

Phantom Tollbooth Prospectus

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Contents:

Overview
Rationale
Objectives
Strategies
Classroom Activities
Standards
Annotated Bibliography
Appendices

Overview

‘Phantom Tollbooth’ is a literacy- based math unit that spans two disciplines: communications and math. The course is based on Norton Juster’s *The Phantom Tollbooth*. The novel seamlessly connects literacy and math. The book is rich with vocabulary, interesting characters and imaginative adventures in the land of robust words and numbers. The unit will focus on the second half of the novel when the main character, Milo, finds himself in Digitopolis, the land of numbers.

The novel touches on a plethora of math concepts including: averages, negative numbers, geometry, infinity, measurement, estimation and data collection. These Students will use a wide range of technology throughout the unit. Online web sources will be utilized as well as computer software programs such as Microsoft Excel and Microsoft Word.

This unit was designed for 4th grade students in the Math department in The Pittsburgh Public Schools gifted education program. The students come to the center once a week. Elementary students choose the two courses they wish to take. This unit would be a part of the first semester course. Each course lasts for two hours a week over a sixteen-week semester.

Rationale

This quote comes from the novel that students will be reading and it sets the framework for the unit.

"Whatever we learn has a purpose and whatever we do affects everything and everyone else, if even in the tiniest way. Why, when a housefly flaps his wings, a breeze goes round the world; when a speck of dust falls to the ground, the entire planet weighs a little more; and when you stamp your foot, the earth moves slightly off its course. Whenever you laugh, gladness spreads like the ripples in a pond; and whenever you're sad, no one anywhere can be really happy. And it's much the same thing with knowledge, for whenever you learn something new; the whole world becomes that much richer." —Norton Juster

Learning something new makes the world richer. Students will learn new math concepts and ideas while reading this novel. This novel is written at a reading level of a middle school student. The unit will address each one of these math concepts with hands on activities that will allow students to apply the knowledge they have gained. These skills are part of the eligible content for fourth, fifth and sixth grade. This unit will extend these concepts and deepen students' understanding. The eligible content areas include: M.A.2, M.A.3, M.B.1, M.B.2, M.C.1, M.D.2, M.E.1 and M.E.4.

In the book, *Integrating Children's Literature and Mathematics into the Classroom* by Michael Schiro, he states that in 1998 The National Teachers of Mathematics declared that one of the major goals of school mathematics should be to increase the amount and quality of children's mathematical communication (Schiro p1). Many teachers have since been motivated to include literary works into their teaching. This unit is a vehicle for facilitating the communication of mathematical ideas. The goal of this unit is to teach mathematics and literature simultaneously.

The students at the gifted center learn through process skills. This unit will address the following process skills: creative thinking, self directed learning, decision making, higher level thinking skills and creative problem solving. Yearly, the staff decides upon two process skills to emphasize. We will be focusing on self-directed learning and decision-making. "Self-Directed Learning" projects allow the students to become independent learners while studying a topic of their choice. This ensures that class time is never wasted, as the students always know what they are to do when they finish regular class work. For this model to be done effectively, the Creative and Higher-level Thinking models must also be used simultaneously. Typically, the Self-Directed Learning model sequence is referred to as "Plan, Action, Result". Decision-making allows students to grapple with the consequences of their decisions. The unit will

incorporate these process skills along with the humanities process skills such as interactive communication and creative writing.

Students will read for a variety of purposes. The novel is rich with word play, puns and double speak. Students will enjoy reading and learning new vocabulary words. Students will gain knowledge of various math concepts and apply them in hands on activities. Students will use technology to research ideas and participate in activities incorporating 21st century learning.

The novel makes an excellent connection between mathematics and literature. For example, one of the characters is a dodecahedron and each of his twelve surfaces is an emotion. He has a smiling face, a frowning face a pouting face and so on. Students will recognize this connection through the reading of the novel and participating in activities. Students will realize that math is part of all we do. This unit will allow students to recognize the role of math in the world and see its connection and application to every day life while obtaining higher-level math skills. The novel will provide students with a meaningful context for learning mathematics. The intent is that students who do not like math or do not feel that they are strong in math will see math in new ways. Students will have the opportunity to get excited about mathematics and enjoy it.

