19
Compass Learning
MA6242
Prentice Hall
Web Code: ayp-0732
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Properties Quiz |
| 4          | 6.12                 | Congruence of Segments, Angles, and Polygons | **Text**
Virginia Math Connects, Course 1, ©2012, Glencoe/McGraw-Hill
page(s) 429 – 433 and 462 -473
Extra Practice page –EP 20 -23 Lessons 8-1, 8-2, and 8-3
Coach book, 6th Grade Virginia Gold Edition
page(s) 162 – 168
**Technology**
Smart Exchange - interactive skill practice
[Similarity and Congruence](http://www.harcourtschool.com/activity/similar_congruent/)
[Congruent and Symmetric Polygons](http://www.harcourtschool.com/activity/similar_congruent/)
Polygons [SMART Notebook lesson] - interactive skill practice | Interactive Achievement
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6.11, 6.12, and 6.13 – page(s) 177 – 179  
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6.17, 6.18, 6.19, and 6.20 – page(s) 256 - 259 |

Technology

http://www.doe.virginia.gov/testing/sol/released_tests/index.shtml  
http://www.iq.poquoson.org/math.htm#six  
http://education.jlab.org/solquiz/  
Henrico 6th Grade Resources

Virginia Department of Education

http://www.doe.virginia.gov/testing/sol/released_tests/index.shtml  
http://doe.virginia.gov/testing/sol/practice_items/  
http://doe.virginia.gov/testing/test_administration/cat/index.shtml  
(CAT Training Test)

Other Sites

http://va.testnav.com/va (ARDT)  
https://richmondva-admin.mapnwea.org (NWEA)

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<td><a href="https://richmondva-admin.mapnwea.org">https://richmondva-admin.mapnwea.org</a></td>
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Mathematics Standards of Learning

Curriculum Framework 2009

Grade 6

Board of Education
Commonwealth of Virginia
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Virginia Department of Education
P.O. Box 2120
Richmond, Virginia 23218-2120
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The Virginia Department of Education wishes to express sincere thanks to Deborah Kiger Bliss, Lois A. Williams, Ed.D., and Felicia Dyke, Ph.D. who assisted in the development of the 2009 Mathematics Standards of Learning Curriculum Framework.

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Introduction

The 2009 *Mathematics Standards of Learning* Curriculum Framework is a companion document to the 2009 *Mathematics Standards of Learning* and amplifies the *Mathematics Standards of Learning* by defining the content knowledge, skills, and understandings that are measured by the Standards of Learning assessments. The Curriculum Framework provides additional guidance to school divisions and their teachers as they develop an instructional program appropriate for their students. It assists teachers in their lesson planning by identifying essential understandings, defining essential content knowledge, and describing the intellectual skills students need to use. This supplemental framework delineates in greater specificity the content that all teachers should teach and all students should learn.

Each topic in the *Mathematics Standards of Learning* Curriculum Framework is developed around the Standards of Learning. The format of the Curriculum Framework facilitates teacher planning by identifying the key concepts, knowledge and skills that should be the focus of instruction for each standard. The Curriculum Framework is divided into three columns: Understanding the Standard; Essential Understandings; and Essential Knowledge and Skills. The purpose of each column is explained below.

**Understanding the Standard**
This section includes background information for the teacher (K-8). It contains content that may extend the teachers’ knowledge of the standard beyond the current grade level. This section may also contain suggestions and resources that will help teachers plan lessons focusing on the standard.

**Essential Understandings**
This section delineates the key concepts, ideas and mathematical relationships that all students should grasp to demonstrate an understanding of the Standards of Learning. In Grades 6-8, these essential understandings are presented as questions to facilitate teacher planning.

**Essential Knowledge and Skills**
Each standard is expanded in the Essential Knowledge and Skills column. What each student should know and be able to do in each standard is outlined. This is not meant to be an exhaustive list nor a list that limits what is taught in the classroom. It is meant to be the key knowledge and skills that define the standard.

The Curriculum Framework serves as a guide for Standards of Learning assessment development. Assessment items may not and should not be a verbatim reflection of the information presented in the Curriculum Framework. Students are expected to continue to apply knowledge and skills from Standards of Learning presented in previous grades as they build mathematical expertise.
In the middle grades, the focus of mathematics learning is to
• build on students’ concrete reasoning experiences developed in the elementary grades;
• construct a more advanced understanding of mathematics through active learning experiences;
• develop deep mathematical understandings required for success in abstract learning experiences; and
• apply mathematics as a tool in solving practical problems.

Students in the middle grades focus on mastering rational numbers. Rational numbers play a critical role in the development of proportional reasoning and advanced mathematical thinking. The study of rational numbers builds on the understanding of whole numbers, fractions, and decimals developed by students in the elementary grades. Proportional reasoning is the key to making connections to most middle school mathematics topics.

Students develop an understanding of integers and rational numbers by using concrete, pictorial, and abstract representations. They learn how to use equivalent representations of fractions, decimals, and percents and recognize the advantages and disadvantages of each type of representation. Flexible thinking about rational number representations is encouraged when students solve problems.

Students develop an understanding of the properties of operations on real numbers through experiences with rational numbers and by applying the order of operations.

Students use a variety of concrete, pictorial, and abstract representations to develop proportional reasoning skills. Ratios and proportions are a major focus of mathematics learning in the middle grades.
STANDARD 6.1 STRAND: NUMBER AND NUMBER SENSE GRADE LEVEL 6

6.1 The student will describe and compare data, using ratios, and will use appropriate notations, such as \( \frac{a}{b} \), \( a \) to \( b \), and \( a:b \).
STANDARD 6.1 STRAND: NUMBER AND NUMBER SENSE GRADE LEVEL 6

6.1 The student will describe and compare data, using ratios, and will use appropriate notations, such as \( \frac{a}{b} \), \( a:b \), and \( a \text{ to } b \).

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<tr>
<td>• Rates can be expressed as ratios.</td>
<td></td>
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### UNDERSTANDING THE STANDARD

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<th>ESSENTIAL UNDERSTANDINGS</th>
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</thead>
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<tr>
<td><em>Percent</em> means “per 100” or how many “out of 100”; <em>percent</em> is another name for <em>hundredths</em>.</td>
<td>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</td>
</tr>
<tr>
<td>A number followed by a percent symbol (%) is equivalent to that number with a denominator of 100 (e.g., $30% = \frac{30}{100} = \frac{3}{10} = 0.3$).</td>
<td></td>
</tr>
<tr>
<td>Percents can be expressed as fractions with a denominator of 100 (e.g., $75% = \frac{75}{100} = \frac{3}{4}$).</td>
<td>Identify the decimal and percent equivalents for numbers written in fraction form including repeating decimals.</td>
</tr>
<tr>
<td>Percents can be expressed as decimal (e.g., $38% = \frac{38}{100} = 0.38$).</td>
<td>Represent fractions, decimals, and percents on a number line.</td>
</tr>
<tr>
<td>Some fractions can be rewritten as equivalent fractions with denominators of powers of 10, and can be represented as decimals or percents (e.g., $\frac{3}{5} = \frac{6}{10} = \frac{60}{100} = 0.60 = 60%$).</td>
<td>Describe orally and in writing the equivalent relationships among decimals, percents, and fractions that have denominators that are factors of 100.</td>
</tr>
<tr>
<td>Decimals, fractions, and percents can be represented using concrete materials (e.g., Base-10 blocks, number lines, decimal squares, or grid paper).</td>
<td>Represent, by shading a grid, a fraction, decimal, and percent.</td>
</tr>
<tr>
<td>Percents can be represented by drawing shaded regions on grids or by finding a location on number lines.</td>
<td>Represent in fraction, decimal, and percent form a given shaded region of a grid.</td>
</tr>
<tr>
<td><em>What is the relationship among fractions, decimals and percents? Fractions, decimals, and percents are three different ways to express the same number. A ratio can be written using fraction form ($\frac{2}{3}$), a colon (2:3), or the word to (2 to 3). Any number that can be written as a fraction can be expressed as a terminating or repeating decimal or a percent.</em></td>
<td>Compare two decimals through thousandths using manipulatives, pictorial representations, number lines, and symbols ($&lt;$, $\le$, $\ge$, $&gt;$, $=$).</td>
</tr>
<tr>
<td>Identify the decimal and percent equivalents for numbers written in fraction form including repeating decimals.</td>
<td>Compare two fractions with denominators of 12 or</td>
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STANDARD 6.2 STRAND: NUMBER AND NUMBER SENSE GRADE LEVEL 6

6.2 The student will
   a) investigate and describe fractions, decimals and percents as ratios;
   b) identify a given fraction, decimal or percent from a representation;
   c) demonstrate equivalent relationships among fractions, decimals, and percents; and
   d) compare and order fractions, decimals, and percents.

