Orange Public Schools

Office of Curriculum & Instruction

2019-2020 Mathematics Curriculum Guide

PLTW Gateway
App Creators

Curriculum Framework

September 9, 2019 – June 25, 2020

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PLTW Curriculum Framework – App Creators (2017-2018)
Lesson 1: Let's Create an App!

Desired Results *(stage 1)*		
Meaning		
ESSENTIAL QUESTIONS: *Students will keep considering …* • Q1 – In what ways does technology affect people's lives? • Q2 – How do computer scientists design and develop mobile apps that meet desired needs? • Q3 – What does effective teamwork look like?		
Meaning	*Acquisition*	
Domains/Understandings *Domains are key understandings and long-term takeaways that go beyond factual knowledge into broader and more conceptual comprehensions.* *Domains are areas of expertise that an employer in a specific field may seek.* *Students will develop understandings about…* *"I will be able to address real-world challenges because I understand…"* *Students will understand that …*	Learning Objectives *Objectives articulate what skills students need to be able to do. (The learning objectives will become targets of assessment.)* *Objectives are functions that directly relate to the workplace or in an applied academic setting.* *Students will use knowledge and skills to…* ***"In the workplace or academic setting, I will need to know and be able to…"***	Knowledge and Skills *Knowledge and skills include the essential facts and basic concepts that a student should know and be able to recall in order to perform the competency.* *Knowledge and skill statements are foundational to the performance of a skill.* *Student will know and be able to…* *"After I learn the information, I will be able to use my knowledge and skills to…"*
D1.1 Mindset: Ethics, analytical thinking, creativity, persistence, iteration, and the positive role of failure are important mindsets and habits of action. They are developed over time in problem solving processes, inquiry, and computational thinking.	LO1.1A: Describe and analyze moments within a problem solving process where persistence, iteration, and the positive aspect of failure played an important role in gaining understanding about a problem or unexpected observation.	KS1.1A1: Recognize that identifying complex problems, defining them clearly, and proposing solutions can be difficult and requires persistence and iteration.
	LO1.1B: Demonstrate creativity and courage to take risks in proposing designs.	KS1.1B1: Develop solutions employing non-traditional techniques; novel combinations of artifacts, tools, techniques; and exploration of personal curiosities throughout a creative process.
D1.2 Problem Solving Process and/or Design Process: Many disciplines, including engineering, computer science, and biomedical science, use an iterative, systematic process to solve problems.	LO1.2A: Apply an iterative process to solve a problem or create an opportunity that can be justified.	KS1.2A2: Explain the goal of any design process. KS1.2A3: Generate ideas and/or build upon existing ideas to innovate.

		KS1.2A4: Iteratively test throughout the design process to ensure that a solution meets the requirements.
	LO1.2B: Apply user-centered design principles when creating a solution.	KS1.2B1: Investigate the types of interactions between users and a proposed solution. KS1.2B2: Describe the importance of involving prospective users early and often during the design process.
D1.3 Computational Thinking: Computational thinking is the thought processes involved in formulating problems and solutions that can be effectively carried out by a computer or electronic device. Common concepts of computational thinking include: the use of algorithms, abstraction, problem decomposition, and data analysis and processing.	LO1.3A: Apply computational thinking to solve problems.	KS1.3A1: Recognize that computational thinking can be applied in multiple disciplines. KS1.3A2: Choose appropriate computational practices when solving a problem. KS1.3A3: Decompose a problem into smaller parts.
D2.1 Data: With the aid of computational power, a tremendous quantity of data can quickly and efficiently processed and analyzed to help solve a problem.	LO2.1B: Create and store data during the execution of a program.	KS2.1B1: Describe ways data can be stored on a digital device. KS2.1B2: Store, access, and update data stored in variables (temporary data).
D2.2 Algorithms: A wide range of professionals use algorithms, a sequence of steps used to solve a problem. This can be accomplished with or without coding.	LO2.2A: Analyze and create algorithms.	KS2.2A1: Create an algorithm or sequence of steps to accomplish a task. KS2.2A2: Identify different algorithms that can be used to solve the same problem. KS2.2A3: Analyze, break down, and explain the logic of an algorithm. KS2.2A4: Locate and debug errors within an algorithm. KS2.2A5: Create simple algorithms that involve variables, conditionals, operators, or logic.
D2.3 Abstraction: An abstraction generalizes a concept, allowing people to ignore some of the details. Abstractions make it easier to handle complexity by focusing on the relevant pieces of the big picture and hiding the details.	LO2.3A: Develop and apply abstractions.	KS2.3A1: Explain the purpose of an abstraction.
D2.4 Programming: Creating a set of statements processed by an electronic device to perform a task.	LO2.4A: Analyze the structure and functionality of a program.	KS2.4A1: Identify and describe the high-level structures of a program, such as user interface components, data components, event handlers, and procedures. KS2.4A2: Describe the appropriate code blocks and convention used in the programming language. KS2.4A3: Identify possible events that can occur during runtime and select the appropriate event-handler blocks to respond to these events. KS2.4A4: Trace a program and deduce the values that variables will have after the code is executed.

