Sample Discovery Mission and Quests

Although a comprehensive curriculum is always a work in progress, this section provides an early sample of two Discovery Missions. Both samples demonstrate the model's potential to support state standards within a gamelike framework.

Box 11

Grade 6	**Trimester 2: Making Connections**	
	Essential Questions How do the relationships between elements in a system bring change to that system?	
	Quest: Creating Character Maps	**Domain:** Being, Space, and Place (ELA/social studies)
	Length: Three weeks	
Quest Overview (written to the student)	In our current Mission about the elements of a story, our storyteller, Calla, has lost her point of view. You discovered this when while reading on of her short stories, "The Lost Ring of Zara." The story began OK, but you noticed by the second chapter that her characters' point of view suddenly disappeared. Without	

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	a point of view, Calla is having trouble inventing her characters and knowing just what they need to do next in the story. The characters are running amok, and she has almost given up! As writers, you've worked hard to understand what a point of view is, how individual points of view are developed, how point of view acts as one component in the system of a story, and why point of view is important. This week you will take another step toward assisting Calla by helping her better understand what part of her story system might be broken.
Quest Brief (written to the student) **Length:** One and a half weeks	Continuing to work toward your goal of helping Calla find her point of view, in this Quest you will choose a character from one of the two short stories we have already read, "Baseball in April" by Gary Soto and "The House on Mango Street" by Sandra Cisneros, and create a concept map of one character's point of view. This map will show how point of view is a system whose components work together in a story to help define a character. Remember to include all of the system components that make up a point of view. These components are outlined in the rubric we have been working with and include the voice the character speaks in (first person, second person, or third person), style of speaking (formal or informal, for example), perspective (how they think about the world), character background (events that have shaped their point of view), and consistency (Does the character's point of view create a reliable account of what is going on?). Use your concept-mapping skills to show connections between the different components. Once you have a model for your map, use one of the digital authoring tools we've been working with this year to translate your map into an interactive format to make the system's relationships come alive. Be very deliberate in your choice of technology, phrasing, content, and organization because these maps will be used later to illustrate your evidence of how Calla lost her perspective and where it might be found.

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	As you build your theory around Calla's lost point of view and move toward completing this Discovery Mission's final goal, remember that writers have goals for the stories they want to tell. Make sure your map tells the story and that your goal is clear. Use your revising skills to refine your ideas: share your map online with friends, play-test other students' maps, talk to your Digital Youth Network mentors. Collect all of the feedback and use it to iterate your map. We will be sharing the maps at the end of the week on the Digital Youth Network site. Good luck with the Quest!
Performance Assessment Task	Create an interactive concept map of a character's point of view, showing how it works as a system of elements.
Essential Question	How does a change in point of view affect other elements in a story?
Enduring Understandings	A story is dependent on transactions between the narrator, readers, and text—what can be seen, known, felt, and understood. Understanding point of view is a key reading strategy for interpreting text.
Content Knowledge	▪ Elements of a story: plot, character, setting, description, conflict ▪ Point of view ▪ Short story form
Major Skills	▪ Reading for understanding ▪ Finding the big idea ▪ Paragraph writing ▪ Identifying themes ▪ Concept mapping ▪ Authoring ▪ Identifying point of view
Differentiation (for use by teacher)	**Individual goals and rewards:** The teacher will develop individual goals with each student for their research. As an incentive, when students achieve the goal, they will get the "reward" of being given a piece of information that students need or give students access to an expert they can pose questions to.