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<th>ESSENTIAL KNOWLEDGE AND SKILLS</th>
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<tbody>
<tr>
<td>• Percents are used in real life for taxes, sales, data description, and data comparison.</td>
<td>• Percent less using manipulatives, pictorial representations, number lines, and symbols (&lt;, ≤, ≥, &gt;, =).</td>
<td></td>
</tr>
<tr>
<td>• Fractions, decimals and percents are equivalent forms representing a given number.</td>
<td>• Compare two percents using pictorial representations and symbols (&lt;, ≤, ≥, &gt;, =).</td>
<td></td>
</tr>
<tr>
<td>• The decimal point is a symbol that separates the whole number part from the fractional part of a number.</td>
<td>• Order no more than 3 fractions, decimals, and percents (decimals through thousandths, fractions with denominators of 12 or less), in ascending or descending order.</td>
<td></td>
</tr>
<tr>
<td>• The decimal point separates the whole number amount from the part of a number that is less than one.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• The symbol • can be used in Grade 6 in place of “x” to indicate multiplication.</td>
<td></td>
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</tr>
<tr>
<td>• Strategies using 0, 1/2 and 1 as benchmarks can be used to compare fractions.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• When comparing two fractions, use 1/2 as a benchmark. Example: Which is greater, 4/7 or 3/9?</td>
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</tr>
</tbody>
</table>
STANDARD 6.2 STRAND: NUMBER AND NUMBER SENSE GRADE LEVEL 6

6.2 The student will
a) investigate and describe fractions, decimals and percents as ratios;
b) identify a given fraction, decimal or percent from a representation;
c) demonstrate equivalent relationships among fractions, decimals, and percents; and
d) compare and order fractions, decimals, and percents.

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<tbody>
<tr>
<td>make the whole. $\frac{3}{9}$ is less than $\frac{1}{2}$ because 3, the numerator, is less than half of 9, the denominator, which tells the number of parts that make the whole. Therefore, $\frac{4}{7} &gt; \frac{3}{9}$.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• When comparing two fractions close to 1, use distance from 1 as your benchmark. Example: Which is greater, $\frac{6}{7}$ or $\frac{8}{9}$? $\frac{6}{7}$ is $\frac{1}{7}$ away from 1 whole. $\frac{8}{9}$ is $\frac{1}{9}$ away from 1 whole. Since $\frac{1}{7} &gt; \frac{1}{9}$, then $\frac{6}{7}$ is a greater distance away from 1 whole than $\frac{8}{9}$, so $\frac{8}{9} &gt; \frac{6}{7}$.</td>
<td></td>
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<tr>
<td>• Students should have experience with fractions such as $\frac{1}{8}$, whose decimal representation is a terminating decimal (e.g., $\frac{1}{8} = 0.125$) and with fractions such as $\frac{2}{9}$, whose decimal representation does not end.</td>
<td></td>
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</table>
STANDARD 6.2  STRAND: NUMBER AND NUMBER SENSE  GRADE LEVEL 6

6.2 The student will
   a) investigate and describe fractions, decimals and percents as ratios;
   b) identify a given fraction, decimal or percent from a representation;
   c) demonstrate equivalent relationships among fractions, decimals, and percents; and
   d) compare and order fractions, decimals, and percents.

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<td>but continues to repeat (e.g., $\frac{2}{9} = 0.222\ldots$). The</td>
<td></td>
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<tr>
<td>repeating decimal can be written with ellipses (three dots) as</td>
<td></td>
<td></td>
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<tr>
<td>in 0.222\ldots or denoted with a bar above the digits that</td>
<td></td>
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<tr>
<td>repeat as in $0.\overline{3}$.</td>
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### STANDARD 6.3  STRAND: NUMBER AND NUMBER SENSE  GRADE LEVEL 6

6.3 The student will
a) identify and represent integers;
b) order and compare integers; and
c) identify and describe absolute value of integers.

#### UNDERSTANDING THE STANDARD
(Background Information for Instructor Use Only)

- Integers are the set of whole numbers, their opposites, and zero.
- Positive integers are greater than zero.
- Negative integers are less than zero.
- Zero is an integer that is neither positive nor negative.
- A negative integer is always less than a positive integer.
- When comparing two negative integers, the negative integer that is closer to zero is greater.
- An integer and its opposite are the same distance from zero on a number line. For example, the opposite of 3 is -3.
- The absolute value of a number is the distance of a number from zero on the number line regardless of direction. Absolute value is represented as \(|-6| = 6\).
- On a conventional number line, a smaller number is always located to the left of a larger number (e.g., -7 lies to the left of -3; thus \(-7 < -3\); 5 lies to the left of 8 thus 5 is less than 8).

#### ESSENTIAL UNDERSTANDINGS

- What role do negative integers play in practical situations?
  Some examples of the use of negative integers are found in temperature (below 0), finance (owing money), below sea level. There are many other examples.
- How does the absolute value of an integer compare to the absolute value of its opposite? They are the same because an integer and its opposite are the same distance from zero on a number line.

#### ESSENTIAL KNOWLEDGE AND SKILLS

- The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to
  - Identify an integer represented by a point on a number line.
  - Represent integers on a number line.
  - Order and compare integers using a number line.
  - Compare integers, using mathematical symbols (<, >, =).
  - Identify and describe the absolute value of an integer.
### STANDARD 6.4  STRAND: NUMBER AND NUMBER SENSE  GRADE LEVEL 6

6.4  The student will demonstrate multiple representations of multiplication and division of fractions.

**Back to MP2**

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</table>
| (Background Information for Instructor Use Only) | - Using manipulatives to build conceptual understanding and using pictures and sketches to link concrete examples to the symbolic enhance students’ understanding of operations with fractions and help students connect the meaning of whole number computation to fraction computation.  
- Multiplication and division of fractions can be represented with arrays, paper folding, repeated addition, repeated subtraction, fraction strips, pattern blocks and area models.  
- When multiplying a whole by a fraction such as $\frac{3}{2}$, the meaning is the same as with multiplication of whole numbers: 3 groups the size of $\frac{1}{2}$ of the whole.  
- When multiplying a fraction by a fraction such as $\frac{2}{3} \cdot \frac{3}{4}$, we are asking for part of a part.  
- When multiplying a fraction by a whole number such as $\frac{1}{2} \times 6$, we are trying to find a part of the whole.  
- For measurement division, the divisor is the number of groups. You want to know how many are in each of those groups. Division of fractions can be explained as how many of a given divisor are needed to equal the given dividend. In other words, | - When multiplying fractions, what is the meaning of the operation?  
When multiplying a whole by a fraction such as $3 \times \frac{1}{2}$, the meaning is the same as with multiplication of whole numbers: 3 groups the size of $\frac{1}{2}$ of the whole.  
When multiplying a fraction by a fraction such as $\frac{2}{3} \cdot \frac{3}{4}$, we are asking for part of a part.  
When multiplying a fraction by a whole number such as $\frac{1}{2} \times 6$, we are trying to find a part of the whole.  
- What does it mean to divide with fractions?  
For measurement division, the divisor is the number of groups and the quotient will be the number of groups in the dividend. Division of fractions can be explained as how many of a given divisor are needed to equal the given dividend. In other words, for $\frac{1}{4} \div \frac{2}{3}$ the question is, “How many $\frac{2}{3}$ make $\frac{1}{4}$?”  
For partition division the divisor is the size of the group, so the quotient answers the question, “How much is the whole?” or “How much for one?” | - The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to  
- Demonstrate multiplication and division of fractions using multiple representations.  
- Model algorithms for multiplying and dividing with fractions using appropriate representations. |
STANDARD 6.4  STRAND: NUMBER AND NUMBER SENSE  GRADE LEVEL 6