	LO2.4B: Create programs by developing and testing code in a modular, incremental approach.	KS2.4B1: Plan a program using appropriate strategies such as natural language or flowcharting. KS2.4B2: Design and develop a program by breaking a large plan into smaller modules using procedures and event handlers (if applicable). KS2.4B3: Test code frequently as it is being developed. KS2.4B4: Debug programs using a variety of strategies to isolate and identify problems, including analyzing error messages, analyzing variable values line-by-line, generating output, or commenting out code.
	LO2.4C: Adapt or improve existing code.	KS2.4C1: Find code relevant to a problem and extend or apply it to a new purpose. KS2.4C2: Improve readability of code by creating or improving documentation, using descriptive variables and procedure names, and using comments.
	LO2.4D: Design and develop a mobile app solution.	KS2.4D1: Describe the components of a mobile app. KS2.4D2: Navigate and use an app development software to design, develop and test a mobile app. KS2.4D3: Design an app's user interface using appropriate tools. KS2.4D4: Select and use appropriate features to meet the desired functionality of an app, such as user interface components, layout arrangements, media objects, drawing and animation, sensors, location awareness, accessing phone features, and data storage. KS2.4D5: Deploy an app using the emulator or a mobile device.
D2.5 Computer Systems: Effectively harnessing computing power requires an understanding of how computers work.	LO2.5A: Identify methods in which electronic devices communicate with each other.	KS2.5A1: Recognize various ways of transferring data from one electronic device to another, such as USB connection, WiFi, or Bluetooth. KS2.5A2: Use a systematic process to identify the source of a problem within individual and connected devices.
D2.6 Social Impacts of Computing: Computer science solutions have global impacts in economic, environmental, and societal contexts.	LO2.6A: Analyze the implications of computing in society.	KS2.6A1: Identify ways that computing has changed or is changing society. KS2.6A2: Give examples of technologies that assist or extend human capabilities.