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	Level of readings: The teacher will provide a variety of texts at multiple reading levels so that all students are challenged and supported in their own ways. Variation in activities: The unit is filled with activities that enact a variety of learning styles and intelligences. Students will engage in creative, academic, and analytical activities. They will be writing, speaking, and working individually and in groups. The variation in activity allows for all students to experience moments of success and challenge.
Standards (for use by teacher)	**ELA** Standard 1: Students will read, write, listen, and speak for information and understanding. Standard 2: Students will read, write, listen, and speak for literary response and expression. Standard 3: Students will read, write, listen, and speak for critical analysis and evaluation. **Social Studies** Standard 2: Students will use a variety of intellectual skills to demonstrate their understanding of major ideas, eras, themes, developments, and turning points in world history and examine the broad sweep of history from a variety of perspectives. **Applied Learning** A1: Problem solving A2: Communication tools and techniques A3a: Information tools and techniques A3b: Use information technology to assist in gathering, organizing, and presenting information. A4: Learning and self-management tools and techniques
Additional Resources + Digital Tools	Part of becoming an expert Quester means learning to use the resources that are available to you outside this class. Is there an XPod you are taking this week, such as Anime Book Club or Science Explorers, that might help you create your maps? Home Base is another resource you might use. Is there a question you might pose to your mentor or group during your meeting

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	that will help you think through a problem you are struggling with? **Platforms and Tools:** Stella Omni Graffle MindMapper Nova Mind PhotoShop Flash Pages

Box 12

Grade 12	**Trimester 1: Empowering Communities of Change** **Essential Questions** *In what ways does the representation of a dynamic system affect our understandings and beliefs about that system?*	
	Mission: Decision Making in a Democracy Length: Six weeks	**Domain:** Codeworlds (math/ELA)
Quest Overview	The power to elect officials is the power to change the world, but the mathematics of voting extends far beyond the notion of majority rule. As a member of a new grassroots group with a mandate to educate young people about the inner workings of the election process, your mission is to use mathematical models and digital simulations to represent this complex process to others. You must first learn what assumptions they hold about how the election system works: The candidate with the most votes wins an election, for example. It is your job to develop a persuasive mathematical model to show that the whole story has as much to do with voting methods as with voting numbers. This Math Mission challenges you to grapple with complex questions that are a very real	

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	part of our political system, through both mathematical modeling and historical analysis of past elections. (Adapted from the COMAP's Mathematics: Modeling Our World curriculum [Author Date].)
Quest Brief Length: three weeks	The Mathematics of Presidential Elections Number notions underlying the election of the president of the United States can be the source of many "what if" questions. Winning and losing outcomes invariably rest on a straightforward application of the counting process and resulting number comparisons. At first glance, such applications may suggest a simple procedure, but further reflection shows that this simplicity feature fades away. Is it the popular vote that elects the president, or does some other counting scheme apply? What if no candidate receives a majority of the electoral votes cast? Who makes the decision if certain vote totals are in doubt?
Performance Assessment Task	Build a mathematically accurate prediction engine for a hypothetical election.
Essential Question	What is an effective election process?
Enduring Understandings	▪ Modeling depends on the quality of the measurements collected. ▪ There is value in verifying that mathematical and statistical models make sense both mathematically and contextually. ▪ Systems have dynamics: there are multiple relationships within a system.
Content Knowledge	▪ Structure of U.S. election process ▪ Advanced algebra ▪ Introduction to mathematical modeling in the context of elections ▪ Feedback loops ▪ Algorithmic modeling
Major Skills	▪ Mathematical modeling ▪ Analytical reasoning

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	▪ Number sense and percentages ▪ Understanding of new representations, including preference diagrams and digraphs, and current election-reform topics such as instant runoffs and approval voting; ▪ Ability to use online models and simulations to conduct students' own elections and explore "what if" questions with election data.
Differentiation	**Varied levels:** Students select approach to modeling based on interest, and readings can vary depending on readiness; students offer multiple forms of presentation of final models. **Individual goals and rewards:** The teacher will develop individual goals with each student for his or her research. **Varied outcomes:** Variation in complexity of models that students can produce based on readiness.
Standards	**Mathematics, Science, and Technology** Standard 1: Students will use mathematical analysis, scientific inquiry, and engineering design, as appropriate, to pose questions, seek answers, and develop solutions. Standard 2: Students will access, generate, process, and transfer information using appropriate technologies. Standard 3: Students will understand mathematics and become mathematically confident by communicating and reasoning mathematically, by applying mathematics in real-world settings, and by solving problems through the integrated study of number systems, geometry, algebra, data analysis, probability, and trigonometry. Standard 5: Students will apply technological knowledge and skills to design, construct, use, and evaluate products and systems to satisfy human and environmental needs.

