Project-Based Learning: Inspiring Middle School Students to Engage in Deep and Active Learning

NYC Department of Education

Includes: New and Updated Resources for Social Studies and Science Exit Projects

Division of Teaching and Learning Office of Curriculum, Standards, and Academic Engagement

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A GUIDE TO PROJECT-BASED LEARNING IN MIDDLE SCHOOLS: INSPIRING STUDENTS TO ENGAGE IN DEEP AND ACTIVE LEARNING

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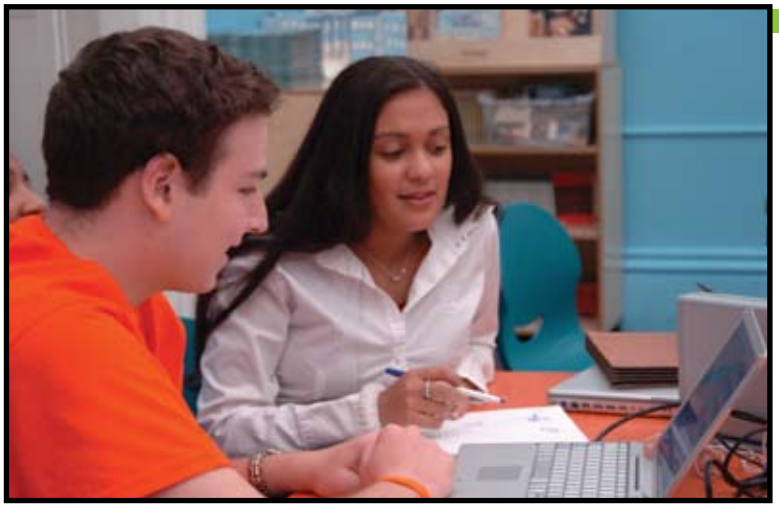
Introduction to this guide

Too often we hear from middle school students that school is boring and that they cannot relate to nor understand the material that is presented to them each day in class. To those of us who teach and love our subjects, it seems incomprehensible that students are not passionate about them. Rather than feel disheartened, we need to understand that we have before us both a challenge and an opportunity. Project-based learning experiences will help us figure out how to make learning come alive for our middle school students.

Imagine what a classroom would look and sound like when students are actively engaged in inquiry work, where they are reading, talking, questioning, analyzing and creating products, in large groups, small groups, independently – toward the goal of demonstrating their learning based on self-selected compelling questions and topics.

The purpose of project-based learning is to provide a structure through which students can demonstrate mastery of a subject by creating, and presenting, a research-based project that is driven by their own interest in a topic and allows them to work within the same parameters as real researchers. While the projects can assess the students' knowledge of content, concepts and skills and the level of depth and complexity to which students have understood them, they also allow students to think deeply and analytically and to question a topic which has particular resonance and meaning for them.

The first four sections of this Guide will give you an overview of project-based learning and give you some tools for implementing project-based learning in your school. The fifth and sixth sections will take a look at two subject areas in which project-based learning has been widely introduced in our schools, social studies and science, and provide some information and tools specifically geared to the application of project-based learning in those fields.



Part 1

OVERVIEW OF PROJECT-BASED LEARNING

What is project-based learning?

Project-based learning is the instructional strategy of empowering learners to pursue content knowledge on their own and demonstrate their new understandings through a variety of presentation modes.

Effective project-based learning has the following characteristics:

- Leads students to investigate **important ideas and questions**
- Is framed around an **inquiry process**
- Is **differentiated** according to student needs and interests
- Is driven by **student independent production and presentation** rather than teacher delivery of information
- Requires the use of **creative thinking, critical thinking, and information skills** to investigate, draw conclusions about, and create content
- Connects to **real world** and **authentic** problems and issues

With those characteristics in mind, teachers can plan learning experiences that result in in-depth understanding of important ideas in the content. Because students are driving the learning, they can draw upon their strengths and create projects that incorporate their own interests, native language, cultural background, abilities and preference for using different types of media.

English Language Learners, in particular, thrive in a project-based learning environment because projects give them the opportunity to learn with others through peer-to-peer exchange, to develop their academic vocabularies through conversation, to use their own strengths and cultural backgrounds, and to accelerate their language acquisition at the same time that they are learning about topics of interest. Project-based learning requires the production of authentic (oral and written) language from ELLs.

Why is project-based learning relevant for middle school students?