		KS2.6A3: Describe possible positive and negative social impacts of computing.
D3.1 Collaboration: Effective collaboration requires an ability to function within teams and is often necessary for successful problem solving, experimentation or design work.	LO3.1A: Collaborate effectively on a diverse team.	KS3.1A1: Describe how diverse perspectives in collaboration typically produce the best results in a process. KS3.1A2: Apply team norms to encourage productivity and define how a team will function and measure its success. KS3.1A3: Recognize individual strengths when defining roles and responsibilities.
D3.2 Communication: Effectively communicating orally and in writing for a given audience is an essential skill for success in all fields.	LO3.2A: Communicate effectively for specific purposes and settings.	KS3.2A1: Communicate to meet the needs of the audience and be appropriate to the situation. KS3.2A2: Use accurate and appropriate terminology.
	LO3.2B: Document a process according to professional standards.	KS3.2B1: Present data and information through a variety of accepted means such as: graphs, charts, images, video, schematics, code, 3D models, or simulations.
D3.3 Project Management: The discipline of carefully projecting or planning, organizing, motivating and controlling resources to achieve specific goals and meet specific success criteria.	LO3.3A: Demonstrate the ability to manage multiple resources throughout a project.	KS3.3A1: Devise, prioritize, and execute a plan to solve a problem, including short-term and long-term objectives when appropriate. KS3.3A2: Manage digital files appropriately.
D3.4 Professionalism and Ethics: Successful computer scientists typically exhibit specific personal and professional characteristics that lend themselves to the creative, collaborative, and solution driven nature of the profession.	LO3.4A: Abide by professional, legal and ethical standards when using digital resources.	KS3.4A2: Describe the importance of protecting personal information.
D3.5 Career Awareness: It is important to prepare a flexible education plan that matches your interests, knowing that you can change or modify that plan as you discover more about career opportunities.	LO3.5A: Identify the variety of careers related to engineering, biomedical sciences, and/or computer science.	KS3.5A2: Explore a variety of careers related to engineering, biomedical sciences, or computer science.

Desired Results *(stage 1)*		
Meaning		
ESSENTIAL QUESTIONS: *Students will keep considering …* • Q1 – In what ways does technology affect people's lives? • Q2 – What do programming best practices look like? • Q3 – How do diverse perspectives of team members impact a solution?		
Meaning	*Acquisition*	
Domains/Understandings *Domains are key understandings and long-term takeaways that go beyond factual knowledge into broader and more conceptual comprehensions.* *Domains are areas of expertise that an employer in a specific field may seek.* *Students will develop understandings about…* *"I will be able to address real-world challenges because I understand…"* *Students will understand that …*	Learning Objectives *Objectives articulate what skills students need to be able to do. (The learning objectives will become targets of assessment.)* *Objectives are functions that directly relate to the workplace or in an applied academic setting.* *Students will use knowledge and skills to…* *"In the workplace or academic setting, I will need to know and be able to…"*	Knowledge and Skills *Knowledge and skills include the essential facts and basic concepts that a student should know and be able to recall in order to perform the competency.* *Knowledge and skill statements are foundational to the performance of a skill.* *Student will know and be able to…* *"After I learn the information, I will be able to use my knowledge and skills to…"*
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D1.2 Problem Solving Process and/or Design Process: Many disciplines, including engineering, computer science, and biomedical science, use an iterative, systematic process to solve problems.	LO1.2A: Apply an iterative process to solve a problem or create an opportunity that can be justified.	KS1.2A3: Generate ideas and/or build upon existing ideas to innovate. KS1.2A4: Iteratively test throughout the design process to ensure that a solution meets the requirements.
D1.3 Computational Thinking: Computational thinking is the thought processes involved in formulating problems and solutions that can be effectively carried out by a computer or electronic device. Common concepts of computational thinking include: the use of algorithms, abstraction, problem decomposition, and data analysis and processing.	LO1.3A: Apply computational thinking to solve problems.	KS1.3A1: Recognize that computational thinking can be applied in multiple disciplines. KS1.3A2: Choose appropriate computational practices when solving a problem. KS1.3A3: Decompose a problem into smaller parts.