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	Standard 7: Students will apply the knowledge and thinking skills of mathematics, science, and technology to address real-life problems and make informed decisions. **Social Studies** Standard 5: Students will apply knowledge in civics, citizenship, and government. **Applied Learning** A1a: Design a product, service or system; identify needs that can be met by new products, services, or systems; and create solutions for meeting them. A1b: Improve a system; develop an understanding of the way systems of people, machines, and processes work; troubleshoot problems in their operation; and devise strategies for improving their effectiveness. A3a: Gather information to assist in completing project work. A3b. Use online resources to exchange information for specific purposes. A4a. Learn from models. A4c. Evaluate one's performance.
Additional Resources + Digital Tools	Multiple resources are available to assist students. The National Election Data Archive and Google's Election Maps Gallery provide sample models. COMAP's Election Machine can help students test their models. Students can use the open framework library of statistical models they built earlier in the year, which contains modules that will assist them in doing calculations. Questions can be posed on the class list-serve. Online mentors are available to work with students through Digital Youth Network Mentors. A class Web page will contain links to all resources.

Sample Sixth-Grade Mission: The Ways Things Work (Math/Science)

Mission Parameters

Mission Title Invisible Pathways
Length 10 weeks
Background to Mission Invisible Pathways follows a 10-week Mission focused on simple machines, which centers on the essential question, "What are the qualities and elements of a system?" and introduces students to science and math-based methods of building simple machines. In this second-trimester Mission, students build on knowledge from the simple-machine unit and apply these understandings to a study of light and matter. The essential question is, "How do the relationships between elements in a system create a dynamic?"
Unit Summary This Mission casts students in the role of scientists and communication specialists tasked with the job of revealing a message hidden in a beam of light. They will study the interactions of light and matter (refraction, absorption, scattering, and reflection), using digital cameras to document the results. They will use a three-dimensional simulation to model the movement of light through space, applying understandings gained through direct observation in the real world to a virtual representation. They will do data analysis to understand the colors of light and study the eye as an optical device. Throughout the Mission, students will use the scientific method to propose and test theories, observe and gather evidence of outcomes, and apply this understanding to the development of new theories. The Mission will culminate in a scientific challenge requiring students

to collaborate in small teams: to construct a pathway for a beam of light to travel to a target, changing direction a minimum of five times. The resulting pathway will require students to apply their understanding of the different ways light interacts with different materials, how it is filtered, strengthened, and changed.

Box 13

STAGE 1: DESIRED RESULTS

Established Goals

New York State Learning Standards for Math, Science, and Technology:

- Students will use mathematical analysis, scientific inquiry, and engineering design, as appropriate, to pose questions, seek answers, and develop solutions.
- Students will access, generate, process, and transfer information using appropriate technologies.
- Students will understand mathematics and become mathematically confident by communicating and reasoning mathematically, by applying mathematics in real-world settings, and by solving problems through the integrated study of number systems, geometry, algebra, data analysis, probability, and trigonometry.
- Students will apply the knowledge and thinking skills of mathematics, science, and technology to address real-life problems and make informed decisions.

Enduring Understandings

Students will understand that

- The interaction of elements (light and matter) creates a set of relationships within a system.
- The relationships between elements in a system can change.
- Systems are dynamic.

Essential Questions

- How does light interact with matter?
- How do the relationships between elements in a system create a dynamic?

Science Skills

Students will be able to

- Collect and use data as evidence
- Observe and describe relationships between light and matter
- Mix and separate colors of light

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- Create material models to show how we see an object
- Create concept maps to model relationships in a system
- Make predictions

Mathematics Skills
Students will be able to
- Analyze data
- Calculate supplemental and complementary angles
- Measure angles
- Recognize and identify patterns

Digital Media Skills
Students will be able to
- Use appropriate graphic and electronic tools and techniques to process information.