The middle school years are challenging. We struggle with keeping students academically engaged during these years of tremendous change. Because projects build on authentic learning tasks that engage and motivate students, middle school is an ideal time to integrate project-based learning. Projects encourage students to encounter, and struggle with, important and “big” ideas. Project-based learning in all content areas (e.g., language arts, social studies, math, science, visual and performing arts, health) shifts the focus of teaching and learning from a set of known facts to a process modeled on the ways that experts in the field think and work.

In addition to subject specific projects, such as the “exit projects” required of students in science and social studies, project-based learning lends itself particularly well to an interdisciplinary approach to instruction. Students benefit from a collaborative, interdisciplinary approach not only because of the connections they find among content ideas, but also because they thrive on the coherent development of their creative and independent learning skills. When students in middle school experience a continuum of interdisciplinary project assignments from grade 6 to 7 to 8, they can develop the knowledge, skills and stamina for independent learning that are required for success in high school, college and the world of work.

When classroom teachers, librarians, and technology specialists design project-based instruction together, they can focus on the content, ideas, concepts and themes that authentically draw upon and connect different disciplines. For example, students might investigate the effect of the environment on the outcome of the Civil War, connecting science and social studies concepts.

Projects might also be designed with a focus on one content area, but an interdisciplinary approach to skills instruction. This across-the-curriculum skills approach fosters coherence in both the teaching of inquiry skills and the use of resources and technology. The content-area teacher collaborates with other educators in the school (e.g., library media specialist, ELL and special education teachers, art specialists) to provide expansion of students' fund of knowledge and contextual information as well as other support in helping students build a high level of knowledge in the project topic. Under an interdisciplinary approach, students not only become immersed in their projects but they also have access to a wider support system of teachers to assist and encourage them. For teachers, the collaborative nature of interdisciplinary projects promotes professional learning communities in a school.

How does project-based learning support student engagement?

The use of project-based learning results in increased student engagement for several reasons.

First, students thrive when they have the opportunity to become experts with what some researchers call "exportable knowledge." Students who work on in-depth projects tend to learn even more about the subject than they demonstrate within the confines of their final product. They translate the information they discover to real knowledge and then share (or "export" into conversations) with others.

Second, projects usually present opportunities for authentic investigations and presentations. There is a real reason for students to learn something and for them to present their learning. Students identify real problems to pursue and they investigate them through real-world sources of information (e.g., interviews, Internet sites, magazine articles, primary sources). Because students are doing their own research, they find connections to their own (real) interests.

Third, learning is social. Projects lend themselves to students' working and learning collaboratively. Students are highly motivated when they have frequent opportunities to talk over ideas with their peers.

Lastly, projects enable students to be active learners. They take charge, question, make decisions, analyze, think critically, create, present – they become independent thinkers. Nothing is more engaging to a middle schooler than that.

How does project-based learning lead to differentiated instruction?

Our students bring diverse backgrounds and experiences to the classroom. Their ability, prior learning, rate of learning, social and cultural background, native language, maturity and individual preferences are factors in the learning process. Project-based learning allows students multiple options for taking in information, making sense of ideas, and expressing what they have learned. It is by definition differentiated as it provides students with multiple ways to acquire content, to process or make sense of ideas, and to develop products that demonstrate effective learning. Students can approach the inquiry process in a variety of ways and build on their own interests and experiences. There is no limit to how deeply students can explore a question, allowing each learner to challenge him or herself to the fullest.

By the middle grades, the diversity of students' prior educational experiences has resulted in widely disparate levels of skills. English Language Learners may have high levels of skills, but limited English proficiency. While the expectations for content learning and project completion remains rigorous, scaffolding and targeted intervention should be offered to any students who need extra supports.

Additionally, students will possess a wide range of reading ability. Supports must be provided so that all students have access to the information. The use of audio-recorded books, books and articles in other languages, reading buddies, as well as on-line software that provides text reading, are useful in ensuring that all students have equal access to the information they need regardless of their ability to read the text on their own.

The following strategies have proven to be effective for all students who are challenging themselves to learn new content and skills.