Objectives

By the end of this course students will be able to:

- Write higher-level questions in regards to a road map using scale, compass, and key.
- Explain what a Platonic solid is by creating nets and explaining each attribute. Students will create a dodecahedron using various materials.
- Add and subtract negative numbers.
- Explore and interpret averages through a hyperbook activity.
- Explore the idea of infinity and discuss very large and very small numbers.
- Collect and analyze data though a census activity.

- Use and explain measurement terms such as rod, miles and yard. Students will measure objects using these units and make comparisons using a Venn diagram.
- Practice estimating using Fermi questions and Internet research.
- Reflect in a math journal about the characters and concepts they met in Digitopolis.
- Create a Math Wizard Game board using math concepts taught in the course.

Strategies

Students will work often in cooperative groups. This group work will be modeled and explained for successful group activities. Students will use turn and talk, think pair share and small groups to complete activities. Cooperative group work allows students to learn how to work with others. They will learn how to discuss ideas and share thoughts in a safe, meaningful, productive way.

Teacher and students will use a variety of technology throughout the unit. Projector, computer and Smart Board will be used in most lessons. Students will participate in PowerPoint activities and hyperbook activities. Students will use the Internet for research. Technology use supports 21st Century learning and provides students with the opportunity to infuse these skills into their learning.

Hands on activities such as measuring objects, building geometric figures and card games will be utilized throughout the unit. See classroom activities for specific details of these.

Students will participate in activities that will address different modalities and learning styles so that all students' needs will be addressed. For example, kinesthetic learners will be successful because there will be activities that will involve hands on manipulating of shapes.

Students will keep reflective journals to keep track of their thoughts, ideas and important concepts they have learned while reading. These ideas will be charted as a "noticings and wonderings time" at the end of each lesson. This will be done so students can share their thoughts with the learning community.

Modeling and scaffolding will take place throughout the unit. Students will benefit from teacher- and -student modeling and appropriate scaffolding will take place based on individual needs.

Questioning the Author discussions, a district standard, will take place after each chapter to ensure students understand the text.

Accountable Talk will be the center of discussions about the novel, activities and concepts being learned throughout the course. In the Accountable Talk class discussion model, the students are able to discuss a topic around what they are reading and studying; that may be selected by the teacher, but the students are carrying on the discussion with minimal interference from the teacher. She or he is merely acting as a facilitator and not really leading the discussion.

Vocabulary discussions will take place to ensure that all students understand the rich text and play on words that are present in the novel. Students will receive vocabulary lists that will enable them to keep track of the robust vocabulary words they learn.

Proposed Classroom Activities

Pre- Activities

Students will have read the book prior to these activities or they can be organized by chapter. A reference will be given to chapter numbers where possible.

To activate prior knowledge, have students share road trip stories. Have them share stories where they may have had an adventure or met new and different people.

Have students think about a time when they were bored. Brainstorm ideas/activities to change the bored feelings. What can you do when you are bored? Have students complete a journal entry responding to a prompt such as: describe a time that you were bored? What did you do to get out of the doldrums? What are some of your favorite activities to do when you are bored?

Go over vocabulary words with students that they will read in the book. You can do this chapter by chapter or by section. The novel is rich in vocabulary; make sure you utilize the opportunity to discuss new words. A sample list of words and vocabulary activities can be found in **Appendix 1 and 2**. These activities will ensure that the new vocabulary is addressed.

Lesson 1: Map Making (Appendix 3)

Objective: Write higher-level questions in regards to a road map using scale, compass, and key.

For this lesson students will be given a roadmap of Milo's adventures. They will create a scale and key. They will create questions with a partner as to where locations are on the map. Students will exchange questions to solve. This lesson can be done at any time after the first few chapters are read.

Lesson 2: Measurement

Objective: Use and explain measurement terms such as rod, miles and yard. Students will measure objects using these units and make comparisons using a Venn diagram.

At the beginning of chapter 14, there is a sign giving distances to Digitopolis in miles, rods, yards, feet, inches and half inches. For this lesson students will learn about rod, mile, yard and inches. Students will practice measuring items in the classroom using these units.

Ask students: How long is a rod? Figure out from the other units and measure it. You can do a Google search if students are having a hard time.

Make a similar table using metric distances (kilometers, decimeters, centimeters, etc). Compare and contrast the numbers on the two tables.

Measure other objects using more than one unit. You can use nonstandard units such as toothpicks, body measures (hand span).

Extend to area or volume/capacity (how many Tic Tacs will fit in a Dixie cup, etc)

Lesson 3: Geometry

Objectives: Explain what a Platonic solid is by creating nets and explaining each attribute.