D2.1 Data: With the aid of computational power, a tremendous quantity of data can quickly and efficiently processed and analyzed to help solve a problem.	LO2.1A: Collect, process, and analyze real or simulated data.	KS2.1A1: Understand that computers enable rapid processing of information. KS2.1A2: Collect, process and interpret data to gain insight on a problem and draw conclusions. KS2.1A3: Compare methods of data representation.
	LO2.1B: Create and store data during the execution of a program.	KS2.1B1: Describe ways data can be stored on a digital device. KS2.1B2: Store, access, and update data stored in variables (temporary data). KS2.1B3: Store, access, and update data stored in a list (temporary data). KS2.1B4: Store, access, and update data stored in a database or file (persistent data) [optional].
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	LO3.2B: Document a process according to professional standards.	KS3.2B1: Present data and information through a variety of accepted means such as: graphs, charts, images, video, schematics, code, 3D models, or simulations.
D3.3 Project Management: The discipline of carefully projecting or planning, organizing, motivating and controlling resources to achieve specific goals and meet specific success criteria.	LO3.3A: Demonstrate the ability to manage multiple resources throughout a project.	KS3.3A1: Devise, prioritize, and execute a plan to solve a problem, including short-term and long-term objectives when appropriate. KS3.3A2: Manage digital files appropriately.
D3.4 Professionalism and Ethics: Successful computer scientists typically exhibit specific personal and professional characteristics that lend themselves to the creative, collaborative, and solution driven nature of the profession.	LO3.4A: Abide by professional, legal and ethical standards when using digital resources.	KS3.4A2: Describe the importance of protecting personal information.

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• Q2 – How do you express yourself and your creativity through computer science?
Q3 – How do diverse perspectives of team members impact a solution?</td></tr>
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Domains are key understandings and long-term takeaways that go beyond factual knowledge into broader and more conceptual comprehensions.

Domains are areas of expertise that an employer in a specific field may seek.

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Objectives articulate what skills students need to be able to do. (The learning objectives will become targets of assessment.)

Objectives are functions that directly relate to the workplace or in an applied academic setting.

Students will use knowledge and skills to…

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Knowledge and skill statements are foundational to the performance of a skill.

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	LO1.2B: Apply user-centered design principles when creating a solution.	KS1.2B1: Investigate the types of interactions between users and a proposed solution. KS1.2B2: Describe the importance of involving prospective users early and often during the design process. KS1.2B3: Recognize that understanding human interaction with a solution can improve the design and extend the abilities of humans.
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D3.4 Professionalism and Ethics: Successful computer scientists typically exhibit specific personal and professional characteristics that lend themselves to the creative, collaborative, and solution driven nature of the profession.	LO3.4A: Abide by professional, legal and ethical standards when using digital resources.	KS3.4A1: Describe property rights of digital media and software to facilitate sharing and avoid infringement. KS3.4A2: Describe the importance of protecting personal information.
	LO3.4B: Consider accessibility and equity when designing products, creating solutions, and collaborating with others.	KS3.4B1: Describe and give examples of universal design strategies that increase accessibility to appropriate resources.
D3.5 Career Awareness: It is important to prepare a flexible education plan that matches your interests, knowing that you can change or modify that plan as you discover more about career opportunities.	LO3.5B: Describe the role, connections between disciplines, and impact of engineering, biomedical science, and/or computer science on society.	KS3.5B1: Demonstrate personal responsibility and initiative for independent learning, keeping in mind that technology and processes will always evolve.