6.4  The student will demonstrate multiple representations of multiplication and division of fractions.

**UNDERSTANDING THE STANDARD**  
*Background Information for Instructor Use Only*

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</table>
### STANDARD 6.5  STRAND: NUMBER AND NUMBER SENSE  GRADE LEVEL 6

6.5 The student will investigate and describe concepts of positive exponents and perfect squares.

#### UNDERSTANDING THE STANDARD

(Background Information for Instructor Use Only)

- In exponential notation, the base is the number that is multiplied, and the exponent represents the number of times the base is used as a factor. In \( 8^3 \), 8 is the base and 3 is the exponent.
- A power of a number represents repeated multiplication of the number by itself (e.g., \( 8^3 = 8 \times 8 \times 8 \) and is read “8 to the third power”).
- Any real number other than zero raised to the zero power is 1. Zero to the zero power (0) is undefined.
- Perfect squares are the numbers that result from multiplying any whole number by itself (e.g., \( 36 = 6 \times 6 = 6^2 \)).
- Perfect squares can be represented geometrically as the areas of squares the length of whose sides are whole numbers (e.g., \( 1 \times 1, 2 \times 2, \) or \( 3 \times 3 \)). This can be modeled with grid paper, tiles, geoboards and virtual manipulatives.

#### ESSENTIAL UNDERSTANDINGS

- What does exponential form represent? Exponential form is a short way to write repeated multiplication of a common factor such as \( 5 \times 5 \times 5 = 5^3 \).
- What is the relationship between perfect squares and a geometric square? A perfect square is the area of a geometric square whose side length is a whole number.

#### ESSENTIAL KNOWLEDGE AND SKILLS

- The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to

  - Recognize and describe patterns with exponents that are natural numbers, by using a calculator.
  - Recognize and describe patterns of perfect squares not to exceed \( 20^2 \), by using grid paper, square tiles, tables, and calculators.
  - Recognize powers of ten by examining patterns in a place value chart: \( 10^4 = 10,000, \) \( 10^3 = 1000, \) \( 10^2 = 100, \) \( 10^1 = 10, \) \( 10^0 = 1 \).
FOCUS 6–8  STRAND: COMPUTATION AND ESTIMATION  GRADE LEVEL 6

In the middle grades, the focus of mathematics learning is to
• build on students’ concrete reasoning experiences developed in the elementary grades;
• construct a more advanced understanding of mathematics through active learning experiences;
• develop deep mathematical understandings required for success in abstract learning experiences; and
• apply mathematics as a tool in solving practical problems.

Students in the middle grades use problem solving, mathematical communication, mathematical reasoning, connections, and representations to integrate understanding within this strand and across all the strands.

• Students develop conceptual and algorithmic understanding of operations with integers and rational numbers through concrete activities and discussions that bring meaning to why procedures work and make sense.
• Students develop and refine estimation strategies and develop an understanding of when to use algorithms and when to use calculators. Students learn when exact answers are appropriate and when, as in many life experiences, estimates are equally appropriate.
• Students learn to make sense of the mathematical tools they use by making valid judgments of the reasonableness of answers.
• Students reinforce skills with operations with whole numbers, fractions, and decimals through problem solving and application activities.
6.6 The student will
a) multiply and divide fractions and mixed numbers; and
b) estimate solutions and then solve single-step and multistep practical problems involving addition, subtraction, multiplication, and division of fractions.

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<tbody>
<tr>
<td>(Background Information for Instructor Use Only)</td>
<td>How are multiplication and division of fractions and multiplication and division of whole numbers alike? Fraction computation can be approached in the same way as whole number computation, applying those concepts to fractional parts.</td>
<td>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</td>
</tr>
<tr>
<td>• Simplifying fractions to simplest form assists with uniformity of answers.</td>
<td>What is the role of estimation in solving problems? - Estimation helps determine the reasonableness of answers.</td>
<td>multiply and divide with fractions and mixed numbers. Answers are expressed in simplest form.</td>
</tr>
<tr>
<td>• Addition and subtraction are inverse operations as are multiplication and division.</td>
<td>• Multiply and divide with fractions and mixed numbers. Answers are expressed in simplest form.</td>
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<tr>
<td>• It is helpful to use estimation to develop computational strategies. For example, $\frac{7}{8} \cdot \frac{3}{4}$ is about $\frac{3}{4}$ of 3, so the answer is between 2 and 3.</td>
<td>• Solve single-step and multistep practical problems that involve addition and subtraction with fractions and mixed numbers, with and without regrouping, that include like and unlike denominators of 12 or less. Answers are expressed in simplest form.</td>
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<tr>
<td>• When multiplying a whole by a fraction such as $\frac{3}{2}$, the meaning is the same as with multiplication of whole numbers: 3 groups the size of $\frac{1}{2}$ of the whole.</td>
<td>• Solve single-step and multistep practical problems that involve multiplication and division with fractions and mixed numbers that include denominators of 12 or less. Answers are expressed in simplest form.</td>
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<tr>
<td>• When multiplying a fraction by a fraction such as $\frac{2}{3} \cdot \frac{3}{4}$, we are asking for part of a part.</td>
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<tr>
<td>• When multiplying a fraction by a whole number</td>
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STANDARD 6.6  STRAND: COMPUTATION AND ESTIMATION  GRADE LEVEL 6

6.6 The student will
   a) multiply and divide fractions and mixed numbers; and
   b) estimate solutions and then solve single-step and multistep practical problems involving addition, subtraction, multiplication, and division of fractions.

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<td>such as ( \frac{1}{2} \cdot 6 ), we are trying to find a part of the whole.</td>
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### UNDERSTANDING THE STANDARD

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<tr>
<td>What is the role of estimation in solving problems? Estimation gives a reasonable solution to a problem when an exact answer is not required. If an exact answer is required, estimation allows you to know if the calculated answer is reasonable.</td>
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<tbody>
<tr>
<td>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</td>
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<tr>
<td>Solve single-step and multistep practical problems involving addition, subtraction, multiplication and division with decimals expressed to thousandths with no more than two operations.</td>
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- Different strategies can be used to estimate the result of computations and judge the reasonableness of the result. For example: What is an approximate answer for $2.19 \div 0.8$? The answer is around 2 because $2 \div 1 = 2$.

- Understanding the placement of the decimal point is very important when finding quotients of decimals. Examining patterns with successive decimals provides meaning, such as dividing the dividend by 6, by 0.6, by 0.06, and by 0.006.

- Solving multistep problems in the context of real-life situations enhances interconnectedness and proficiency with estimation strategies.

- Examples of practical situations solved by using estimation strategies include shopping for groceries, buying school supplies, budgeting an allowance, deciding what time to leave for school or the movies, and sharing a pizza or the prize money from a contest.
6.8 The student will evaluate whole number numerical expressions, using the order of operations.