- **Generate interest** in the project by bringing in articles or providing experiences that pique their curiosities; allow students to follow up on the ideas that interest them.
- Set out **clear expectations** and **frequent reminders** regarding each aspect of the process, delivered in a manner consistent with the student's learning preferences.
- Offer **clear models** and extra teacher-guided opportunities to practice abstract phases of inquiry like "construct." Let students see the connection between drawing conclusions based on evidence and making decisions in their own lives, like deciding which sneakers have the best advantages for the money they cost.
- Be sure that these students do not get lost in the group; give them **individual attention** or **pair them with fellow students** for one-on-one practice time.
- **Modify** the expectations for standards and assessment for those students with disabilities who may exhibit delayed mastery of some of the inquiry-skills benchmarks.
- Provide opportunities for **multi-modality learning** throughout the project.
- Offer **multiple opportunities** for students to interact with the ideas (English Language Learners – and all learners – benefit greatly from increased practice in developing competencies).
- Use **facilitative teaching** techniques:
  - Ask leading questions to help elicit responses and generate understanding.
  - Use verbal prompts to help students connect previously learned information to current information and to draw conclusions.
  - Provide organizational structures to keep students on track (e.g., checklists, reminder notes).
  - Provide visual cues throughout the classroom to guide the process.
  - Provide modeling, including think alouds, to demonstrate the process.
- Provide **support and feedback** throughout the process:
  - Strategically group students with peers who can serve as models and supportive partners. Group English Language Learners with those who speak the same native language.
  - Conduct frequent one-on-one discussions with students to monitor progress and assess the need for additional accommodations.
- **Extend the time** to complete assignments when warranted.
- Provide an **alternative manner of reporting** for students with academic challenges or disabilities who exhibit limited written expression skills or a physical impairment that may impede writing. For these students, consider strategies derived from universal design principles such as voice recognition software which allows them to participate fully in this process.
- Encourage English Language Learners to **use their native language** resources to develop their project and afford them opportunities to present in the native language as well as English.

Teachers can also design final products to ensure success for all students, including those with varying levels of academic preparation and differing levels of expertise with the English language. Teachers can offer specific choices of final products based on a taxonomy of thinking levels and different formats, like Bloom's Taxonomy. [See sample products for each level of a thinking-skills taxonomy that is a variation of Bloom's Taxonomy (the REACTS Taxonomy) in Appendix 1.]

Part 2

PLANNING THE PROJECT

The Planning Process: Overview

Projects must be carefully planned before being implemented to clarify student learning goals, final products, timeline, and instructional activities. The following is an overview of the planning process.

Planning Step One: Establish Content and Skill Goals

- What is the overarching theme or "big idea" of the project?
- What should students know and be able to do as a result of this project assignment? What knowledge and skills do students already have that can provide a foundation for this project?
- What content standards will this assignment address?
- What are the essential and focus questions that will drive the unit?
- What inquiry skills and process skills will be required for successful completion of the project?
- What academic language skills (academic vocabulary, disciplinary discourse, disciplinary presentations) will be required/expected/mastered?

Planning Step Two: Develop Formats for Final Products

- How can authenticity be built into the final product choices?
- How and to what audience will students demonstrate their understanding?
- What level of thinking is required by the final product?
- How do final product choices provide opportunities for differentiation?
- What presentation/production/performance skills are required for the final product?

Planning Step Three: Plan the Scope of the Project

- What is the timeline for the project? How can the project be broken down into a set of tasks with interim and final due dates?
- Will students work independently or in groups?
- How will individual accountability be measured?
- What resources beyond the classroom will be required for each phase of the project?

Planning Step Four: Design Instructional Activities

- What instructional activities and support will move students through the phases of the inquiry process?
- What content and skills will be taught through explicit instruction; what will be scaffolded?
- What initial activity will engage students in a thought-provoking experience and connect them immediately to background knowledge and their own experiences?
- How will students gain a quick understanding of the scope of the project, the products that will be required, and the assessments that will take place during the project?
- How will formative assessment be integrated throughout the process?
- What evaluation criteria will be used for the final product?
- How can the presentations/performances be shaped into interactive learning experiences for all students?

Planning Step Five: Assess the Project Design

- Does the project design
  - Meet the standards?
  - Engage students?
  - Encourage higher-level thinking?
  - Integrate teaching and reinforcement of literacy, inquiry, technology, and necessary basic skills?
  - Differentiate instruction?
  - Allow all students to succeed?
  - Use clear, precise assessments and rubrics?
  - Integrate resources and technology appropriately?

Planning Step One: Establish Content and Skill Goals

Big Idea or Theme

Projects should be directed toward essential ideas or themes in the curriculum that are rigorous enough to support in-depth study and student construction of meaning. Research with English Language Learners has shown that they thrive in classrooms that focus on key processes and ideas, especially if those ideas are introduced cyclically, so that students have the chance to revisit earlier concepts at a higher level of sophistication as they develop their language proficiencies.