Modifications

Special Education/504:	English Language Learners:
• Adhere to all modifications and health concerns stated in each IEP. • Give students a MENU of options, allowing them to choose assignments from different levels based on difficulty. • Accommodate Instructional Strategies: use of post-its, reading aloud text, graphic organizers, one-on-one instruction, class website (Google Classroom), handouts, definition list with visuals, extended time • Allow extra time to complete assignments or tests • Allow students to demonstrate understanding of a problem by drawing a functional model of the answer and then explaining the reasoning orally and/or writing. • Provide breaks between tasks, use positive reinforcement, use proximity • Work in a small group • Use large print books, Braille, or digital texts • Strategies for Students with 504 Plans	• Simplify written and verbal instructions • Use manipulatives to promote conceptual understanding and enhance vocabulary usage • Allow for alternate forms of responses- drawing or speaking instead of writing to demonstrate knowledge when you are not specifically assessing writing • Allow the use of an online dictionary to look up the definition and hear the pronunciation of unknown words • Provide graphic representations, gestures, drawings, equations, and pictures during all segments of instruction • Utilize program translations tools such as Snap and Read (if available) • Utilize graphic organizers which are concrete, pictorial ways of constructing knowledge and organizing information • Use sentence frames and questioning strategies so that students will explain their thinking/ process of how to solve real life problems. • Reword questions in simpler language • Provide class notes ahead of time to allow students to preview material and increase comprehension • Provide extended time
Gifted and Talented:	**Students at Risk for Failure:**
• Organize and offer flexible small group learning opportunities / activities. • Utilize elevated contextual complexity • Inquiry based or open ended assignments, performance tasks and projects • Allow more time to study concepts with greater depth • Provide options, alternatives and choices to differentiate and broaden the curriculum. • Promote the synthesis of concepts and making real world connections • Provide students with enrichment practice that are imbedded in the curriculum o allowing students to design problems to be addressed by the class	• Assure students have experiences that are on the Concrete- Pictorial- Abstract spectrum • Modify Instructional Strategies; extended time, reading aloud text, graphic organizers, flexible grouping, one-on-one instruction, class website (Google Classroom), inclusion of more visuals and manipulatives, Utilize Scaffolded Questioning, Field Trips, Google Expeditions, Peer Support, Modified Assignments, Chunking of Information, Peer Buddies • Assure constant parental/ guardian contact throughout the year with successes/ challenges • Provide academic contracts to students and guardians • Create an interactive notebook with samples, key vocabulary words, student goals/ objectives. • Always plan to address students at risk in the designing of learning tasks, instructions, and directions.

○ allowing students to modify the lesson by introducing a related phenomena ○ allow for interest-based extension activities • Utilize an enhanced set of introductory activities (e.g. phenomena, organizers, concept maps etc) • Provide whole group enrichment explorations. • Teach cognitive and methodological skills • Allow for the use of stations • Organize integrated problem-solving simulations.	• Try to anticipate where the needs will be and then address them prior to lessons. • Teacher should allow for preferential seating • Include Visual Cues/Modeling • Allow for technology Integration, especially Assistive Technology

21st Century Life and Career Skills:

Career Ready Practices describe the career-ready skills that all educators in all content areas should seek to develop in their students. They are practices that have been linked to increase college, career, and life success. These skills enable students to make informed decisions that prepare them to engage as active citizens in a dynamic global society and to successfully meet the challenges and opportunities of the 21st century workplace.
As such, they should be taught and reinforced in all career exploration and preparation programs, with increasingly higher levels of complexity and expectation as a student advances through a program of study.

https://www.state.nj.us/education/cccs/2014/career/9.pdf

- **CRP1**. Act as a responsible and contributing citizen and employee.
- **CRP2**. Apply appropriate academic and technical skills.
- **CRP3**. Attend to personal health and financial well-being.
- **CRP4**. Communicate clearly and effectively and with reason.
- **CRP5**. Consider the environmental, social and economic impacts of decisions.
- **CRP6**. Demonstrate creativity and innovation.
- **CRP7**. Employ valid and reliable research strategies.
- **CRP8**. Utilize critical thinking to make sense of problems and persevere in solving them.
- **CRP9**. Model integrity, ethical leadership and effective management.
- **CRP10**. Plan education and career paths aligned to personal goals.
- **CRP11**. Use technology to enhance productivity.
- **CRP12**. Work productively in teams while using cultural global competence.

Students are provided with an equitable opportunity to communicate with peers effectively, clearly, and with the use of technical language. They are also encouraged to reason through experiences and exposure to phenomena that promote critical thinking and emphasize the importance of perseverance. Students are exposed to various mediums of technology, such as digital learning, and educational websites.

Technology Standards:

All students will be prepared to meet the challenge of a dynamic global society in which they participate, contribute, achieve, and flourish through universal access to people, information, and ideas.

https://www.state.nj.us/education/cccs/2014/tech/

8.1 Educational Technology:

All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.