Knowledge
Students will know
- There are different kinds of interactions between light and matter (refraction, absorption, scattering, reflection).
- The anatomy of the eye.
- How light moves.
- Light from a primary or secondary source must enter the eye in order for the source to be seen. Human eyes can detect only a limited range of light wavelengths.
- Different wavelengths of light are perceived as different colors. Colors of light can be combined or separated to appear as new colors.
- Colored objects selectively reflect, transmit, and absorb different colors of light.
- Shadows are the result of the absence of light.
- Nonvisible light behaves like visible light but cannot be detected by human eyes.
- The difference between supplementary and complementary angles.

STAGE 2: ASSESSMENT EVIDENCE

Performance Task:	Other Evidence:
Digital model (game): During stage 2 of the unit, students will build complex three-dimensional	Online Lab Notebook (Daily) Test Self-assessments

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spaces from simulated light and matter. Culminating assessment (experiment): Students will construct a pathway for a beam of light to travel to a target, changing direction a minimum of five times.	Concept maps Written reflections

STAGE 3: LEARNING ACTIVITIES (Quests)

Quest I. The Problem of the Oar (one week total)
Students will develop an inventory of behaviors for "Photon," a beam of light that has lost its way. Using the scientific method, students will produce a series of increasingly complex experiments pairing Photon with a range of materials (water, glass, Plexiglass, mirrors, etc.) to gather data on its behavior. Near the end of this stage, they must decipher an invisible message using only a light. This "secret message" is printed in red and green letters on a black background inside a box. When the message is illuminated with red or green light, only vowels or consonants appear. Only when illuminated with white light will the entire message be visible. Students will document their findings using digital cameras and annotate the resulting images in an online notebook.

Quest II. Enigmo (two weeks total)
Having collected an inventory of behaviors describing Photon's interaction with different forms of matter, students are challenged to apply this knowledge within a three-dimensional simulation tool called "Enigmo 2." This tool allows students to build complex three-dimensional spaces from simulated light and matter. The digital models built by students will be made available for play by other students at Q2L on the school's online network.

Quest III. Can You Believe What You See? (three weeks total)
Students work with a digital model of the eye. Using "light-boxes," they establish the conditions for sight: a light source, an object, an eye, and a straight unblocked path. They are challenged to create material models to show how we see an object. As a result, the students generate questions they would like to answer about light and sort them into four categories: How does light allow me to see? How does light interact

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with matter? How can light have different colors? Is there light that I cannot see? These questions lead the students to understand that light needs to "bounce" from an object to their eyes in order to be seen. But how does light bounce? Does it always bounce? Are there other things it can do?

Quest IV. Invisible Pathways (four weeks total)
The Mission culminates in a Quest requiring students to collaborate in small teams. The challenge: construct a pathway for a beam of light to travel to a target, but changing direction a minimum of five times on its way. The resulting pathway will require students to apply their understanding of the different ways light interacts with different materials—how it is filtered, strengthened, and changed by these materials.

Quest: Light Traveler

Background to Lesson 1 This lesson occurs over two class periods (one hour each) during stage I of the Invisible Pathways Mission. Students develop theories about the ways light can travel as they experiment with different materials to create a light pathway for "Photon," a beam of light who has lost his way. This lesson prepares students for the lesson at the end of Quest I, where they must create a pathway of white light to display a secret message. It also scaffolds their learning so they are prepared for the Mission's final challenge, where they must construct a pathway for a beam of light to travel to a target through a series of complex obstacles.

Box 14

Essential Questions	How does light travel? How does light respond to different materials?