Big ideas or themes provide an overall goal for a project-based unit and offer possibilities for interdisciplinary collaboration. For example, if a unit in social studies on the American Revolution is focused on Conflict and Change, then English Language Arts and theater teachers might select a piece of literature, video, article, or interview investigating the same theme through characterization; the visual arts, music, and dance teachers might explore conflict and change through the public's reaction to new art styles and forms; and the science teachers might investigate conflict and change in the animal kingdom. This interdisciplinary approach will lead students to a multi-faceted and deeper understanding of conflict and change as well as knowledge in all three content areas.

Essential Questions

Once the big ideas or themes have been determined, the teacher provides a framework for students to pursue those essential ideas or themes by crafting essential questions. An essential question asks students to think beyond the literal. It is complex and open to discussion and interpretation. Essential questions are important in terms of getting students to think about the complexities around issues, scientific principles, and events.

Essential questions:

- are relevant in multiple settings (e.g., in the history and science classroom, the evening news and a student's personal life).
- recur naturally, creating opportunities for transfer to other situations.
- are provocative. They must challenge students to rethink big ideas and assumptions and to go beyond superficialities to deep thought, lively discussion, sustained inquiry and new understanding.
- are open-ended. They lead to genuine and relevant inquiry, not to easy answers. Essential questions require students to integrate, synthesize, and critically evaluate information. While essential questions should be open-ended, they should also be feasible.
- go to the heart of a topic.
- are challenging. They encourage students to confront difficult issues or complex scientific ideas.
- can examine real-world dilemmas or natural processes that students find interesting. They spark meaningful connections to prior knowledge and experiences.
- can be interpreted through and from a variety of perspectives.
- are consistent with curricular standards and frameworks.
- lead to more questions.

Creating a powerful and compelling essential question usually involves drafting and refining the first version of the question.

Some essential questions in social studies might be:

- How do geography and key events connect to shape a continent?
- How can we use geography to interpret the past?
- How does the place we live in affect how we live?
- What does it mean to be free and democratic?
- What is the price of "progress?"
- Are wars avoidable?
- Who has the "American Dream?"
- Can the use of nuclear weapons be justified?
- Should natural resources be used or protected?
- What is the balance between independence and interdependence?

Learning Skills

The integration of content and learning skills is an essential component of project-based learning and should be identified in the project outcomes. Students need to learn, practice, apply, and extend these skills as part of the project design. Skill development must follow a coherent continuum of instruction and practice throughout the years of schooling, K-12 and beyond, to enable all children to become independent learners. Through collaborative teaching by classroom teachers and school library media specialists, students will develop their inquiry skills in the context of content learning in all subject areas.

The skill set for project-based learning is diverse and includes literacy and group process skills. Throughout the process students will engage in and develop proficiency in the following types of skills:

- Comprehension Skills
- Research and Writing Skills
- Questioning Skills
- Group Processes/ Collaborative Learning Skills
- Sequencing and Chronology Skills
- Skills with Resources such as Maps and Globes
- Skills with Presentation Tools such as Charts and Graphs
- Analysis Skills
- Communication Skills
- Problem Solving and Critical Thinking Skills
- Task and Self Management Skills

A grade-by-grade continuum of the information and critical thinking skills necessary for successful completion of projects, the Information Fluency Continuum, may be found at the NYC Library Services Website: *http://schools.nyc.gov/Academics/LibraryServices.*

Planning Step Two: Develop Formats for Final Products

Authentic Products and Presentation/Performance Formats

Students are more likely to be engaged in their learning if they see a connection to their own world. That connection can be made through the subject matter itself (e.g., science experiments or research on current issues), or through the product the student is expected to create or the presentation or performance the student is expected to give (e.g., a television talk show segment, a dance performance, or a podcast).

Authentic products have a real-life context and involve thinking and learning as the product is created; they cannot be simply copied from somewhere else. Performances, presentations, exhibitions and portfolios are all examples of authentic products. Often authentic products involve sharing with an audience beyond the teacher – other students, parents, and community members. This sharing process creates an environment of collaboration where students are engaged in teaching and learning from each other and from adults.

Projects may culminate in products at multiple levels of thinking and in multiple formats. Final products provide outstanding opportunities for differentiation; students may select the format, style, and language that most closely match their own preferences and strengths. Students may use their, artistic talents, performance abilities, writing expertise, and presentation skills to prepare and present their learning in effective ways. Teachers will find that engaging final product ideas draw students into the whole process of investigation and inquiry. Students are more likely to complete projects successfully when they look forward to creating their final product.

