

**COURSE TITLE**

Brain Games and Puzzles

**LENGTH**

One Semester

**DEPARTMENT**

STEM Department

**SCHOOL**

Union Middle School

**DATE**

September 10, 2018

## Brain Games and Puzzles

### I. Introduction/Overview/Philosophy

This course will allow students to infuse mathematical thinking into engaging activities that will allow them to solve problems through reasoning. Students will discover techniques for solving problems through appropriate activities, which will include Sudoku, Rummi Cube, and other logic puzzles and games. Students will use deductive reasoning and adaptable thinking skills while fostering imagination and creativity. All of the work and activities will increase the student's appreciation for and understanding of mathematical ways of thinking.

### II. Objectives

#### *Course Outline:*

1. Probability and Statistics
  - a. The Factor Game
  - b. Probability/Gaming
  - c. SKUNK
  - d. Prime Time
2. Expressions and Equations
  - a. Equate
  - b. One Grain of Rice
  - c. Supreme Court Handshake
  - d. Baseball Towers
3. Geometry
  - a. Blockus
  - b. Blockers
  - c. Puzzling Pentominoes
  - d. Pattern Blocks
  - e. Counting Embedded Figures
  - f. Four Quadrant Graphing
  - g. Pythagorean Theorem Activity
4. Number Systems
  - a. Magic Squares
  - b. Sudoku
  - c. Mathduko
  - d. Balance Quest
  - e. 24
  - f. Contig
  - g. Mancala
  - h. Tri-ominoes
  - i. Rummikub
  - j. Backgammon

- k. Logic Puzzles
5. Culminating Project
  - a. BreakoutEdu
  - b. Create your Game
  - c. Planning an Amusement Park
  - d. Strategy Guide

***Student Outcomes:***

After successfully completing this course, the student will:

- Make sense of problems and persevere in solving them.
- Reason abstractly and quantitatively.
- Construct viable arguments and critique the reasoning of others.
- Model with mathematics
- Use appropriate tools strategically.
- Attend to precision.
- Look for and make use of structure.
- Look for and express regularity in repeated reasoning.

***New Jersey Student Learning Standards******CAREER READY PRACTICES******CRP1 Act as a responsible and contributing citizen and employee.***

Career-ready individuals understand the obligations and responsibilities of being a member of a community, and they demonstrate this understanding every day through their interactions with others. They are conscientious of the impacts of their decisions on others and the environment around them. They think about the near-term and long-term consequences of their actions and seek to act in ways that contribute to the betterment of their teams, families, community and workplace. They are reliable and consistent in going beyond the minimum expectation and in participating in activities that serve the greater good.

***CRP2 Apply appropriate academic and technical skills.***

Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be more productive. They make connections between abstract concepts with real-world applications, and they make correct insights about when it is appropriate to apply the use of an academic skill in a workplace situation

***CRP4 Communicate clearly and effectively and with reason.***

Career-ready individuals communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods. They communicate in the workplace with clarity and purpose to make maximum use of their own and others' time. They are excellent writers; they master conventions, word choice, and organization, and use effective tone and presentation skills to articulate ideas. They are skilled at interacting with others; they are active listeners and speak clearly and with purpose. Career-ready individuals think about the audience for their communication and prepare accordingly to ensure the desired outcome.

***CRP6. Demonstrate creativity and innovation.***

Career-ready individuals regularly think of ideas that solve problems in new and different ways, and they contribute those ideas in a useful and productive manner to improve their organization. They can consider unconventional ideas and suggestions as solutions to issues, tasks or problems, and they discern which ideas and

suggestions will add greatest value. They seek new methods, practices, and ideas from a variety of sources and seek to apply those ideas to their own workplace. They take action on their ideas and understand how to bring innovation to an organization.

***CRP7. Employ valid and reliable research strategies.***

Career-ready individuals are discerning in accepting and using new information to make decisions, change practices or inform strategies. They use reliable research process to search for new information. They evaluate the validity of sources when considering the use and adoption of external information or practices in their workplace situation.

***CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.***

Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem, and devise effective plans to solve the problem. They are aware of problems when they occur and take action quickly to address the problem; they thoughtfully investigate the root cause of the problem prior to introducing solutions. They carefully consider the options to solve the problem. Once a solution is agreed upon, they follow through to ensure the problem is solved, whether through their own actions or the actions of others.

***CRP11. Use technology to enhance productivity.***

Career-ready individuals find and maximize the productive value of existing and new technology to accomplish workplace tasks and solve workplace problems. They are flexible and adaptive in acquiring new technology. They are proficient with ubiquitous technology applications. They understand the inherent risks-personal and organizational-of technology applications, and they take actions to prevent or mitigate these risks.

***CRP12. Work productively in teams while using cultural global competence.***

Career-ready individuals positively contribute to every team, whether formal or informal. They apply an awareness of cultural difference to avoid barriers to productive and positive interaction. They find ways to increase the engagement and contribution of all team members. They plan and facilitate effective team meetings.

## ***TECHNOLOGY***

**Standard 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.

***Strand A: Technology Operations and Concepts:*** Students demonstrate a sound understanding of technology concepts, systems and operations.

8.1.8.A.3- Use and/or develop a simulation that provides an environment to solve a real world problem or theory.

***Strand B. Creativity and Innovation:*** Students demonstrate creative thinking, construct knowledge and develop innovative products and process using technology.

8.1.8.B.1- Synthesize and publish information about a local or global issue or event (ex. telecollaborative project, blog, school web).

***Strand D. Digital Citizenship:*** Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior.

8.1.8.D.4- Assess the credibility and accuracy of digital content.

***Strand E: Research and Information Fluency:*** Students apply digital tools to gather, evaluate, and use information.

8.1.8.E.1- Effectively use a variety of search tools and filters in professional public databases to find information to solve a real world problem.

**Standard 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.

**Strand A. The Nature of Technology: Creativity and Innovation** Technology systems impact every aspect of the world in which we live.

8.2.8.A.2- Examine a system, consider how each part relates to other parts, and discuss a part to redesign to improve the system.

**Strand C. Design:** The design process is a systematic approach to solving problems.

8.2.8.C.1- Explain how different teams/groups can contribute to the overall design of a product

8.2.8.C.4- Identify the steps in the design process that would be used to solve a designated problem.

**Strand D. Abilities for a Technological World:** The designed world is the product of a design process that provides the means to convert resources into products and systems.

8.2.8.D.3- Build a prototype that meets a STEM-based design challenge using science, engineering, and math principles that validate a solution.

**21ST CENTURY LIFE AND CAREERS****9.2 Career Awareness, Exploration, and Preparation****Strand B: Career Exploration**

9.2.8.B.3 Evaluate communication, collaboration, and leadership skills that can be developed through school, home, work, and extracurricular activities for use in a career.

**NEW JERSEY STUDENT LEARNING STANDARDS- MATH**

7.SP.C.5 Understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. Larger numbers indicate greater likelihood. A probability near 0 indicates an unlikely event, a probability around  $1/2$  indicates an event that is neither unlikely nor likely, and a probability near 1 indicates a likely event.

7.SP.C.6 Approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency, and predict the approximate relative frequency given the probability

7.SP.C.8 Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation.

7.RP.A.1 Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units. For example, if a person walks  $1/2$  mile in each  $1/4$  hour, compute the unit rate as the complex fraction  $1/2/1/4$  miles per hour, equivalently 2 miles per hour.

7.RP.A.2 Recognize and represent proportional relationships between quantities.

7.EE.B.3 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.

7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.

8.G.B.6 Explain a proof of the Pythagorean Theorem and its converse.

A-CED.A.1 Create equations and inequalities in one variable and use them to solve problems.

F-IF.A.3 Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.

F-IF.C.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).

***Mathematical Practices***

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

**III. Proficiency Levels**

This course is open to students in grades 7 and 8.

**IV. Methods of Assessment****Student Assessment**

The teacher will provide a variety of assessments during the course of the year. The assessment may include but is not limited to: projects, teacher observations, presentations, open-ended problems, cooperative work, and homework.