**UNDERSTANDING THE STANDARD**

- The order of operations is a convention that defines the computation order to follow in simplifying an expression.
- The order of operations is as follows:
  - First, complete all operations within grouping symbols*. If there are grouping symbols within other grouping symbols, do the innermost operation first.
  - Second, evaluate all exponential expressions.
  - Third, multiply and/or divide in order from left to right.
  - Fourth, add and/or subtract in order from left to right.
- *Parentheses ( ), brackets [ ], braces { }, and the division bar – as in \( \frac{3+4}{5+6} \) should be treated as grouping symbols.
- The power of a number represents repeated multiplication of the number (e.g., \( 8^3 = 8 \cdot 8 \cdot 8 \)). The base is the number that is multiplied, and the exponent represents the number of times the base is used as a factor. In the example, 8 is the base, and 3 is the exponent.
- Any number, except 0, raised to the zero power is 1. Zero to the zero power is undefined.

**ESSENTIAL UNDERSTANDINGS**

- What is the significance of the order of operations? The order of operations prescribes the order to use to simplify expressions containing more than one operation. It ensures that there is only one correct answer.

**ESSENTIAL KNOWLEDGE AND SKILLS**

- The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to

- Simplify expressions by using the order of operations in a demonstrated step-by-step approach. The expressions should be limited to positive values and not include braces { } or absolute value | |
- Find the value of numerical expressions, using order of operations, mental mathematics, and appropriate tools. Exponents are limited to positive values.
STANDARD 6.8 STRAND: COMPUTATION AND ESTIMATION GRADE LEVEL 6

6.8 The student will evaluate whole number numerical expressions, using the order of operations.

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FOCUS 6–8   STRAND: MEASUREMENT   GRADE LEVEL 6

In the middle grades, the focus of mathematics learning is to
• build on students’ concrete reasoning experiences developed in the elementary grades;
• construct a more advanced understanding of mathematics through active learning experiences;
• develop deep mathematical understandings required for success in abstract learning experiences; and
• apply mathematics as a tool in solving practical problems.

Students in the middle grades use problem solving, mathematical communication, mathematical reasoning, connections, and representations to integrate understanding within this strand and across all the strands.

• Students develop the measurement skills that provide a natural context and connection among many mathematics concepts. Estimation skills are developed in determining length, weight/mass, liquid volume/capacity, and angle measure. Measurement is an essential part of mathematical explorations throughout the school year.

• Students continue to focus on experiences in which they measure objects physically and develop a deep understanding of the concepts and processes of measurement. Physical experiences in measuring various objects and quantities promote the long-term retention and understanding of measurement. Actual measurement activities are used to determine length, weight/mass, and liquid volume/capacity.

• Students examine perimeter, area, and volume, using concrete materials and practical situations. Students focus their study of surface area and volume on rectangular prisms, cylinders, pyramids, and cones.
STANDARD 6.9     STRAND: MEASUREMENT     GRADE LEVEL 6

6.9  The student will make ballpark comparisons between measurements in the U.S. Customary System of measurement and measurements in the metric system.

UNDERSTANDING THE STANDARD  
(Background Information for Instructor Use Only)

- Making sense of various units of measure is an essential life skill, requiring reasonable estimates of what measurements mean, particularly in relation to other units of measure.
  - 1 inch is about 2.5 centimeters.
  - 1 foot is about 30 centimeters.
  - 1 meter is a little longer than a yard, or about 40 inches.
  - 1 mile is slightly farther than 1.5 kilometers.
  - 1 kilometer is slightly farther than half a mile.
  - 1 ounce is about 28 grams.
  - 1 nickel has the mass of about 5 grams.
  - 1 kilogram is a little more than 2 pounds.
  - Water freezes at 0°C and 32°F.
  - Water boils at 100°C and 212°F.
  - Normal body temperature is about 37°C and 98°F.
  - Room temperature is about 20°C and 70°F.
- Mass is the amount of matter in an object. Weight is the pull of gravity on the mass of an object. The mass of an object remains the same regardless of its location. The weight of an object changes dependent on the gravitational pull at its location. In everyday life, most people are actually interested in determining an object’s mass, although they use the term weight, as shown by the questions: “How much does it weigh?” versus “What is its mass?”

ESSENTIAL UNDERSTANDINGS

- What is the difference between weight and mass? Weight and mass are different. Mass is the amount of matter in an object. Weight is the pull of gravity on the mass of an object. The mass of an object remains the same regardless of its location. The weight of an object changes dependent on the gravitational pull at its location.
- How do you determine which units to use at different times? Units of measure are determined by the attributes of the object being measured. Measures of length are expressed in linear units, measures of area are expressed in square units, and measures of volume are expressed in cubic units.
- Why are there two different measurement systems? Measurement systems are conventions invented by different cultures to meet their needs. The U.S. Customary System is the preferred method in the United States. The metric system is the preferred system worldwide.

ESSENTIAL KNOWLEDGE AND SKILLS

The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to:

- Estimate the conversion of units of length, weight/mass, volume, and temperature between the U.S. Customary system and the metric system by using ballpark comparisons. Ex: 1 L ≈ 1qt. Ex: 4L ≈ 4 qts.
- Estimate measurements by comparing the object to be measured against a benchmark.
## STANDARD 6.9  STRAND: MEASUREMENT  GRADE LEVEL 6

### 6.9

The student will make ballpark comparisons between measurements in the U.S. Customary System of measurement and measurements in the metric system.

### UNDERSTANDING THE STANDARD

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<tbody>
<tr>
<td>• The degree of accuracy of measurement required is determined by the situation.</td>
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<tr>
<td>• Whether to use an underestimate or an overestimate is determined by the situation.</td>
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<tr>
<td>• Physically measuring objects along with using visual and symbolic representations improves student understanding of both the concepts and processes of measurement.</td>
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</table>
STANDARD 6.10    STRAND: MEASUREMENT    GRADE LEVEL 6

The student will
a) define pi (π) as the ratio of the circumference of a circle to its diameter;
b) solve practical problems involving circumference and area of a circle, given the diameter or radius;
c) solve practical problems involving area and perimeter; and
d) describe and determine the volume and surface area of a rectangular prism.

UNDERSTANDING THE STANDARD
(Background Information for Instructor Use Only)

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<tr>
<td>What is the relationship between the circumference and diameter of a circle? The circumference of a circle is about 3 times the measure of the diameter.</td>
<td>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</td>
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<tr>
<td>What is the difference between area and perimeter? Perimeter is the distance around the outside of a figure while area is the measure of the amount of space enclosed by the perimeter.</td>
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<tr>
<td>What is the relationship between area and surface area? Surface area is calculated for a three-dimensional figure. It is the sum of the areas of the two-dimensional surfaces that make up the three-dimensional figure.</td>
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<tr>
<td>The value of pi (π) is the ratio of the circumference of a circle to its diameter.</td>
<td>Derive an approximation for pi (3.14 or ( \frac{22}{7} )) by gathering data and comparing the circumference to the diameter of various circles, using concrete materials or computer models.</td>
</tr>
<tr>
<td>Experiences in deriving the formulas for area, perimeter, and volume using manipulatives such as tiles, one-inch cubes, adding machine tape, graph paper, geoboards, or tracing paper, promote an understanding of the formulas and facility in their use.†</td>
<td>Find the circumference of a circle by substituting a value for the diameter or the radius into the formula ( C = \pi d ) or ( C = 2\pi r ).</td>
</tr>
<tr>
<td>The perimeter of a polygon is the measure of the distance around the polygon.</td>
<td>Find the area of a circle by using the formula ( A = \pi r^2 ).</td>
</tr>
<tr>
<td>Circumference is the distance around or perimeter of a circle.</td>
<td>Apply formulas to solve practical problems involving area and perimeter of triangles and rectangles.</td>
</tr>
<tr>
<td>The area of a closed curve is the number of nonoverlapping square units required to fill the region enclosed by the curve.</td>
<td>Create and solve problems that involve finding the circumference and area of a circle when given the diameter or radius.</td>
</tr>
<tr>
<td>The perimeter of a square whose side measures ( s ) is 4 times ( s ) ( (P = 4s) ), and its area is side times side ( (A = s^2) ).</td>
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<tr>
<td>The perimeter of a rectangle is the sum of twice the length and twice the width ( (P = 2l + 2w, \text{ or } P = 2(l + w)) ), and its area is the product of the length and the width ( (A = lw) ).</td>
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STANDARD 6.10        STRAND: MEASUREMENT        GRADE LEVEL 6

6.10        The student will
        a) define pi (π) as the ratio of the circumference of a circle to its diameter;
        b) solve practical problems involving circumference and area of a circle, given the diameter or radius;
        c) solve practical problems involving area and perimeter; and
        d) describe and determine the volume and surface area of a rectangular prism.