In Appendix 1, the REACTS Taxonomy, a taxonomy (modeled after Bloom's Taxonomy) of creative project ideas at different levels of thinking, is presented. The REACTS ideas have proven to be effective in inspiring a creative approach to final products. Teachers may adopt or adapt the example products as they are described, or they may use the verbs and examples as brainstorming triggers for additional product ideas.

Portfolios

To document their learning process, students should create a print and/or electronic portfolio in which all drafts of work are maintained, including but not limited to: any kind of data/tables, observations, notes, sketches, resource lists, maps, photocopies, and pictures/photographs/images. Classroom teachers, library media specialists, and technology specialists can collaborate to support students in their portfolio development.

Completed portfolios for all projects can become part of students' overall academic portfolios. They can travel with the students to later grades and enable students to scaffold their work and build upon the projects to pursue more in-depth investigations in high school. Exit projects in science can be early investigations that lead to high school science entries in national and international competitions such as Intel or Siemens Westinghouse.

Planning Step Three: Plan the Scope of the Project

Developing a Timeline and Scope for the Project

A well-constructed project plan includes more than a sequence of activities; it is a design for supporting and directing students as they create products to complete the project. A plan helps you develop the timeline for the project with interim deadlines, decide the balance between teacher instruction and student investigation, incorporate both group and individual activities, and identify the skills that your students need to successfully complete the project.

- Organize tasks and activities.
  - Break down the products in the project into a set of tasks in order to allocate the right amount of time for each task.
  - Identify any resources needed for each task. Think about resources in languages other than English, and at varying levels of difficulty.
  - Build in opportunities for repeated exposure to new learning, especially for English Language Learners.

- Decide on assessments
  - When will works-in-progress be collected in order to provide feedback to students?
  - What skills do you expect students to learn during the process? Spend time preparing students by having them practice crucial project skills.
  - How will you scaffold the skills you are not planning to teach?

- Analyze the final products required
  - Do your students know enough to succeed at the tasks included in the project?
  - What lessons will be planned to support students at each phase?

- Create a timeline for the entire project
  - Once you have outlined the main activities for the project, create a timeline for the project, in a visual format, and identify major milestones and assignments, along with the other important activities:
    - The project launch
    - Sequence of activities (scheduling of library and computer time)
    - Due dates for drafts, homework, rehearsals, or products
    - Preparation of drafts
    - Rehearsals, practices, etc
    - Assessments and rubrics
    - Reflection and review

- Plan how you will share the project assignment, timelines, rubrics, and templates with parents. Parents want to be involved and supportive; reaching out to them at the beginning of a project will benefit everyone.

Planning Step Four: Design Instructional Activities

Instructional Strategies

Set students up to succeed by teaching and scaffolding the knowledge and skills that they need to take on the project. Good projects do not occur by accident. They result from rigorous up-front planning that includes thoughtful outcomes, timelines, and management strategies.

Key strategies the students will need to possess for effective project-based learning are:

- Developing focus research questions/hypotheses
- Locating, evaluating, and using resources (both primary and secondary)
- Finding and evaluating information / making observations
- Organizing information or data
- Considering the needs of the audience
- Using the writing/creating process: prewriting, drafting, revising, editing, publishing
- Creating a bibliography

- Creating a graphic representation of research (See Appendices 5 and 6 for a sample mini-lesson and student handout on developing the graphic portion of a project)
- Developing appropriate presentation format (aligned to written component)
- Developing the oral presentation (See Appendices 7 and 8 for a sample mini-lesson and student handout on developing an effective oral presentation.)
- Creating speaking notes/script
- Aligning presentation to written and graphic components
- Planning for use of visuals in presentation

Design instructional activities to provide direct instruction on these skills of inquiry when appropriate. A useful model for explicit teaching of skills includes the following steps:

- Introduce and explain the purpose of the strategy
- Demonstrate and model its use through a mini-lesson
- Provide guided practice for students to apply the strategy with feedback
- Allow students to apply the strategy independently
- Ask students to reflect and share about the appropriate use of the strategy and its effectiveness

In addition to direct instruction, plan to provide **scaffolding** for the students through examples, guidelines, and orientation: checklists, templates, rubrics, outlines, models, labels, signs, list of steps, rules, roles, written examples, oral instructions, and graphic organizers.

Possible Mini-lessons

Teachers should consider delivering mini-lessons on the skills that are critical for successful completion of projects. As examples of what these might look like, a number of Model Mini-Lessons are included in the Appendices to this Guide.

