



Course Syllabus

Title: **Proportional Reasoning in the Middle Grades - MAT 6710 C03**

Credits: 3 Graduate Credits

Instructor:

Meeting dates and times:

Location:

CourseDescription:

In this three graduate credit course we will investigate deeply proportional reasoning content in the middle grades and identify proportionality in each strand of the NCTM Standards, Number and Operations, Geometry and Measurement, Algebra and Functions, and Probability and Statistics. Educators will experience formative assessment strategies for assessing student understanding on an ongoing basis and a variety of differentiated instruction strategies to help all students succeed. In addition the student will have virtual hands-on opportunities to explore and test mathematical models of proportional reasoning.

Goals:

During this in-depth study of rates, ratios and proportions, middle level educators will:

- Delve into challenging mathematics content as an adult learner
- Explore the prevalence of this content across the middle grade curriculum
- Increase awareness of current research on the ways in which adolescents build proportional reasoning skills
- Experience formative assessment strategies for assessing student understanding on an ongoing basis
- Identify language issues that affect student learning and learn strategies for diagnosing and addressing those issues
- Experience a variety of differentiated instruction strategies to help all students succeed
- Investigate applications of this content in middle level mathematics classrooms
- Participate in a dialogue with middle level colleagues and course instructors about this work through the fall semester

Learning Outcomes:

Specific Mathematics Content Learning Objectives:

- Identify, compare, and contrast proportional relationships, inversely proportional relationships, and other types of relationships in tables, graphs, equations, etc.
- Identify proportionality in geometry and measurement, number and operations, functions and algebra, probability and statistics, and in everyday life
- Investigate the effects of scaling up and down on perimeter and area of 2D figures, and on volume and surface area of 3D figures.
- Recognize that the numbers involved and the contexts used impact the difficulty of proportionality problems for students
- Investigate real-world exchange rate problems
- Use proportional reasoning to determine fractions, decimals, and percents of figures
- Explore two-way tables

- Investigate proportionality in relative frequencies
- Create and interpret rate graphs when the rate of change is constant and when the rate of change is changing
- Complete an engineering experiment involving simulations of cantilever bridges
- Recognize aspects of proportional reasoning in changing situations and use them to solve complex problems
- Solve proportions using several conceptual strategies and recognize the pros and cons of cross multiplication
- Investigate applications of proportionality in trigonometry

General Course Information

Course Policies/Expectations:

All instructors and participants are expected to:

- **Celebrate errors:**
 - Learn from errors and successes
 - Persevere through challenges
- **Challenge and stretch ourselves:**
 - Find other ways to solve or extend problems
 - Embrace the discomfort of disequilibrium
 - Seek help when needed
- **Help each other learn:**
 - Be sensitive to math fears
 - Recognize that we all have much to learn from each other
 - “The more you learn, the more you realize you don’t know.”
- **Strive for excellence for self and all others:**
 - Continually reflect on and refine our work
 - “No one is done until everyone is done.”

Contributions in Class:

See Grading below.

Academic Honesty & Professionalism:

As a community of scholars, the administration, faculty and students at Castleton expect all to maintain the highest integrity in scholarly work. All tests, papers, assignments, and projects must be the work of the individual or group assigned. Any work that is not original must be properly credited or it is plagiarized. Any violation of academic honesty will be considered cheating and will be dealt with accordingly by the individual instructor. For more information see page 12 of the “Castleton College Handbook & Calendar, 2003-2004”, also accessible online at:

<http://www.castleton.edu/campus/StudentHandbook/pages6to43.pdf>

Required and/or recommended readings:

- Post, Thomas R., Merlyn J. Behr, and Richard Lesh. (1988) Proportionality and the Development of Prealgebra Understandings. In J. Hiebert & M. Behr (eds.) *Number Concepts and Operations in the Middle Grades* (pp. 93-118). Reston, VA: Lawrence Erlbaum & National Council of Teachers of Mathematics (NCTM). Retrieved May 10, 2006, from http://education.umn.edu/rationalnumberproject/99_10.html
- Lamon, Susan J. (2005). *Teaching Fractions and Ratios for Understanding: Essential Content Knowledge and Instructional Strategies for Teachers*. Mahwah, NJ: Lawrence Erlbaum Associates, Inc. (selected chapters)

- Langrall, Cynthia W., and Jane Swafford. (December 2000). Three Balloons for Two Dollars: Developing Proportional Reasoning. In National Council of Teachers of Mathematics (NCTM), *Mathematics Teaching in the Middle School*, (pp. 254-261). Reston, VA: NCTM.
- Boston, Melissa D., Margaret S. Smith, and Amy F. Hillen. (November 2003). Building on Students' Intuitive Strategies to Make Sense of Cross Multiplication. In National Council of Teachers of Mathematics (NCTM), *Mathematics Teaching in the Middle School*, (pp. 150-155). Reston, VA: NCTM.
- Lanius, Cynthia S., and Susan E. Williams. (April 2003). Proportionality: A Unifying Theme for the Middle Grades. In National Council of Teachers of Mathematics (NCTM), *Mathematics Teaching in the Middle School*, (pp. 392-396). Reston, VA: NCTM.
- Chapin, Suzanne E., and Nancy Canavan Anderson. (April 2003). Crossing the Bridge to Formal Proportional Reasoning. In National Council of Teachers of Mathematics (NCTM), *Mathematics Teaching in the Middle School*, (pp. 420-425). Reston, VA: NCTM.
- Additional readings as needed.