UNDERSTANDING THE STANDARD
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<tr>
<td>• The ratio of the circumference to the diameter of a circle is a constant value, pi (π), which can be approximated by measuring various sizes of circles.</td>
<td>• Solve problems that require finding the surface area of a rectangular prism, given a diagram of the prism with the necessary dimensions labeled.</td>
</tr>
<tr>
<td>• The fractional approximation of pi generally used is ( \frac{22}{7} ).</td>
<td>• Solve problems that require finding the volume of a rectangular prism given a diagram of the prism with the necessary dimensions labeled.</td>
</tr>
<tr>
<td>• The decimal approximation of pi generally used is 3.14.</td>
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<tr>
<td>• The circumference of a circle is computed using ( C = \pi d ) or ( C = 2\pi r ), where ( d ) is the diameter and ( r ) is the radius of the circle.</td>
<td></td>
</tr>
<tr>
<td>• The area of a circle is computed using the formula ( A = \pi r^2 ), where ( r ) is the radius of the circle.</td>
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</tr>
<tr>
<td>• The surface area of a rectangular prism is the sum of the areas of all six faces ( (S = 2lw + 2lh + 2wh) ).</td>
<td></td>
</tr>
<tr>
<td>• The volume of a rectangular prism is computed by multiplying the area of the base, ( B ), (length x width) by the height of the prism ( (V = lwh = Bh) ).</td>
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</table>

*Revised March 2011*
FOCUS 6–8 STRAND: GEOMETRY GRADE LEVEL 6

In the middle grades, the focus of mathematics learning is to
- build on students’ concrete reasoning experiences developed in the elementary grades;
- construct a more advanced understanding of mathematics through active learning experiences;
- develop deep mathematical understandings required for success in abstract learning experiences; and
- apply mathematics as a tool in solving practical problems.

Students in the middle grades use problem solving, mathematical communication, mathematical reasoning, connections, and representations to integrate understanding within this strand and across all the strands.

- Students expand the informal experiences they have had with geometry in the elementary grades and develop a solid foundation for the exploration of geometry in high school. Spatial reasoning skills are essential to the formal inductive and deductive reasoning skills required in subsequent mathematics learning.
- Students learn geometric relationships by visualizing, comparing, constructing, sketching, measuring, transforming, and classifying geometric figures. A variety of tools such as geoboards, pattern blocks, dot paper, patty paper, miras, and geometry software provides experiences that help students discover geometric concepts. Students describe, classify, and compare plane and solid figures according to their attributes. They develop and extend understanding of geometric transformations in the coordinate plane.
- Students apply their understanding of perimeter and area from the elementary grades in order to build conceptual understanding of the surface area and volume of prisms, cylinders, pyramids, and cones. They use visualization, measurement, and proportional reasoning skills to develop an understanding of the effect of scale change on distance, area, and volume. They develop and reinforce proportional reasoning skills through the study of similar figures.
- Students explore and develop an understanding of the Pythagorean Theorem. Mastery of the use of the Pythagorean Theorem has far-reaching impact on subsequent mathematics learning and life experiences.

The van Hiele theory of geometric understanding describes how students learn geometry and provides a framework for structuring student experiences that should lead to conceptual growth and understanding.

- **Level 0: Pre-recognition.** Geometric figures are not recognized. For example, students cannot differentiate between three-sided and four-sided polygons.
- **Level 1: Visualization.** Geometric figures are recognized as entities, without any awareness of parts of figures or relationships between components of a figure. Students should recognize and name figures and distinguish a given figure from others that look somewhat the same. (This is the expected level of student performance during grades K and 1.)
FOCUS 6–8   STRAND: GEOMETRY   GRADE LEVEL 6

- **Level 2: Analysis.** Properties are perceived but are isolated and unrelated. Students should recognize and name properties of geometric figures. (Students are expected to transition to this level during grades 2 and 3.)

- **Level 3: Abstraction.** Definitions are meaningful, with relationships being perceived between properties and between figures. Logical implications and class inclusions are understood, but the role and significance of deduction is not understood. (Students should transition to this level during grades 5 and 6 and fully attain it before taking algebra.)

- **Level 4: Deduction.** Students can construct proofs, understand the role of axioms and definitions, and know the meaning of necessary and sufficient conditions. Students should be able to supply reasons for steps in a proof. (Students should transition to this level before taking geometry.)
STANDARD 6.11     STRAND: GEOMETRY     GRADE LEVEL 6

6.11 The student will
   a) identify the coordinates of a point in a coordinate plane; and
   b) graph ordered pairs in a coordinate plane.

Back to MP1
### STANDARD 6.11  STRAND: GEOMETRY  GRADE LEVEL 6

#### UNDERSTANDING THE STANDARD
(Background Information for Instructor Use Only)

- In a coordinate plane, the coordinates of a point are typically represented by the ordered pair \((x, y)\), where \(x\) is the first coordinate and \(y\) is the second coordinate. However, any letters may be used to label the axes and the corresponding ordered pairs.

- The quadrants of a coordinate plane are the four regions created by the two intersecting perpendicular number lines. Quadrants are named in counterclockwise order. The signs on the ordered pairs for quadrant I are \((+ , +)\); for quadrant II, \((- , +)\); for quadrant III, \((- , -)\); and for quadrant IV, \((+ , -)\).

- In a coordinate plane, the origin is the point at the intersection of the \(x\)-axis and \(y\)-axis; the coordinates of this point are \((0,0)\).

- For all points on the \(x\)-axis, the \(y\)-coordinate is 0. For all points on the \(y\)-axis, the \(x\)-coordinate is 0.

- The coordinates may be used to name the point. (e.g., the point \((2,7)\)). It is not necessary to say “the point whose coordinates are \((2,7)\)”.

#### ESSENTIAL UNDERSTANDINGS

- Can any given point be represented by more than one ordered pair?
  The coordinates of a point define its unique location in a coordinate plane. Any given point is defined by only one ordered pair.

- In naming a point in the plane, does the order of the two coordinates matter?
  Yes. The first coordinate tells the location of the point to the left or right of the \(y\)-axis and the second point tells the location of the point above or below the \(x\)-axis. Point \((0, 0)\) is at the origin.