A. **Technology Operations and Concepts:** Students demonstrate a sound understanding of technology concepts, systems and operations.
B. **Creativity and Innovation:** Students demonstrate creative thinking, construct knowledge and develop innovative products and process using technology.
C. **Communication and Collaboration:** Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.
D. **Digital Citizenship:** Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior.
E. **Research and Information Fluency:** Students apply digital tools to gather, evaluate, and use of information.
F. **Critical thinking, problem solving, and decision making:** Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming:

All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.

A. **The Nature of Technology: Creativity and Innovation-** Technology systems impact every aspect of the world in which we live.
B. **Technology and Society:** Knowledge and understanding of human, cultural, and societal values are fundamental when designing technological systems and products in the global society.
C. **Design:** The design process is a systematic approach to solving problems.
D. **Abilities in a Technological World:** The designed world in a product of a design process that provides the means to convert resources into products and systems.
E. **Computational Thinking: Programming-** Computational thinking builds and enhances problem solving, allowing students to move beyond using knowledge to creating knowledge.

Interdisciplinary Connections:

Science:

- MS-ETS1-1 - Engineering Design
  Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- MS-ETS1-3 - Engineering Design
  Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
- P1 - Science and Engineering Practices
  Asking questions (for science) and defining problems (for engineering)
- P2 - Science and Engineering Practices
  Developing and using models
- P4 - Science and Engineering Practices
  Analyzing and interpreting data
- P5 - Science and Engineering Practices
  Using mathematics and computational thinking
- P6 - Science and Engineering Practices
  Constructing explanations (for science) and designing solutions (for engineering)
- P8 - Science and Engineering Practices
  Obtaining, evaluating, and communicating information

Interdisciplinary Connections:

English Language Arts:

- 7.RL.4 - Reading Literature

Determine the meaning of words and phrases as they are used in a text, including figurative and connotative meanings; analyze the impact of rhymes and other repetitions of sounds (e.g., alliteration) on a specific verse or stanza of a poem or section of a story or drama.

- 7.RI.4 - Reading Informational

Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze the impact of a specific word choice on meaning and tone.

- 7.W.2 -Writing

Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

- 7.W.2.d -Writing

Use precise language and domain-specific vocabulary to inform about or explain the topic.

- 7.W.3.d -Writing

Use precise words and phrases, relevant descriptive details, and sensory language to capture the action and convey experiences and events.

- 7.SL.1 – Speaking and Listening

Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly.

- 7.SL.1.b - Speaking and Listening

Follow rules for collegial discussions, track progress toward specific goals and deadlines, and define individual roles as needed.

- 7.SL.1.c - Speaking and Listening

Pose questions that elicit elaboration and respond to others' questions and comments with relevant observations and ideas that bring the discussion back on topic as needed.

- 7.SL.1.d - Speaking and Listening

Acknowledge new information expressed by others and, when warranted, modify their own views.

- 7.SL.6 - Speaking and Listening

Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when indicated or appropriate.

- 7.L.2.b - Language

Spell correctly.

- 7.L.3 - Language

Use knowledge of language and its conventions when writing, speaking, reading, or listening.

- 7.L.4.a - Language

Use context (e.g., the overall meaning of a sentence or paragraph; a word's position or function in a sentence) as a clue to the meaning of a word or phrase.

- 7.L.4.c - Language

Consult general and specialized reference materials (e.g., dictionaries, glossaries, thesauruses), both print and digital, to find the pronunciation of a word or determine or clarify its precise meaning or its part of speech.

- 7.L.5.b - Language

Use the relationship between particular words (e.g., synonym/antonym, analogy) to better understand each of the words.

- 7.L.6 - Language

Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases; gather vocabulary knowledge when considering a word or phrase important to comprehension or expression.

Interdisciplinary Connections:

Mathematics:

- 7.NS.1.d - The Number System
  Apply properties of operations as strategies to add and subtract rational numbers.