Electronic Submissions/Internet Use: - If applicable

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Castleton State College - Use and Ownership of Copyrighted Materials:

For information and guidance, faculty and students are referred to the Vermont State College Manual of Policy and Procedures as it relates to the use and ownership of copyrighted materials. Guidelines are set out in Policy 416, accessible online at the following address:

<http://www.castleton.edu/library/VSC%20Copyright%10Policy.pdf>

Additional information on this subject is contained in the publication "Questions and Answers on Copyright for the Campus Community." This document can be accessed online on the National Association of College Stores web site at the following address: <http://www.nacs.org/public/copyright/>.

Student Evaluation/Assessment

Grading:

Evaluation is based on a final problem set, a final project, participation in Second Life sessions or Moodle threaded discussion, and participation in class sessions, including discussions of homework assignments.

Grade: A

- Present and prepared at all six classes, participates actively in all discussions and activities and one of on-line options and
- Problem set successfully completed, and
- Final project successfully completed.

Grade: B

- Present and prepared at all six classes, participates actively in all discussions and activities, and
- Final project successfully completed, and
- Problem set not successfully completed or no participation in on-line options.

Grade: F

- No final project, or
- 1 or more days missed and not made up, or
- Final project not successfully completed and problem set missing.

Castleton State College – Grading Policy:

Grades are indicated by letters with a designated “quality point” value assigned to each as follows:

A+	=	4.0
A	=	4.0
A-	=	3.7
B+	=	3.3
B	=	3.0
B-	=	2.7
C+	=	2.3
C	=	2.0
C-	=	0.0

Additional grading information can be found beginning on page 22 of the “Castleton College Handbook & Calendar, 2003-2004”, also accessible online at: <http://www.castleton.edu/campus/StudentHandbook/pages6to43.pdf>

Course Drop Policy:

Castleton State College offers courses to educators with the expectation participants will complete the course. However, the College realizes circumstances arise in one’s personal life that may cause disruptions. The policy for dropping a course is that a participant will notify the instructor in writing of the intent to withdraw from the course. The notice should include the reason for withdrawing and be made as follows:

- 1 credit course (15 hours) – before 3 hours of the course have taken place
- 2 credit course (30 hours) – before 6 hours of the course have taken place
- 3 credit course (45 hours) – before 9 hours of the course have taken place

After that, changes in class status will be considered for health, bereavement, and personal or emergency situations only. Those who withdraw without adhering to this policy may be liable for associated course costs.

Note: If an absence is unavoidable, please discuss requirements for making up the session with the instructor.

Description of Class Assignments:

1. Daily assignments, may include readings, journal entries related to the readings, and mathematics problems.
2. A final problem set will be distributed on . . . The problem set should be completed by . . .
3. **The final project is due at the final session in . . . The project will be presented at that time.**

Final Project

- I. Create a pre-test to assess your students' incoming level of proportional reasoning.
 - II. Administer the pre-test to at least one of your classes.
 - III. Analyze the results using the sort form provided.
 - IV. Summarize your findings.
 - V. Respond to the following:
 - Did anything surprise you about the results?
 - How will the results of the pre-assessment impact your instruction of proportionality throughout the school year?
 - VI. Select one item that yielded particularly interesting results and select pieces of student work that capture the variety of responses in the class (including a variety of correct and incorrect solutions) and create a mini presentation on this item. Include a discussion of:
 - The numerical relationships in the problem.
 - The context of the problem.
 - What about the design of the problem elicited interesting results?
 - What question(s) you might ask to follow-up on this item?
 - How will you address the mix of understandings and misunderstandings elicited by this problem?
- OR
- VII. Choose three students (suggestion: choose one with a high level of readiness, one with a typical level of readiness, and one with a low level of readiness) and create a display of their work on the pre-assessment as a whole. Include a discussion of:
 - The students' level of proportional reasoning as related to the numerical relationships involved, and the contexts of the problems. (e.g. did the student exhibit a level 2 understanding when the numerical relationships involved were all integer relationships and a level 1 understanding when the relationships were non-integral?)
 - How will you address the needs of these three students in your instruction?

Scoring Rubrics:

See Grading above.

Percentage Contribution of Each Assignment:

See Grading above.

Instructional Sequence: - List the course topics for each scheduled class meeting date including readings and assignment due dates.

Session 1: What does it mean to be proportional?

Assignment: Lamon readings, activities, and reflections

Session 2: Proportional Reasoning in Number and Operations

Assignment: Lamon readings, activities, and reflections

Session 3: Proportional Reasoning in Number and Operations (cont)

Assignment: Post, Behr, and Lesh proportionality reading and Clarke, Roche, and Mitchell fraction article, problem solving, and reflection

Session 4: Proportional Reasoning in Geometry

Assignment: Lamon reading, activity, reflections, and problem solving task

Session 5: Proportionality Framework

Assignment: Ercole reading and problem solving

Session 6: Proportionality in Connected Mathematics II

Assignment: Lamon reading and activities

Session 7: Proportionality and its Inverse

Assignment: Search the internet for three sites to be using in the classroom.

Session 8: Using the Internet to Support Proportional Reasoning

Assignment: Final Problem set and activity to complete with students

Session 9: Rates of Change

Assignment: Lamon reading and activity

Session 10: Presentation of final project and review of the final problem set.