#### ESSENTIAL KNOWLEDGE AND SKILLS

The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to

- Identify and label the axes of a coordinate plane.
- Identify and label the quadrants of a coordinate plane.
- Identify the quadrant or the axis on which a point is positioned by examining the coordinates (ordered pair) of the point.
- Graph ordered pairs in the four quadrants and on the axes of a coordinate plane.
- Identify ordered pairs represented by points in the four quadrants and on the axes of the coordinate plane.
- Relate the coordinate of a point to the distance from each axis and relate the coordinates of a single point to another point on the same horizontal or vertical line.†

†Revised March 2011
<table>
<thead>
<tr>
<th>UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)</th>
<th>ESSENTIAL UNDERSTANDINGS</th>
<th>ESSENTIAL KNOWLEDGE AND SKILLS</th>
</tr>
</thead>
</table>
| • Congruent figures have exactly the same size and the same shape.  
• Noncongruent figures may have the same shape but not the same size.  
• The symbol for congruency is $\cong$.  
• The corresponding angles of congruent polygons have the same measure, and the corresponding sides of congruent polygons have the same measure.  
• The determination of the congruence or noncongruence of two figures can be accomplished by placing one figure on top of the other or by comparing the measurements of all sides and angles.  
• Construction of congruent line segments, angles, and polygons helps students understand congruency. | • Given two congruent figures, what inferences can be drawn about how the figures are related? The congruent figures will have exactly the same size and shape.  
• Given two congruent polygons, what inferences can be drawn about how the polygons are related? Corresponding angles of congruent polygons will have the same measure. Corresponding sides of congruent polygons will have the same measure. | The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to  
• Characterize polygons as congruent and noncongruent according to the measures of their sides and angles.  
• Determine the congruence of segments, angles, and polygons given their attributes.  
• Draw polygons in the coordinate plane given coordinates for the vertices; use coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate. Apply these techniques in the context of solving practical and mathematical problems.† |

†Revised March 2011
### STANDARD 6.13  STRAND: GEOMETRY  GRADE LEVEL 6

**6.13** The student will describe and identify properties of quadrilaterals.

**Back to MP3**

#### UNDERSTANDING THE STANDARD
(Background Information for Instructor Use Only)

- A quadrilateral is a closed planar (two-dimensional) figure with four sides that are line segments.
- A parallelogram is a quadrilateral whose opposite sides are parallel and opposite angles are congruent.
- A rectangle is a parallelogram with four right angles.
- Rectangles have special characteristics (such as diagonals are bisectors) that are true for any rectangle.
- To bisect means to divide into two equal parts.
- A square is a rectangle with four congruent sides or a rhombus with four right angles.
- A rhombus is a parallelogram with four congruent sides.
- A trapezoid is a quadrilateral with exactly one pair of parallel sides. The parallel sides are called *bases*, and the nonparallel sides are called *legs*. If the legs have the same length, then the trapezoid is an isosceles trapezoid.
- A kite is a quadrilateral with two pairs of adjacent congruent sides. One pair of opposite angles is congruent.

#### ESSENTIAL UNDERSTANDINGS

- Can a figure belong to more than one subset of quadrilaterals? Any figure that has the attributes of more than one subset of quadrilaterals can belong to more than one subset. For example, rectangles have opposite sides of equal length. Squares have all 4 sides of equal length thereby meeting the attributes of both subsets.

#### ESSENTIAL KNOWLEDGE AND SKILLS

- The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to:
  - Sort and classify polygons as quadrilaterals, parallelograms, rectangles, trapezoids, kites, rhombi, and squares based on their properties. Properties include number of parallel sides, angle measures and number of congruent sides.
  - Identify the sum of the measures of the angles of a quadrilateral as $360^\circ$.
6.13 The student will describe and identify properties of quadrilaterals.

<table>
<thead>
<tr>
<th>UNDERSTANDING THE STANDARD</th>
<th>ESSENTIAL UNDERSTANDINGS</th>
<th>ESSENTIAL KNOWLEDGE AND SKILLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>and square each have two pairs of parallel sides; a trapezoid has only one pair of parallel sides; other quadrilaterals have no parallel sides.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quadrilaterals can be classified by the measures of their angles: a rectangle has four 90° angles; a trapezoid may have zero or two 90° angles.</td>
<td></td>
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</tr>
<tr>
<td>Quadrilaterals can be classified by the number of congruent sides: a rhombus has four congruent sides; a square, which is a rhombus with four right angles, also has four congruent sides; a parallelogram and a rectangle each have two pairs of congruent sides.</td>
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</tr>
<tr>
<td>A square is a special type of both a rectangle and a rhombus, which are special types of parallelograms, which are special types of quadrilaterals.</td>
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<td></td>
</tr>
<tr>
<td>The sum of the measures of the angles of a quadrilateral is 360°.</td>
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<tr>
<td>A chart, graphic organizer, or Venn Diagram can be made to organize quadrilaterals according to attributes such as sides and/or angles.</td>
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</tbody>
</table>
FOCUS 6–8   STRAND: PROBABILITY AND STATISTICS   GRADE LEVEL 6

In the middle grades, the focus of mathematics learning is to
• build on students’ concrete reasoning experiences developed in the elementary grades;
• construct a more advanced understanding of mathematics through active learning experiences;
• develop deep mathematical understandings required for success in abstract learning experiences; and
• apply mathematics as a tool in solving practical problems.

Students in the middle grades use problem solving, mathematical communication, mathematical reasoning, connections, and representations to integrate understanding within this strand and across all the strands.

• Students develop an awareness of the power of data analysis and probability by building on their natural curiosity about data and making predictions.
• Students explore methods of data collection and use technology to represent data with various types of graphs. They learn that different types of graphs represent different types of data effectively. They use measures of center and dispersion to analyze and interpret data.
• Students integrate their understanding of rational numbers and proportional reasoning into the study of statistics and probability.
• Students explore experimental and theoretical probability through experiments and simulations by using concrete, active learning activities.
STANDARD 6.14      STRAND: PROBABILITY AND STATISTICS      GRADE LEVEL 6

6.14 The student, given a problem situation, will
   a) construct circle graphs;
   b) draw conclusions and make predictions, using circle graphs; and
   c) compare and contrast graphs that present information from the same data set.

Back to MP2

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<th>ESSENTIAL UNDERSTANDINGS</th>
<th>ESSENTIAL KNOWLEDGE AND SKILLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Background Information for Instructor Use Only)</td>
<td>What types of data are best presented in a circle graph? Circle graphs are best used for data showing a relationship of the parts to the whole.</td>
<td>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</td>
</tr>
<tr>
<td>• To collect data for any problem situation, an</td>
<td>• Collect, organize and display data in circle graphs by depicting information as fractional.</td>
<td>• Collect, organize and display data in circle graphs by depicting information as fractional.</td>
</tr>
<tr>
<td>experiment can be designed, a survey can be</td>
<td>• Draw conclusions and make predictions about data presented in a circle graph.</td>
<td>• Draw conclusions and make predictions about data presented in a circle graph.</td>
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<tr>
<td>conducted, or other data-gathering strategies can be</td>
<td>• Compare and contrast data presented in a circle graph with the same data represented in other graphical forms.</td>
<td>• Compare and contrast data presented in a circle graph with the same data represented in other graphical forms.</td>
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<tr>
<td>used. The data can be organized, displayed, analyzed,</td>
<td>• All graphs include a title, and data categories should have labels.</td>
<td></td>
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<tr>
<td>and interpreted to answer the problem.</td>
<td>• A scale should be chosen that is appropriate for the data.</td>
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<tr>
<td>• Different types of graphs are used to display different</td>
<td>• A key is essential to explain how to read the graph.</td>
<td></td>
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<tr>
<td>types of data.</td>
<td>• A title is essential to explain what the graph represents.</td>
<td></td>
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<tr>
<td>– Bar graphs use categorical (discrete) data (e.g.,</td>
<td>• Data are analyzed by describing the various features and elements of a graph.</td>
<td></td>
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<tr>
<td>months or eye color).</td>
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<tr>
<td>– Line graphs use continuous data (e.g., temperature and time).</td>
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<td></td>
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<tr>
<td>– Circle graphs show a relationship of the parts to a whole.</td>
<td></td>
<td></td>
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<tr>
<td>• All graphs include a title, and data categories should have</td>
<td></td>
<td></td>
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<tr>
<td>labels.</td>
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<tr>
<td>• A scale should be chosen that is appropriate for the data.</td>
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<td>• Data are analyzed by describing the various features and</td>
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<tr>
<td>elements of a graph.</td>
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</tbody>
</table>
6.15 The student will
   a) describe mean as balance point; and
   b) decide which measure of center is appropriate for a given purpose.

