



Curriculum Guide

Part of: **Inquiry Science with Dartmouth**

The Number Devil

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Overview

This lesson focuses on incorporating reading, writing, critical thinking, and independence into the math classroom. Students will work in groups to read an assigned chapter from the mathematical fiction book, The Number Devil, by Hans Magnus Enzenberger. Students will then be responsible for the math concepts covered in their assigned chapters, will compose a writing piece detailing the math, and create a technology presentation to share this information with the other students.

Common Core Standards

Reading Common Core Standards

RI 7-8.2: Determine two or more central ideas in a text and analyze their development over the course of the text; provide an objective summary of the text.

RI 7-8.7: Evaluate the advantages and disadvantages of using different mediums (e.g., print or digital text, video, multimedia) to present a particular topic or idea.

RST 6-8.7: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table)

Writing Common Core Standards

W.8.2: Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

The Number Devil is listed in the Common Core, Appendix B; Text Exemplars under grades 6-8 "Information Texts: Science, Mathematics, and Technical Subjects"

Objectives

Through this lesson, students will:

- Independently interpret technical concepts through reading and problem solving
- Logically develop a narrative in their own words to describe the content of their assigned reading
- Improve mathematical communication skills through peer-editing and collaboration
- Relay the content of their chapters through a technology presentation that focuses on interpreting the mathematical concepts in a visual way

Materials

- Copies of *The Number Devil*, by Hans Magnus Enzenberger (enough so that each group has at least one)
- Access to computers
- Attached project worksheet

Preparation

Students should be broken into groups of 2-3 by ability (as much as possible) and assigned a chapter. Groups that are more advanced can be assigned later chapters to challenge them. Below is a chapter guide which gives a difficulty measure on each of the chapters (leaving out some of the last chapters that don't work particularly well for this project).

Chapter	Subject Matter	Difficulty
1	Infinity, Division, Squaring 111...1	Easy
2	Zero, Powers	Easy
3	Prime Numbers	Easy - Medium
4	Rational/Irrational Numbers, Square Roots	Medium
5	Triangle Numbers	Medium
6	Fibonacci Numbers	Medium
7	Pascal's Triangle	Medium
8	Permutations and Combinations	Medium - Hard
9	Sequences and Series	Hard
10	Golden Ratio, more Fibonacci, 2D & 3D shapes	Hard

You will also want to create a timeline for this project. Determine when you want each element of the project to be due, so the students can know this on the first day.

Procedure

1. Place students in their assigned groups. Distribute project sheets and assign the chapters.
2. Go through the project with the students (expectations, due dates)
3. Let students start working in their groups. The goal of this project is to have **as little teaching involvement as possible**. Students should spend some time thinking through, and trying to figure out their chapter. In this project, it is perfectly okay for a student to not understand immediately. Encourage them to create their own examples of a math concept to see if they can understand it better.
4. When checking concept charts as part of #3 on the project sheet, be sure students have identified concepts of "the appropriate size." If concepts are too small, it can be hard to make a writing piece based on them. Similarly if the concepts are too large. At this

point, choose what concepts seem appropriate for the students to compile into a writing piece.

5. When checking student writing as part of #6 you should be very strict. Have the student read their writing out loud. If they have missed a logical step in the explanation, let them know where you are confused. It is best to pretend you have no prior knowledge of the material to truly critique a student's writing and bring their composition closer to mathematical accuracy. **Students should have explanations of their concept in general, not just a string of examples.** This is the hardest part of the assignment. A student may understand the concept for some examples, but has not thought about how they can generalize it to work for others. Their task is to explain how it works without giving specific numbers.

Here are two different examples for Fibonacci Numbers:

What you don't want: You create the Fibonacci numbers by starting with 1,1. Then you add those together to get 2. So you have 1,1,2. Then you add 1 and 2 to get 3. So you have 1,1,2,3. **And so on.** *(The number one tendency of the students is to replace an explanation with "and so on." This should be discouraged.)*

A good example: You create the Fibonacci numbers by starting with 1,1. **In general, to get the next Fibonacci number, you add the previous two Fibonacci numbers together.** *(Here we get the general rule for the Fibonacci numbers!).* To get the number after 1,1 you add $1+1=2$. So we now have 1,1,2. To get the next number you add $1+2=3$. Continue adding the last two numbers to get the newest number in the sequence.

6. Continue critiquing student writing throughout the process. It may be helpful to have students turn in a "Final" draft of the paper that you can look through and give feedback for students to make corrections for a real final draft.
7. As students begin work on the technology projects, discourage them from simply reproducing their written paper into a presentation. Instead, encourage them to **use visuals to help their audience understand the math concepts.**

Assessment

- Grading the written assignment: Focus should be put on whether the student managed to clearly explain the **general rule** of a concept. Following is a suggestion for how points can be distributed: 60% to general rule, 30% to examples, 10% for grammar and conventions.
- Presentations can be graded a number of different ways. One way is to have students grade each other based on how well they understood the material, as well as their opinions on preparation and creativity of the presenter.

Name: _____ Date: _____

The _____ Night

1. Read, with your partner, your assigned night.
2. After your first reading, go back through the text and list all the math concepts that the Number Devil showed to Robert in the table below. Be sure to include the page number they occurred on.

Concept	Page Number

3. Discuss the table from number 2 with one of your teachers.
4. Prior to writing, collaborate with the other members of your group to make sure everyone understands each of the concepts from number 2. Feel free to take notes, do examples, and to work through the math.
5. Individually explain in writing (with complete sentences) each of the concepts you identified in number 2. Where possible, include an explanation of a general rule along with 2-3 examples. Make sure your explanation can be understood by someone who is not familiar with your concept - before proceeding, test your writing out on your groups members to make sure it is understandable.
6. Test out your writing with one of the teachers. Make changes where necessary.

7. Choose one of the main concepts from number 2 (and any concepts you feel are closely related) and write a proposal (using complete sentences) for how your group can present this concept in a creative video or technology presentation. **Your presentation should visually represent the concept you have chosen. Your goal should be to have as few words written words as possible in your presentation.**
8. Show the proposal to one of the teachers for changes and approval.
9. If you are doing a video, develop a script. If you are doing another type of presentation, create an outline for how you will format the work. Your plan should include who is responsible for what in your group.
10. Show your script/plan to one of the teachers for changes and approval.
11. Begin the production of your video/animation/other. **Refer to the presentation checklist for criteria.** Your edited, finished presentation should be no more than three minutes long. When you feel you are halfway through the process of having a complete product, please show it to one of your teachers for input and critique.
12. Finish and finalize the presentation. Show your presentation to your friends and/or family for feedback purposes, especially concerning understanding the math concepts presented. If it seems like they don't understand the concept, consider making modifications to your product.
13. Show your finished product to your teachers for their feedback.
14. Prepare to present to the entire class.

Checklist for Presentation:

- The concept should be clear from the information you provide in your presentation. Using both audio and visual media to reinforce your concept is required.
- For a video, film your project in a good location with adequate lighting and minimal background noises. The actors should not be reading off of scripts in the movie. (i.e. *memorize* your lines)
- Make sure you edit your presentation. Your presentation should flow from beginning to end to keep the interest of the audience. Dead time in the middle of the presentation does not make for a good production. This is also the time to add music, voice-overs, sound effects, transitions, and any text or visual additions you would like to make to your presentation.
- Your presentation must have a title screen and an ending credits page.