Students will create a dodecahedron using various materials.

Milo and his friends meet the dodecahedron in chapter 14. This lesson will focus on Platonic solids. Students will participate in a PowerPoint activity on Platonic solids. Students will then work in groups with provided nets that they will construct (**Appendix 4**).

Students will be asked questions such as: Suppose you were a tiny bug living on a dodecahedron. Could you take a walk along the edges that starts at a vertex, visits all vertices, and returns to the starting place? Such a walk is called a Hamiltonian Circuit. Can you find Hamiltonian Circuits on cubes and other polyhedra? How many colors do you need in order to color the faces of your dodecahedron so that pairs of faces that meet at edges are colored with different colors?

The students will then be given various materials to construct a 3D dodecahedron. Students will build the dodecahedron out of polyhedron kits such as ZomeTools. The class will chart their experience with the activity as a community on the noticings and wonderings chart to close the lesson.

Lesson 4: Estimation

Objective: Practice estimating using Fermi questions and Internet research. Explore the idea of infinity and discuss very large and very small numbers.

The Mathemagician claims that he has 4,827,659 hairs on his head in chapter 14. Students will practice estimating hairs on their head. They will figure out a strategy for estimating this.

Ask students: Is it plausible for a person to have this number of hairs on his/her head? Or is the number too small or too high?

The physicist Enrico Fermi used to like to give estimation questions that seemed impossible on first glance, but with some thought could yield a very good estimate.

Ask students questions that will yield discussion of big numbers and good estimates. Ex: How long would it take to count to a million? a billion? How many minutes have you been alive?

Have students create Fermi questions for each other to solve using the website <http://mathforum.org/workshops/sum96/interdisc/sheila1.html>

Lesson 5: Infinity

Objective: Explore the idea of infinity and discuss very large and very small numbers.

In chapter 15, Milo wants to know the greatest number and the Mathmagician shows him that no matter what number he thinks of, there is always a bigger number.

Students will discuss infinity. In partnerships students will practice creating very large numbers by trying to create a larger number than their partner created and again with the smallest number. They will chart their discoveries through this exploration. Students will experiment with operations and strategies to complete this task. They may use calculators and number lines to complete this activity.

We will discuss fractions and Zeno's Paradoxes and infinite sets through the use of the website <http://mathforum.org/isaac/problems/zeno1.html>

To investigate small numbers we will investigate fractals. Fractals are one of the newest math topics out there, with lots of wonderful graphics and some topics (often involving concepts of infinity) that are accessible to elementary and middle school students. We will use the following site, which is especially aimed at elementary and middle grades teachers. <http://math.rice.edu/~lanius/frac/>

Lesson 6: Positive and Negative Numbers

Objective: Add and subtract negative numbers.

In Digitopolis, people start out full and eat to get hungrier. Then, as they digest their food, they become full again. Eating here can represent a model of addition and subtraction of negative numbers. Being full represents the positive direction and being hungry represents the negative direction, eating corresponds to adding negative numbers; digesting corresponds to subtracting negative numbers. Subtracting negative numbers moves one in the positive direction.

Students will learn about positive and negative numbers using the number line. The “rules” of adding, subtracting, multiplying and dividing negative numbers will be discussed.

The concept of subtracting negative numbers can be further conceptualized through the use of thermometers and credits and debits.

Students will then apply their knowledge by playing a card game called 25 with a partner where red cards are negative and black cards are positive. A regular card deck can be used. Arrange students into groups of two. Have students deal out as many cards as possible from a deck of cards, so that each student has an equal number of cards. Put aside any extra cards.

Explain to students that every black card in their pile represents a positive number. Every red card represents a negative number. In other words a black seven is worth +7 (seven), a red three is worth -3 (negative 3). At the start of the game, have each player place his or her cards in a stack, face down. Then ask the player to the right of the dealer to turn up one card and say the number on the card.

For example, if the player turns up a black eight, he or she says “8”.

Continue from one player to the next in a clockwise direction. The second player turns up a card, adds it to the first card, and says the sum of the two cards aloud.

For example, if the card is a red 9, which has a value of -9 , the player says “ $8 + (-9) = (-1)$ ”

The next player takes the top card from his or her pile, adds it to the first two cards, and says the sum.