<table>
<thead>
<tr>
<th>UNDERSTANDING THE STANDARD</th>
<th>ESSENTIAL UNDERSTANDINGS</th>
<th>ESSENTIAL KNOWLEDGE AND SKILLS</th>
</tr>
</thead>
</table>
| (Background Information for Instructor Use Only) | • What does the phrase “measure of center” mean? This is a collective term for the 3 types of averages for a set of data – mean, median, and mode.  
• What is meant by mean as balance point? Mean can be defined as the point on a number line where the data distribution is balanced. This means that the sum of the distances from the mean of all the points above the mean is equal to the sum of the distances of all the data points below the mean. This is the concept of mean as the balance point. | The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to  
• Find the mean for a set of data.  
• Describe the three measures of center and a situation in which each would best represent a set of data.  
• Identify and draw a number line that demonstrates the concept of mean as balance point for a set of data. |
| • Measures of center are types of averages for a data set. They represent numbers that describe a data set. Mean, median, and mode are measures of center that are useful for describing the average for different situations.  
  – Mean works well for sets of data with no very high or low numbers.  
  – Median is a good choice when data sets have a couple of values much higher or lower than most of the others.  
  – Mode is a good descriptor to use when the set of data has some identical values or when data are not conducive to computation of other measures of central tendency, as when working with data in a yes or no survey.  
  • The mean is the numerical average of the data set and is found by adding the numbers in the data set together and dividing the sum by the number of data pieces in the set.  
  • In grade 5 mathematics, mean is defined as fair-share.  
  • Mean can be defined as the point on a number line where the data distribution is balanced. This means that the sum of the distances from the mean of all the points above the mean is equal to the sum of the distances of all the data points below the mean. This is the concept of mean as the balance point. |
STANDARD 6.15    STRAND: PROBABILITY AND STATISTICS    GRADE LEVEL 6

6.15 The student will
a) describe mean as balance point; and
b) decide which measure of center is appropriate for a given purpose.

**UNDERSTANDING THE STANDARD**

(Background Information for Instructor Use Only)

<table>
<thead>
<tr>
<th>ESSENTIAL UNDERSTANDINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Defining mean as balance point is a prerequisite for understanding standard deviation.</td>
</tr>
<tr>
<td>• The median is the middle value of a data set in ranked order. If there are an odd number of pieces of data, the median is the middle value in ranked order. If there is an even number of pieces of data, the median is the numerical average of the two middle values.</td>
</tr>
<tr>
<td>• The mode is the piece of data that occurs most frequently. If no value occurs more often than any other, there is no mode. If there is more than one value that occurs most often, all these most-frequently-occurring values are modes. When there are exactly two modes, the data set is bimodal.</td>
</tr>
<tr>
<td>ESSENTIAL KNOWLEDGE AND SKILLS</td>
</tr>
</tbody>
</table>
STANDARD 6.16    STRAND: PROBABILITY AND STATISTICS    GRADE LEVEL 6

6.16 The student will
a) compare and contrast dependent and independent events; and
b) determine probabilities for dependent and independent events.

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<tr>
<th>UNDERSTANDING THE STANDARD</th>
<th>ESSENTIAL UNDERSTANDINGS</th>
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</tr>
</thead>
</table>
| (Background Information for Instructor Use Only) | How can you determine if a situation involves dependent or independent events? Events are independent when the outcome of one has no effect on the outcome of the other. Events are dependent when the outcome of one event is influenced by the outcome of the other. | The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to
| • The probability of an event occurring is equal to the ratio of desired outcomes to the total number of possible outcomes (sample space). | • Determine whether two events are dependent or independent. |
| • The probability of an event occurring can be represented as a ratio or the equivalent fraction, decimal, or percent. | • Compare and contrast dependent and independent events. |
| • The probability of an event occurring is a ratio between 0 and 1. | • Determine the probability of two dependent events. |
| – A probability of 0 means the event will never occur. | • Determine the probability of two independent events. |
| – A probability of 1 means the event will always occur. | |
| • A simple event is one event (e.g., pulling one sock out of a drawer and examining the probability of getting one color). | |
| • Events are independent when the outcome of one has no effect on the outcome of the other. For example, rolling a number cube and flipping a coin are independent events. | |
| • The probability of two independent events is found by using the following formula: \( P(A \text{ and } B) = P(A) \cdot P(B) \) | |
| Ex: When rolling two number cubes simultaneously, what is the probability of rolling a 3 on one cube and a 4 on the other? | |
STANDARD 6.16    STRAND: PROBABILITY AND STATISTICS    GRADE LEVEL 6

6.16 The student will
   a) compare and contrast dependent and independent events; and
   b) determine probabilities for dependent and independent events.

Back to MP2

UNDERSTANDING THE STANDARD
(Background Information for Instructor Use Only)

<table>
<thead>
<tr>
<th>ESSENTIAL UNDERSTANDINGS</th>
<th>ESSENTIAL KNOWLEDGE AND SKILLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P(3\text{ and }4) = P(3) \cdot P(4) = \frac{1}{6} \cdot \frac{1}{6} = \frac{1}{36}$</td>
<td></td>
</tr>
<tr>
<td>- Events are dependent when the outcome of one event is influenced by the outcome of the other. For example, when drawing two marbles from a bag, not replacing the first after it is drawn affects the outcome of the second draw.</td>
<td></td>
</tr>
<tr>
<td>- The probability of two dependent events is found by using the following formula: $P(A\text{ and }B) = P(A) \cdot P(B\text{ after }A)$</td>
<td></td>
</tr>
<tr>
<td>Ex: You have a bag holding a blue ball, a red ball, and a yellow ball. What is the probability of picking a blue ball out of the bag on the first pick and then without replacing the blue ball in the bag, picking a red ball on the second pick?</td>
<td></td>
</tr>
<tr>
<td>$P(\text{blue and red}) = P(\text{blue}) \cdot P(\text{red after blue}) = \frac{1}{3} \cdot \frac{1}{6} = \frac{1}{18}$.</td>
<td></td>
</tr>
</tbody>
</table>
FOCUS 6–8      STRAND: PATTERNS, FUNCTIONS, AND ALGEBRA GRADE LEVEL 6

In the middle grades, the focus of mathematics learning is to
• build on students’ concrete reasoning experiences developed in the elementary grades;
• construct a more advanced understanding of mathematics through active learning experiences;
• develop deep mathematical understandings required for success in abstract learning experiences; and
• apply mathematics as a tool in solving practical problems.

Students in the middle grades use problem solving, mathematical communication, mathematical reasoning, connections, and representations to integrate understanding within this strand and across all the strands.