Decide How to Launch the Project

Though it is important to provide a clear overview at the beginning of the project, it is equally important to generate enthusiasm and excitement for the launch of the project. A thought-provoking beginning will get students interested in the work they are about to begin. A lively debate or discussion, special event, person or activity can all be used to engage students.

Planned Assessment

What teachers assess sends a strong signal to students about what is important for them to learn. Both *formative* assessments - assessments that allow you to give feedback as the project progresses - and *summative* assessments - assessments that provide students with a culminating appraisal of their performance - should be built into the instructional design. Formative assessment may be based on the work products that students complete as they are writing their research questions, constructing their research plans, finding and evaluating sources, observing the results of their experiments, reflecting on what they have discovered, organizing their conclusions for presentation, and even drafting their final project. By analyzing these interim products and consulting with students along the way, teachers are able to redirect students and clear up confusions before they have gone too far in the wrong direction. Other guidelines for effective assessments follow:

- Choose the right assessment for the right product and decide which blend of assessments will provide evidence that students have met the range of outcomes for the project.
- Include assessments that capture the process-oriented as well as the content-oriented outcomes of project-based learning. A balanced assessment plan will include a variety of assessments closely tied to the outcomes of the project. Multiple indicators for performance give different kinds of students, each with different strengths, the opportunity to succeed.

- Every outcome must be assessed, giving students the opportunity to demonstrate what they are required to know and do. Content knowledge and skills need to be broken down – unpacked and laid out in a series of specific statements of what needs to be learned.

- Use multiple products with staggered due dates. This gives students more opportunities to improve over time and meet project outcomes. Multiple products give teachers more control over the process, providing an early look at whether students are meeting the goals of the project or encountering unforeseen problems.

- Use artifacts – evidence of the process of student thinking – to assess skills. Artifacts can be used to evaluate both skills and affective outcomes. Establish and share with students the standards and expectations for the artifacts.

- Examples of artifacts include:
  - Notes
  - Journal/sketchbook entries
  - Records of conversations, decisions
  - Interviews
  - Reflective paragraphs describing the progress of the project
  - Group progress reports

Rubrics for Project-Based Learning

Students should have a clear idea of the evaluation criteria that will be used on the final product and presentation when they are first starting their work. They will be able to self-assess and revise their own work if they know the criteria for success. When thoughtfully constructed, rubrics provide a clear description of proficient student work and serve as a guide for helping students achieve and exceed performance standards. Rubrics tell students exactly what is expected and should be available at the start of the project. Students can also help create the rubrics. Students will try harder to meet the criteria if they have participated in the development of the rubric.

Teachers should develop their own rubrics, or have the class develop rubrics for project-based learning. RubiStar, *http://rubistar.4teachers.org/index.php,* is a website that provides sample rubrics and templates for teachers who wish to create their own quality rubrics.

- Rubrics break down the tasks in an assignment into separate categories for assessment. For example, a rubric for a research paper might contain criteria for five categories: (1) content; (2) organization; (3) depth of research; (4) use of primary resources; and (5) writing mechanics.

- Build your rubrics from the top, starting from a description of exemplary performance. Regardless of whether or not students can perform at exemplary levels, the rubric should be built from a picture of excellence to establish a valid target and anchor for the scoring. The key to developing good descriptions is to pinpoint the meaning of words like “excellent” with language that describes what excellence actually looks like.

- Link the scoring criteria to content standards. By consulting the performance indicators for the content standards that are part of the outcomes for the projects, students will be assessed on vital content.

Rubrics will help teachers create an assessment plan that is fair and accurate, targets specific content and skills, and provides timely, useful feedback to students. A rubric specific to the written aspects of a project and additional rubrics may be found in Appendices 9-13 at the end of this Guide.

Planning Step Five: Assess the Project Design

Once all the instructional activities have been designed, teachers may pause to reflect on the design, looking for alignment with curriculum priorities, clarity and feasibility of organization, availability of resources, and the differentiation that is planned for meeting the needs of all learners. The questions on the following checklist may be used to prompt reflections.

PROJECT DESIGN CHECKLIST

Goals

- ☐ Are the learning expectations challenging and in alignment with my curriculum priorities?
- ☐ Have I broadened the project to an interdisciplinary focus?
- ☐ Will the final product be engaging for my students to create and present?
- ☐ Can my students be successful at this project?
- ☐ Have I integrated the teaching and scaffolding of all the skills that students will need to complete their projects successfully?
- ☐ Will this project build my students' literacy skills?
- ☐ Have I built in both formative and summative assessments?
- ☐ Have I built in academic language goals for all students, including English Language Learners?