For example, if the card is a black 2, which has a value of $+2$, the player says “ $(-1) + 2 = 1.$ ”

The game continues until someone shows a card that, when added to the stack, results in a sum of exactly 25.

Lesson 7: Averages

Objective: Explore and interpret averages through a hyperbook activity. Students will meet the character .58 boy in chapter 16. We will discuss averages. Students will partner up and complete a hyperbook (**Appendix 5**) to explore and investigate averages. The hyperbook will take them to

the Internet to analyze a U.S. Census. The activity will incorporate an activity from NCTM within the hyperbook. Students will work together to complete the activity.

Lesson 8: Collecting and Analyzing Data

Objective: Interpret and analyze data for a variety of purposes such as: decision making, summarizing and finding patterns. Students will meet the Senses Taker in the novel and will create their own census questions in a group of 4. Students (in partnerships) will use Survey Monkey (an online free software that allows one to create and post a survey and collect responses) to create a survey for their classmates to take. After the results are collected each group will analyze their responses and will share their results with the class through a presentation. This activity will afford students the opportunity to be a part of data collection from start to finish.

Lesson 9: Festival of Knowledge

Objective: Celebrate the accomplishments of students throughout the unit.

Students will have a culminating activity that will happen an evening after the unit has been completed. This will be a parent night that will “show off” student work and their accomplishments. (**Appendix 6**)

Students will create artwork to display such as: a tollbooth that is at the entry point of the classroom, Tollbooth board games, wall murals, and so on.

Events which include: spelling bees, math competitions, festival of food, photography opportunities and green screen video tapings will be planned for the event. Students who participate will be presented with “scrolls of wisdom”.

Standards

There are eight categories from which Communication standards are derived. The numerical listing is the category and the italicized list is a description of the skill sets within the category. These skill sets are expounded upon in great detail and are sequentially based on grade level. The details are known as Eligible Content. The following communications and math standards will be met in this unit.

Learning to Read Independently

Purposes for Reading
Word Recognition Skills
Vocabulary Development
Comprehension and Interpretation

Third Grade

Use knowledge of phonics, word analysis (e.g., root words, prefixes and suffixes), syllabication, picture and context clues to decode and understand new words during reading.

Reading Critically in All Content Areas

Detail
Inferences
Fact from opinion
Comparison
Analysis and Evaluation

Reading, Analyzing and Interpreting Literature

Literary Elements
Literary Devices

Speaking and Listening

Listening Skills
Speaking Skills
Discussion
Presentation

Characteristics and Function of the English Language

Word Origins
Variations
Application

Research

Selection

*Location of Information
Organization*

State Math Standards

Third Grade

Numbers, Number Systems and Number Relationships

*Types of numbers (e.g., whole, prime, irrational, complex)
Equivalent forms (e.g. fractions, decimals, percents)*

Computation and Estimation

*Basic functions (+, -, \times , \div)
Reasonableness of answers
Calculators*

Measurement and Estimation

*Types of measurement (e.g., length, time)
Units and tools of measurement
Computing and comparing measurements*

Third Grade

*Estimate and verify measurements.
Demonstrate that a single object has different attributes that can be measured in different ways (e.g. length, mass, weight, time, area, temperature, capacity, perimeter).*

Mathematical Reasoning and Connections

*Using inductive and deductive reasoning
Validating arguments (e.g., if . . . then statements, proofs)*

Mathematical Problem Solving and Communication

*Problem solving strategies
Representing problems in various ways
Interpreting results*

Statistics and Data Analysis

*Collecting and reporting data (e.g., charts, graphs)
Analyzing data*

Probability and Predictions

Validity of data

Calculating probability to make predictions

Algebra and Functions

Equations

Patterns and functions

Geometry

Shapes and their properties

Using geometric principles to solve problems

Name and label geometric shapes in two and three dimensions (e.g., circle/sphere, square/cube, triangle/pyramid, rectangle/prism).

Find and describe geometric figures in real life.

Annotated Bibliography

Books for Teachers

Bulloch, Kathleen. *A Guide for Using The Phantom Tollbooth in the Classroom*. California: Teacher Created Resources, 1994.

Resources for teachers of activities that go with the novel.

Fogelberg, Ellen Carole Skalinder, Patti Satz, and Barbara Hiller. *Integrating Literacy and Math: Strategies for K-6 Teachers (Tools for Teaching Literacy)*. New York: Guilford Press, 2008

Shows connections to literacy and math.