• Students extend their knowledge of patterns developed in the elementary grades and through life experiences by investigating and describing functional relationships.
• Students learn to use algebraic concepts and terms appropriately. These concepts and terms include variable, term, coefficient, exponent, expression, equation, inequality, domain, and range. Developing a beginning knowledge of algebra is a major focus of mathematics learning in the middle grades.
• Students learn to solve equations by using concrete materials. They expand their skills from one-step to two-step equations and inequalities.
• Students learn to represent relations by using ordered pairs, tables, rules, and graphs. Graphing in the coordinate plane linear equations in two variables is a focus of the study of functions.
STANDARD 6.17 STRAND: PATTERNS, FUNCTIONS, AND ALGEBRA GRADE LEVEL 6

6.17 The student will identify and extend geometric and arithmetic sequences.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)

- Numerical patterns may include linear and exponential growth, perfect squares, triangular and other polygonal numbers, or Fibonacci numbers.
- Arithmetic and geometric sequences are types of numerical patterns.
- In the numerical pattern of an arithmetic sequence, students must determine the difference, called the *common difference*, between each succeeding number in order to determine what is added to each previous number to obtain the next number. Sample numerical patterns are 6, 9, 12, 15, 18, …; and 5, 7, 9, 11, 13, …
- In geometric number patterns, students must determine what each number is multiplied by to obtain the next number in the geometric sequence. This multiplier is called the *common ratio*. Sample geometric number patterns include 2, 4, 8, 16, 32, …; 1, 5, 25, 125, 625, …; and 80, 20, 5, 1.25, …
- Strategies to recognize and describe the differences between terms in numerical patterns include, but are not limited to, examining the change between consecutive terms, and finding common factors. An example is the pattern 1, 2, 4, 7, 11, 16, …

ESSENTIAL UNDERSTANDINGS

- What is the difference between an arithmetic and a geometric sequence? While both are numerical patterns, arithmetic sequences are additive and geometric sequences are multiplicative.

ESSENTIAL KNOWLEDGE AND SKILLS

The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to

- Investigate and apply strategies to recognize and describe the change between terms in arithmetic patterns.
- Investigate and apply strategies to recognize and describe geometric patterns.
- Describe verbally and in writing the relationships between consecutive terms in an arithmetic or geometric sequence.
- Extend and apply arithmetic and geometric sequences to similar situations.
- Extend arithmetic and geometric sequences in a table by using a given rule or mathematical relationship.
- Compare and contrast arithmetic and geometric sequences.
- Identify the common difference for a given arithmetic sequence.
- Identify the common ratio for a given geometric sequence.
STANDARD 6.18 STRAND: PATTERNS, FUNCTIONS, AND ALGEBRA GRADE LEVEL 6

6.18 The student will solve one-step linear equations in one variable involving whole number coefficients and positive rational solutions.

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</tr>
</thead>
<tbody>
<tr>
<td>(Background Information for Instructor Use Only)</td>
<td></td>
<td>The student will use problem solving, mathematical communication, mathematical reasoning, connections and representation to</td>
</tr>
<tr>
<td>• A one-step linear equation is an equation that requires one operation to solve.</td>
<td>• When solving an equation, why is it necessary to perform the same operation on both sides of an equal sign? To maintain equality, an operation performed on one side of an equation must be performed on the other side.</td>
<td>• Represent and solve a one-step equation, using a variety of concrete materials such as colored chips, algebra tiles, or weights on a balance scale.</td>
</tr>
<tr>
<td>• A mathematical expression contains a variable or a combination of variables, numbers, and/or operation symbols and represents a mathematical relationship. An expression cannot be solved.</td>
<td></td>
<td>• Solve a one-step equation by demonstrating the steps algebraically.</td>
</tr>
<tr>
<td>• A term is a number, variable, product, or quotient in an expression of sums and/or differences. In $7x^2 + 5x - 3$, there are three terms, $7x^2$, $5x$, and 3.</td>
<td></td>
<td>• Identify and use the following algebraic terms appropriately: equation, variable, expression, term, and coefficient.</td>
</tr>
<tr>
<td>• A coefficient is the numerical factor in a term. For example, in the term $3xy^2$, 3 is the coefficient; in the term $z$, 1 is the coefficient.</td>
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<tr>
<td>• Positive rational solutions are limited to whole numbers and positive fractions and decimals.</td>
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<tr>
<td>• An equation is a mathematical sentence stating that two expressions are equal.</td>
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<tr>
<td>• A variable is a symbol (placeholder) used to represent an unspecified member of a set.</td>
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</tbody>
</table>
STANDARD 6.19 STRAND: PATTERNS, FUNCTIONS, AND ALGEBRA GRADE LEVEL 6

6.19 The student will investigate and recognize
   a) the identity properties for addition and multiplication;
   b) the multiplicative property of zero; and
   c) the inverse property for multiplication.

Back to MP4
STANDARD 6.19 STRAND: PATTERNS, FUNCTIONS, AND ALGEBRA GRADE LEVEL 6

UNDERSTANDING THE STANDARD
(Background Information for Instructor Use Only)

- Identity elements are numbers that combine with other numbers without changing the other numbers. The additive identity is zero (0). The multiplicative identity is one (1). There are no identity elements for subtraction and division.
- The additive identity property states that the sum of any real number and zero is equal to the given real number (e.g., 5 + 0 = 5).
- The multiplicative identity property states that the product of any real number and one is equal to the given real number (e.g., 8 · 1 = 8).
- Inverses are numbers that combine with other numbers and result in identity elements.
- The multiplicative inverse property states that the product of a number and its multiplicative inverse (or reciprocal) always equals one (e.g., 4 · $\frac{1}{4} = 1$).
- Zero has no multiplicative inverse.
- The multiplicative property of zero states that the product of any real number and zero is zero.
- Division by zero is not a possible arithmetic operation. Division by zero is undefined.

ESSENTIAL UNDERSTANDINGS

- How are the identity properties for multiplication and addition the same? Different? For each operation the identity elements are numbers that combine with other numbers without changing the value of the other numbers. The additive identity is zero (0). The multiplicative identity is one (1).
- What is the result of multiplying any real number by zero? The product is always zero.
- Do all real numbers have a multiplicative inverse? No. Zero has no multiplicative inverse because there is no real number that can be multiplied by zero resulting in a product of one.

ESSENTIAL KNOWLEDGE AND SKILLS

The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to:

- Identify a real number equation that represents each property of operations with real numbers, when given several real number equations.
- Test the validity of properties by using examples of the properties of operations on real numbers.
- Identify the property of operations with real numbers that is illustrated by a real number equation.

NOTE: The commutative, associative and distributive properties are taught in previous grades.
## Standard 6.20  STRAND: PATTERNS, FUNCTIONS, AND ALGEBRA Grade Level 6

### 6.20 The student will graph inequalities on a number line.

**Back to MP2**

### Understanding the Standard

**Background Information for Instructor Use Only**

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<th>ESSENTIAL KNOWLEDGE AND SKILLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Inequalities using the &lt; or &gt; symbols are represented on a number line with an open circle on the number and a shaded line over the solution set. Ex: (x &lt; 4)</td>
<td>• In an inequality, does the order of the elements matter? Yes, the order does matter. For example, (x &gt; 5) is not the same relationship as (5 &gt; x). However, (x &gt; 5) is the same relationship as (5 &lt; x).</td>
<td></td>
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<tr>
<td><img src="image" alt="Number Line" /></td>
<td></td>
<td>The student will use problem solving, mathematical communication, mathematical reasoning, connections and representation to</td>
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<tr>
<td>• When graphing (x \leq 4) fill in the circle above the 4 to indicate that the 4 is included.</td>
<td>• Given a simple inequality with integers, graph the relationship on a number line.</td>
<td></td>
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<tr>
<td>• Inequalities using the (\leq) or (\geq) symbols are represented on a number line with a closed circle on the number and shaded line in the direction of the solution set.</td>
<td>• Given the graph of a simple inequality with integers, represent the inequality two different ways using symbols (&lt;, &gt;, ≤, ≥).</td>
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<tr>
<td>• The solution set to an inequality is the set of all numbers that make the inequality true.</td>
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<tr>
<td>• It is important for students to see inequalities written with the variable before the inequality symbol and after. For example (x &gt; -6) and (7 &gt; y).</td>
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</tbody>
</table>

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Mathematics Standards of Learning Curriculum Framework 2009: Grade 6