Collaboration

- ☐ Have I established a partnership with fellow teachers, library media specialists, and technology specialists?
- ☐ Have I involved cultural and scientific institutions in the City, such as public libraries, museums, and science agencies?

Instruction

- ☐ Will I be following best teaching practices by using such techniques as setting high expectations, modeling, guiding individual practice, structuring learning activities around active engagement by students, and employing the use of critical questioning to push the level of thinking?
- ☐ Will my skills instruction build coherently on previous instruction and experience by my students?
- ☐ Have I provided enough opportunities for feedback to the students?

Resources and Technology

- ☐ Will my students be able to access and use the resources they need?
- ☐ Have I collaborated with the library media specialist to identify the most valuable resources, both in print and online?
- ☐ Do my students know how to evaluate resources to find the best information?
- ☐ Will my students have access to the technology they will need? Do they need instruction in the skills to navigate databases and online resources?
- ☐ Do my students need instruction or reminders to access information ethically, legally, and responsibly (e.g., copyright, fair use, plagiarism, illegal downloading, diverse points of view).

Environment

- ☐ Will the learning environment be structured to support the project focus and deadlines?
- ☐ Is the climate conducive to learning?

Final Presentation and Celebration

- ☐ Have I arranged for a celebration of student learning at the end of the project, when students can share their learning with fellow students, parents, the community, or other audiences?

Part 3

TEACHING THE SKILLS AND CONTENT

Once the project assignment is planned, teachers need to consider how to teach the content and skills necessary for each student to be successful. The following section provides some teaching ideas for each phase of the inquiry process.

Create an Optimal Learning Environment

Before starting the project, teachers must create a learning environment that will support success for every student. Teachers will want to collaborate with others, such as the library media specialist and technology specialist, to ensure that support for successful completion of projects extends throughout the school. In Appendix 14 to this Guide, there is a ***Checklist for Student Project Success*** that teachers may want to adopt or adapt. It can be shared with students at the beginning to help them understand the scope of the project. Many teachers also introduce each individual project assignment with a letter to parents, so that parents understand the expectations from the beginning.

A learning environment that fosters project-based learning has six essential elements.

Climate

Establish an atmosphere of collaboration and reflection:

- Structure groups carefully
- Plan opportunities for conversation and sharing of new ideas throughout the process
- Encourage reflective thinking
- Consult with students regularly to monitor and support their progress
- Provide a role for all students, including those with academic challenges and ELLs
- Provide structured opportunities for peer feedback

Modeling

A successful teaching strategy for project-based learning is modeling the process of inquiry. Students may not have experienced this before, and they may not understand what to do at every step of the process. Teachers can choose a sample topic (related to the essential question or theme) and model each step of the process as whole-class instruction before students proceed independently on their own work.

Scaffolding

The third aspect of the classroom that creates an optimal learning environment for projects is the integration of scaffolding. Scaffolding techniques are critical for English Language Learners, but all students benefit from effective scaffolding that offers a balance between continuous support and independence. Students need flexible structures in the classroom that provide supportive guidance and encourage them to reach higher levels of achievement than they would reach on their own.

Several types of scaffolding should be offered:

- Connections – learning is grounded in a framework (e.g., a project) that allows students to see how one day's learning is connected to the next.
- Collaborations – students are expected to collaborate with one another and build on shared expertise and knowledge.

- Gradual release of responsibility – teachers gradually release responsibility for learning to the students as the students develop self-sufficiency. This is sometimes called "handover-takeover" among ESL educators.
- Interactive questioning – everyone is encouraged to ask and answer questions.
- Modeling – students should have a clear picture of the skill or product they are trying to master. The modeling can be provided by the teacher or fellow students.
- Bridging – new concepts and ideas should be connected to prior knowledge and experience through techniques like class brainstorming, think-alouds, and reciprocal teaching.

[Portions of above were adapted from Walqui, Aída. "Scaffolding Instruction for English Learners," in Quality Teaching for English Learners. San Francisco, CA: West Ed, 2002.]

Conferring

The act of conferring will enable the teacher to guide students to think about their project plan, progress, formulation of ideas, problems, "next steps," and creation of the final products.