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Learning Goals	▪ Students will identify a technological design dilemma associated with testing how light travels by brainstorming possible ways to observe light using mirrors, prisms, and both clear and clouded materials. ▪ Students will determine procedural sequence, success criteria, and design options to "construct" a light pathway with a single obstacle to investigate how light energy is affected. ▪ Students will begin to develop an understanding of reflection, refraction, absorption, and transmission.
Lesson Objective	**Science/Math Skills** Students will be able to ▪ Identify the ways that light can travel because it is a form of energy. ▪ Design ways to demonstrate the ways that light can travel. ▪ Explain how the ways that light can travel. ▪ Display and analyze data from investigation. ▪ Communicate the findings to explain how light travels. ▪ Generate possible alternative designs for testing light again. ▪ Understand the relationship between complementary and supplementary angles. ▪ Given a vector, calculate the vector's complement.
Digital Platform	Being Me (Q2L online social network), Internet, digital cameras
Learning Sequence and Assessments	1. *Mini-Lesson*: Teacher explains to students that today they will develop an understanding of how light moves so they can get different colors of light to move in the right directions to decipher a secret message. Teacher demonstrates how to investigate properties of light by modeling with a penlight pointer and materials such as mirrors, prisms, and so on. Teacher introduces students to the terms reflection, refraction, absorption, and transmission.

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2. *Investigation*: A small group of students practices with different materials to see how light is affected. For example, they use prisms and see how the prisms refract regular (white) light (from a focused flashlight or another light source) into a rainbow of colors; test mirrors for their capabilities to reflect light; experiment with various materials such as colored filters, waxed paper, clear glass, and translucent (clouded) glass to see how they allow light to travel through. The teacher encourages multiple combinations of materials. Students record their observations in their lab notebooks.
3. *Developing a hypothesis*: Teacher instructs students to examine their data and construct a theory around the behavior of light.
4. *Hypothesis testing*: Students design a light pathway so that light (from a penlight pointer) can travel to a single point through one obstacle. Students sketch out the projected light pathway and predict what will happen at the obstacle. They test their ideas with a penlight pointer to adjust location of their obstacle, through which their final pathway must follow. Adjustments to design are allowed.
5. *Presentation*: Students must display their final light pathway and determine the success of the design based on the class-determined criteria. (Students are required to generate one or more proposals for how to improve their prototype. They may suggest adjustments to the "success" criteria for additional testing.)
6. *Debrief*: Teacher asks students to propose their generalizations about how energy travels, based on what they have learned about light. (Do other forms of energy—heat, sound, electrical and mechanical energy—travel in the same ways as light?). Teacher asks students to revisit the terms introduced at the start of class (reflection, refraction, absorption, and transmission) and asks students to give examples of each term from their experiments. Students record their answers in a graphic organizer.

Box 14

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Differentiation	Each step of the lesson allows for differentiation of instruction. *Step 1*: Teacher modeling. *Step 2*: Guided practice—teacher circulates and works with groups and individuals one on one. *Step 3*: Students work in groups of mixed ability levels to develop hypothesis. *Step 4*: Multiple learning styles are engaged as students test hypothesis. Students are allowed choice in which materials they wish to work with. *Step 5*: Students choose their own job responsibilities for the presentation of their work—some students may be speakers, others demonstrators, others recorders, and so on. *Step 6*: Graphic organizer helps students organize examples of each term.

Box 15

Assessment Culminating Performance Task	**Invisible Pathways**: Construct a pathway for a beam of light to travel to a target, but changing direction a minimum of five times. Experiment: Demonstration—a beam of light changes direction five times, each helping it to reach its target. You have the opportunity to take four trial runs, brainstorming alternative designs to make your light path hit five targets. **Visual map**: Graphical representation (diagram, concept map) of the structure, flow, and spatial relationships of pathways of light and matter in your experiment. This is your vision: be creative about how you conceive of it and what digital tools you use. **"My Inquiry" essay**: A narrative synthesizing your scientific reasoning, procedure, and reflection on being a team member. Include data and examples from your online lab notebook and team experience. Place your drafts and final essay in your "Being Me" networking site for feedback and comments. (Essay: five to seven pages)