Hancewicz Euthecia. Loretta Heuer, Diana Metsisto, and Cynthia L. Tuttle *Literacy Strategies for Improving Mathematics Instruction*. Virginia: ASCD, 2005.

Describes common ways in which students misinterpret the language of mathematics.

Schiro, Michael *Integrating Children's Literature and Mathematics in the Classroom: Children As Meaning Makers, Problem Solvers, and Literary Critics*. New York: Teacher's College Press, 1997

Discusses the philosophical and pedagogical assumptions underlying the movement to integrate the teaching of mathematics and children's literature.

Books for Students

Juster, Norton *The Dot and the Line*. New York: Random House, 1963.

Allows students an introduction to Norton Juster and literacy in mathematics.

Juster, Norton *The Phantom Tollbooth*. New York: Random House, 1961.

The novel that is the basis for the unit

Websites:

<http://illuminations.nctm.org/Standards.aspx>

NCTM Math standards

<http://mathforum.org/workshops/sum96/interdisc/sheila1.html>

<http://mathforum.org/isaac/problems/zeno1.html>

Math Forum

<http://www.surveymonkey.com>

Survey website

Vocabulary Lists

On this page are vocabulary lists which correspond to each sectional grouping of chapters, as outlined in the Table of Contents (page 2). Vocabulary activity ideas can be found on page 9 of this book. Because of the rich vocabulary experience offered in *The Phantom Tollbooth*, it is highly recommended that a significant amount of time be devoted to vocabulary and discussions about figurative language.

Section 1 (Chapters 1-4)

speculate	monotonous	disdain	reticence	infuriate
indignantly	tollbooth	precaution	lethargy	procrastinate
cartographer	ordinance	conciliatory	destination	flabbergast
unethical	dawdle	principality	balderdash	quagmire
surmise	loiter	presume	disrepute	proclamation
minstrels	misapprehension	tumult	bunting	palatinate

Section 2 (Chapters 5-8)

suspicious	brevity	wreaking	corrupts	havoc
miserly	macabre	barren	flickering	dank
domain	presumption	vaulted	prosperous	commendable
animosity	contemplating	provision	controversies	reconcile
arbitration	ominously	agitated	superfluous	conveyance
brougham	shandrydan	charabanc	signet	rigmarole
ragamuffin	indigestion	harrowing	chasms	crag

Section 3 (Chapters 9-12)

lure	promontory	magenta	contradict	chartreuse
inconvenient	illuminated	complicated	apothecary	cascade
deficiency	metropolis	exasperated	illusion	concocting
mirage	din	shaft	pandemonium	profusion
laudable	podium	disconsolate	gaunt	consensus
inquisitively	banished	constellations	interlude	pigment
crestfallen	spectrum	accurate	poised	dissonance

Section 4 (Chapters 13-16)

ominous	nuisance	console	vigorously	buffing
knickers	infinity	strenuous	caldrion	billowy
savory	pungent	beret	logical	admonishing
famine	grimace	theatrical	accustomed	magnitude
stalactites	precise	honeycombed	distinction	daintily
complex	imaginary	convincingly	melancholy	intimidated
banished	pining	brandishing	furrow	interpret

Section 5 (Chapters 17-20)

indignantly	silhouettes	villainous	frock	ogre
ledger	punctuated	plunged	deliberation	murky
loathsome	precariously	destination	ovation	gnarled
plateau	compromise	lurch	invariably	calloused
bulbous	unkempt	grotesque	colossal	hideous
conspicuous	pathetic	gelatinous	proclamation	desperately
pavilions	assumption	desolate	lumbered	intruders

Vocabulary Activity Ideas

Each section contains several vocabulary words. You may wish to divide these words and assign them to small groups of students. The groups may define the words, find them in the context of the book, and present the information to the class to record in a vocabulary notebook.