**Curriculum/Teacher Assessment**

The teacher will provide the subject area supervisor with suggestions for changes on an ongoing basis.

**V. Grouping**

This is a middle school elective course offered to students in grade 7 and grade 8.

**VI. Articulation/Scope & Sequence/Time Frame**

Course length is one semester.

**VII. Resources*****Texts/Supplemental Reading/References***

Resources include but are not limited to:

1. NCTM Illuminations
2. Online Videos
3. Various Board Games
4. Various Strategy Games

**VIII. Suggested Activities**

Appropriate activities are listed in the curriculum map.

## **IX. Methodologies**

The following methods of instruction are suggested: teacher guided explorations, working in groups/working with a partner, working with manipulatives and discovery activities.

## **X. Interdisciplinary Connections**

The primary focus of this course is to allow students to connect concepts learned in the regular mathematics classroom to activities and situations in the real world. Applications to business, science, geography, and art will be made on a daily basis through a variety of projects and explorations.

## **XI. Differentiating Instruction for Students with Special Needs: Students with Disabilities, Students at Risk, English Language Learners, and Gifted & Talented Students**

Differentiating instruction is a flexible process that includes the planning and design of instruction, how that instruction is delivered, and how student progress is measured. Teachers recognize that students can learn in multiple ways as they celebrate students' prior knowledge. By providing appropriately challenging learning, teachers can maximize success for all students.

Differentiating in this course includes but is not limited to:

### *Differentiation for Support (ELL, Special Education, Students at Risk)*

- Peer mentoring on problems
- Differentiated teacher feedback on assignments
- Modeling out problems on whiteboard
- Visual aids as we project problems on whiteboard
- Study guides
- Tiered assignments
- Scaffolding of materials and assignments
- Re-teaching and review
- Guided note taking
- Exemplars of varied performance levels
- Multi-media approach to accommodating various learning styles

### *Differentiation for Enrichment*

- Supplemental reading material for independent study
- Flexible grouping
- Tiered assignments
- Topic selection by interest
- Enhanced expectations for independent study
- Elevated questioning techniques using Webb's Depth of Knowledge matrix

## **XII. Professional Development**

The teacher will continue to improve expertise through participation in a variety of professional development opportunities.



## XII. Curriculum Map/Pacing Guide

Unit Topic	Time Allocated	Differentiating Instruction for Students with Disabilities, Students at Risk, English Language Learners, & Gifted & Talented Students	Standards	Assessments
<b>Probability and Statistics</b> <ul style="list-style-type: none"> <li>• The Factor Game</li> <li>• Probability/Gaming</li> <li>• SKUNK</li> <li>• Prime Time</li> </ul>	4 weeks	<i>For Support:</i> Use of calculator, Pre-teaching of vocabulary and concepts, teacher modeling  <i>For Enhancement:</i> Provide extension activities, Interest-based content	7.SP.C.5 7.SP.C.6 7.SP.C.8 CRP1,2,4,6,7,8,11,12 8.1.8.A.3, 8.1.8.B.1, 8.1.8.D.4, 8.1.8.E.1 8.2.8.A.2, 8.2.8.C.1, 8.2.8.C.4, 8.2.8.D.3 9.2.8.B.3	<i>Formative Assessment:</i> Questioning, Classwork, Group and cooperative work  <i>Summative Assessment</i> Culminating Skunk Project- Interpreting the Game of Skunk
<b>Expressions and Equations</b> <ul style="list-style-type: none"> <li>• Equate</li> <li>• One Grain of Rice</li> <li>• Supreme Court Handshake</li> <li>• Baseball Towers</li> </ul>	4 weeks	<i>For Support:</i> Use of calculator, rephrase questions, directions, and explanations, modification of content, visual learning (graphic organizers), Allow errors  <i>For Enhancement:</i> Higher-order thinking skills, Independent Study, Critical and Analytical Thinking tasks.	A-CED.A.1 F-IF.A.3 F-IF.C.9 CRP1,2,4,6,7,8,11,12 8.1.8.A.3, 8.1.8.B.1, 8.1.8.D.4, 8.1.8.E.1 8.2.8.A.2, 8.2.8.C.1, 8.2.8.C.4, 8.2.8.D.3 9.2.8.B.3	<i>Formative Assessment:</i> Discussion, reaction questions, Observation of Game, Classwork  <i>Summative Assessment</i> Project on One Grain of Rice and Exponential growth.
<b>Geometry</b> <ul style="list-style-type: none"> <li>• Blockus</li> <li>• Blockers</li> <li>• Puzzling Pentominoes</li> </ul>	4 Weeks	<i>For Support:</i> Use of algebraic manipulatives, Teacher modeling, Modified assessments, Visual Learning	8.G.B.6 7.RP.A.1 7.RP.A.2 MP.1 MP.8	<i>Formative Assessment:</i> Questioning, Entry/Exit Tickets, Classwork, Cooperative Work  <i>Summative Assessment:</i>