You can help your students learn and retain the vocabulary in *The Phantom Tollbooth* by providing them with interesting vocabulary activities. Here are some ideas to try:

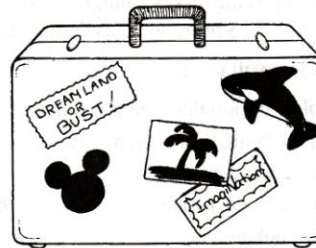
- ❑ Encourage students to make their own **Crossword or Wordsearch Puzzles** using the vocabulary words from the novel.
- ❑ Challenge your students to a **Vocabulary Bee**. This is similar to a spelling bee, but in addition to spelling each word correctly, the game participants must correctly define the words.
- ❑ Play **Vocabulary Concentration**. The goal of this game is to match vocabulary words with their definitions. Divide the class into groups of 2-5 students. Have students make two sets of cards the same size and color. On one set have them write the vocabulary words. On the second set have them write the definitions. All cards are mixed together and placed face down on a table. A player picks two cards. If the player matches the word with its definition, the player keeps the cards and takes another turn. If the cards don't match, they are returned to their places face down on the table, and another player takes a turn. Players must concentrate to remember the locations of words and definitions. The game continues until all matches have been made. This is an ideal activity for free exploration time.
- ❑ Have your students practice their writing skills by creating sentences and paragraphs in which multiple vocabulary words are used correctly. Ask them to share their **Vocabulary Sentences and Paragraphs** with the class.
- ❑ Challenge your students to use a specific vocabulary word from the story at least **10 Times in One Day!** They must keep a record of when, how, and why the word was used.
- ❑ As a group activity, have students work together to create an **Illustrated Dictionary** of vocabulary words.
- ❑ Play **20 Clues** with the entire class. In this game, one student selects a vocabulary word and gives clues about this word, one by one, until someone in the class guesses the word.
- ❑ Play **Vocabulary Charades**. In this game, vocabulary words are acted out.

You probably have many more ideas to add to this list. Try them. See if experiencing vocabulary on a personal level increases your students' vocabulary interest and retention!

Beyond the Phantom Tollbooth

In the beginning of *The Phantom Tollbooth*, Milo was given a road map, a book of rules and regulations, and assorted coins for his journey. Have your students divide into groups. Their challenge is to plan a trip. In preparing their plans, students should note the following:

- destination (real or imaginary)
- length of trip
- mode of transportation
- what to pack in suitcase
- climate of destination
- currency used
- language spoken
- what sights they can expect to see



Have a spokesman for each group present the plans to the whole class. Students may choose to present the information as an advertisement for a travel agency.

As an extended activity, encourage students to create murals that depict their destinations. Use long strips of butcher paper attached to walls to create the mural backgrounds. Crayons, paints, markers, or colored paper cut-outs can be used to add details to each mural.



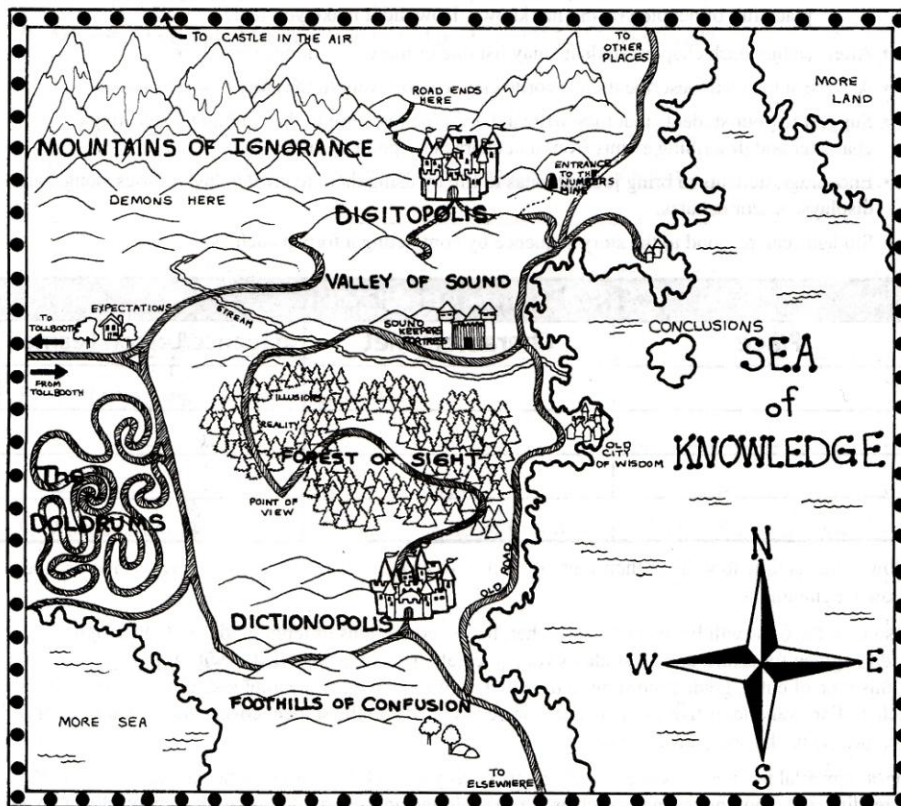
Where in the World Is Milo?

Below is the road map Milo was given for his adventures through The Lands Beyond. Have students divide into pairs or groups and write six to eight questions concerning locations on the map.

Examples:

1. What direction do you travel to get to Digitopolis from the Valley of Sound?
2. If you are in the Doldrums, which is closer, the city of Dictionopolis or the Sea of Knowledge?
3. If you are in the Foothills of Confusion, what direction must you travel to get to the Island of Conclusions?

Extension Activity: Use an overhead projector to enlarge the map to the size of a bulletin board. Students can color in map sections and record Milo's progress as he journeys.



Platonic Solids Group Directions

- ❖ Working in your group, together you will build each platonic shape. Each group will build one of each shape. MANAGER will assign each person a net. You may color the shapes with any art supply you chose. You should color your net before you cut and build. You may use glue or scissors.
- ❖ Once the shapes are built, you will fill out the Polyhedra worksheet. RECORDER will fill out this sheet of paper.
- ❖ On a separate sheet of paper, you will answer the following questions: RECORDER & SKEPTIC
 - Suppose you are a tiny bug living on a dodecahedron. Could you take a walk along the edges that starts at a vertex, visits all vertices, and returns to the starting place? Such a walk is called a Hamiltonian Circuit.
 - How many colors do you need in order to color the faces of your dodecahedron so that pairs of faces that meet at edges are colored with different colors?
- ❖ Once you have completed the solids, filled out the worksheet and answered the questions attach the answer sheets together. Make sure all of your names are on the papers. RECORDER WILL ENSURE THIS.
- ❖ Using the supplies given to you, each person will build a dodecahedron. You can work together, but each of you will make your own solid. If you do not finish it, you can take the supplies home to finish it.

Net of Tetrahedron

Polyhedra

Name: _____

There are five regular polyhedra. A regular polyhedron has regular polygons for faces and the same number of faces at each vertex.

Using the materials provided, make the five regular polyhedra. You'll need the following:

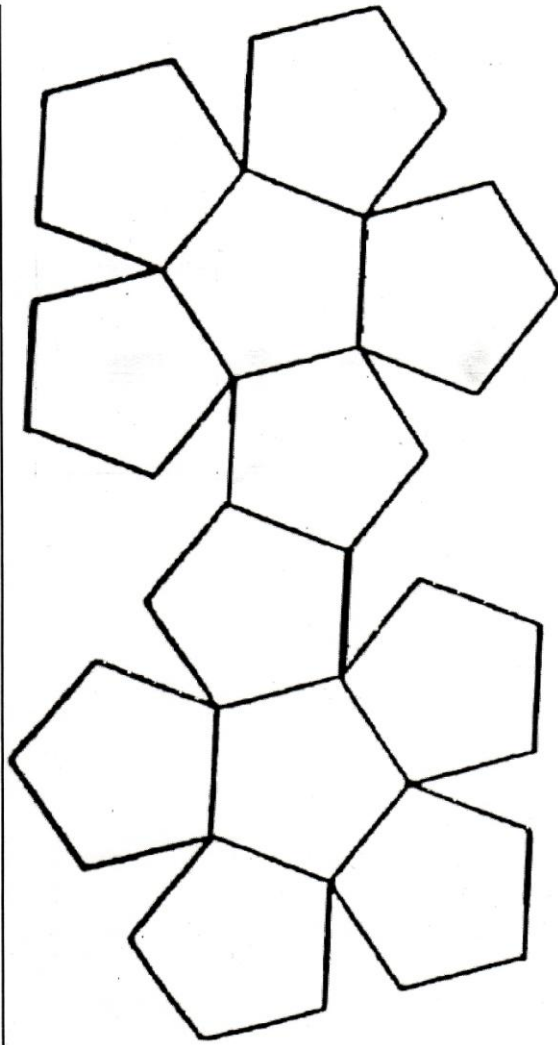
- ▶ 4 equilateral triangles for a tetrahedron
- ▶ 6 squares for a hexahedron
- ▶ 8 equilateral triangles for an octahedron
- ▶ 12 regular pentagons for a dodecahedron
- ▶ 20 equilateral triangles for an icosahedron

Complete the chart below for five regular polyhedra. Look for a pattern!