Unit Topic	Time Allocated	Differentiating Instruction for Students with Disabilities, Students at Risk, English Language Learners, & Gifted & Talented Students	Standards	Assessments
<ul style="list-style-type: none"> <li>• Pattern Blocks</li> <li>• Counting Embedded Figures</li> <li>• Four Quadrant Graphing</li> <li>• Pythagorean Theorem Activity</li> </ul>		<p><i>For Enhancement:</i> Provide Extension Activities, Inquiry-based instruction, Student Driven Projects, Real-world problems and scenarios</p>	CRP1,2,4,6,7,8,11,12 8.1.8.A.3, 8.1.8.B.1, 8.1.8.D.4, 8.1.8.E.1 8.2.8.A.2, 8.2.8.C.1, 8.2.8.C.4, 8.2.8.D.3 9.2.8.B.3	Project Create Your Own Graphing Picture, Pythagorean Theorem Project
<b>Number Systems</b> <ul style="list-style-type: none"> <li>• Magic Squares</li> <li>• Sudoku</li> <li>• Mathduko</li> <li>• Balance Quest</li> <li>• 24</li> <li>• Contig</li> <li>• Mancala</li> <li>• Tri-ominoes</li> <li>• Rummikub</li> <li>• Backgammon</li> <li>• Logic Puzzles</li> </ul>	4 Weeks	<p><i>For Support:</i> Allow Errors, Use of visual and multi-sensory formats, Teacher Modeling, Visual Learning, Use of Calculator</p> <p><i>For Enhancement:</i> Inquiry-based instruction, Student-driven projects,</p>	8.G.B.6 MP.1 MP.8 CRP1,2,4,6,7,8,11,12 8.1.8.A.3, 8.1.8.B.1, 8.1.8.D.4, 8.1.8.E.1 8.2.8.A.2, 8.2.8.C.1, 8.2.8.C.4, 8.2.8.D.3 9.2.8.B.3	<p><i>Formative Assessment:</i> Group Work, Classwork, Questioning</p> <p><i>Summative Assessment:</i> Project Create Your Own Sudoku, Project Create Your Own Logic Puzzle</p>
<b>Culminating Project</b> <ul style="list-style-type: none"> <li>• BreakoutEdu</li> <li>• Create your Game</li> <li>• Planning an Amusement Park</li> <li>• Strategy Guide</li> </ul>	4 Weeks	<p><i>For Support:</i> Modification of Student products, Rephrase directions and explanations, think-pair-share</p> <p><i>For Enhancement:</i> Provide extension activities, student-driven projects, inquiry-based instruction, Independent Study</p>	MP.1 MP.8 7.EE.B CRP1,2,4,6,7,8,11,12 8.1.8.A.3, 8.1.8.B.1, 8.1.8.D.4, 8.1.8.E.1 8.2.8.A.2, 8.2.8.C.1, 8.2.8.C.4, 8.2.8.D.3 9.2.8.B.3	<p><i>Formative Assessment:</i> Questioning, Group work, Classwork</p> <p><i>Summative Assessment</i> Project Create Your Own Breakout, Project Create Your Own Strategy Guide, Project Create Your Own Game</p>