	Number of Faces	Number of Vertices	Sum of the number of faces & vertices	Number of Edges
Tetrahedron				
Hexahedron				
Octahedron				
Dodecahedron				
Icosahedron				

Look carefully at the chart you've just completed. You should be able to find a pattern: the sum of F and V is always _____ more than E or, $F + V =$ _____. This formula is called Euler's formula because the mathematician Leonard Euler developed it.

Net of Dodecahedron



Averages

A Phantom Tollbooth Hyperbook

Names:

Day

Objective:

- ✚ Students will explore and interpret the concept of averages by completing the Hyperbook with a partner

Directions:

- ✚ Work with your partner to answer each question
- ✚ You may use a calculator
- ✚ You may use the book as well.
- ✚ A response is required wherever you see a gray box. Simply click in it and type your answer.
- ✚ Follow the links to outside web sources to complete each activity.
- ✚ Directions will be provided for each section.
- ✚ Stop protection under “tools” to access the links
- ✚ To continue filling in the form, choose protect document under “tools”
- ✚

In *The Phantom Tollbooth*, 0.58 of a child tells Milo that being a fraction of a person is really quite lucky. He says, “Every average family has 2.58 children, so I always have someone to play with.”

Can it be?

1. Explain what it means to have an average of 2.58 children in each family. Why is this average not necessarily a whole number?
2. Milo also learns how useful averages can be: “For instance, if you didn’t have any money at all, but you happened to be with four other people who had ten dollars apiece, then you’d each have a mean average of eight dollars.” Can it be? Explain.

3. Where else are averages used in everyday life? Look in the Post Gazette (follow the link below) for any mention of an average. Describe what the average means in that situation. <http://www.postgazette.com/>

4. Compare the information that the novel gives us about average family size (2.58).
What is the difference between “average per family” and “average per family with children?” Which states have significantly lower or higher numbers of children per family? What might explain these differences?
Use the following link to see current U.S. information.
<http://www.census.gov/population/socdemo/hh-fam/tabST-F1-2000.pdf>

5. What kinds of families might not be correctly counted in the U.S. census?
Is the real number of children per family likely to be higher or lower than the official number?

Find the average (mean) for you and your partner for each of the following examples.

Letters in name
Person A
Person B
Mean

Pulse (count your pulse for 60 seconds)
Person A
Person B
Mean

Number of people in your family
Person A
Person B
Mean

Go to the following web site and read the information on batting averages for the game of baseball. After you read the information click on [Click Here to Figure Some Averages.](#)

<http://web.buddyproject.org/web012/web012/averages.htm>

Festival of Knowledge

Celebrate the completion of reading *The Phantom Tollbooth*, as well as the knowledge you have gained, with a Festival of Knowledge in honor of the occasion. (You may choose to incorporate the festival with your school's Open House event.) Small groups may be organized to assist with the planning. The Brainstorming Sheet on page 40 may be used. Here are some ideas for projects, displays, and events for your Festival of Knowledge:

Projects and Displays

Designate areas in the classroom to be Dictionopolis, Digitopolis, City of Wisdom, etc. In each area display reading, math, or book reports. Encourage parents to tour through the "Phantom Classroom Lands!"

- Design a Tollbooth around the classroom door entrance. (See pattern idea on page 39.)
- Display pictures of characters from the book.
- Make letter-and number-shaped sugar cookies for refreshments.
- Create bulletin board and displays for students' work and projects done in this literature unit. (This includes projects on pages: 11, 16, 23, 31, 33).
- Display classroom diaries and research work.
- Let students design a Phantom Tollbooth board game.
- Have students make a wall mural of the map of The Lands Beyond. (See pattern on page 13.)
- Take photographs at the Festival of Knowledge. Make a scrapbook, including sample projects.
- Make marketplace booths to display student work, sell alphabet-shaped cookies, and alphabet posters, etc. Empty appliance boxes work well.

Events

- Have a spelling bee.
- Perform skits.
- Host a royal banquet (*refreshments*).
- Make banners.
- Write songs.
- Recite epic poems.
- Give speeches.
- Conduct math tournaments.
- Hold a reading tournament.
- Present scrolls of wisdom.
- Challenge student teams to find verbs, idioms, etc. in the book.
- Read portions of the book aloud. Each time student hears idiom, he/she claps hand.