Below is a general format for conducting conferences with your students. You can use the sample conference sheet available in Appendix 15 or keep records electronically for each conference on a spreadsheet:

1. Set up a regular schedule for conferences with students. Ideally, they should be on a weekly basis.
    a. Conferences should occur at each major component of the project process.

2. On the conference sheet:
    a. Note where the students are in the process of working on their project.
    b. For current direction, summarize the focus and progress of the students.
    c. For conference summary, note what was discussed. Has the focus changed? What suggestions were given for next steps?
    d. For follow-up, summarize what you expect for the next conference.

3. Distribute post-conference sheets to students for their review (see Appendix 16). Collect them the following day and have them note anything they do not understand. This will help you determine if the students are on the right track or if they need further guidance before the next conference date.

Access to Resources

A fifth essential component to a project-based learning environment is ready access to the resources that students will need to complete their projects. The resources should be in multiple formats (print, non-print, and electronic), languages, and reading levels. Ideally, students will have many scheduled days in the library for investigation and many days of class time to work. Students should also be able to check out the resources they need (which is another argument for allowing students to pick diverse and individual topics within the broad theme of the unit). With enough notice, some libraries are able to borrow materials from other libraries to fill unexpected needs.

- Check to be sure print resources in the library are adequate and place them on reserve if necessary.
- Be sure that resources at all different reading levels and from diverse perspectives are available including books on tape or digitized audio (in the languages of the students enrolled) for those students who would benefit from these (the Andrew Heiskell branch of the New York Public Library has a huge repository of audiotaped material, as do other public libraries).
- Prepare a list of websites to research (*Trackstar* is a useful website where you can organize and annotate other websites for use in lessons).
- Schedule class time in the library for the library media specialist to deliver information literacy instruction.
- Build time within project activities for students to learn to use the resources productively.
- Ensure that arts references (images, recordings, etc.) are of high quality.
- Reserve adequate time in the library for students to find and use appropriate resources.

Integration of Technology

The sixth essential component is the integration of technology. Students should have access to computers and electronic databases in the library, classroom, and home.

Arrange access to computers and other technology.

- Schedule time for computer use in library or computer lab
- Allow extra access time at school for those students with limited access at home
- Make sure students have a public library card for access in the evenings and on weekends

The climate of a project-based school is one of intellectual energy and collaborative conversation. Teachers may incorporate the use of web-based collaborative tools for sharing and collaborative work during the project and presentation of final products. Creating a technology-based collaborative community for projects enables teachers to be learners and all learners to be teachers. As students become experts in their own areas of study, they will be able to share their expertise electronically and the whole level of conversation throughout the school will rise.

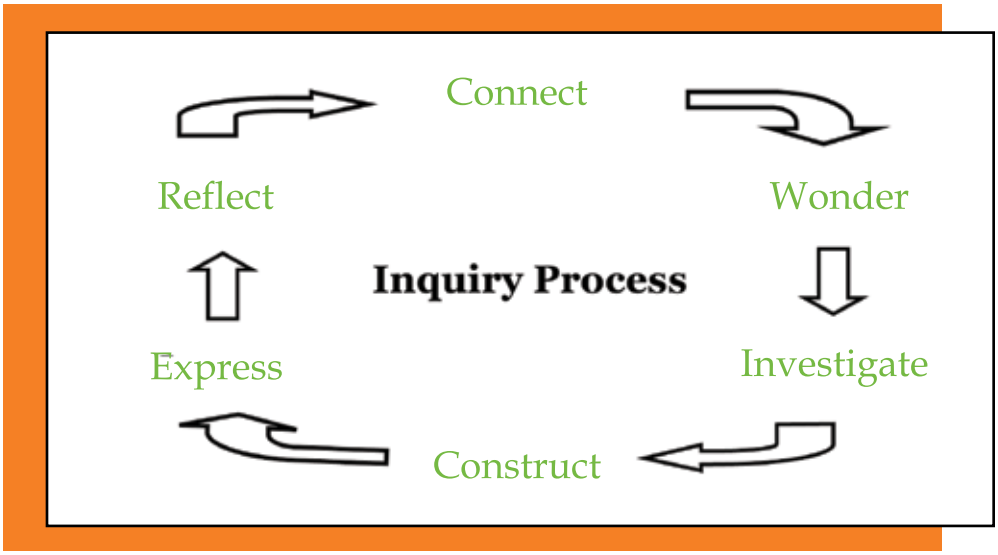
Structure the Project Around an Inquiry Process

Projects are most successful when they are framed around inquiry. Inquiry is a process of teaching and learning that empowers students to follow their sense of wonder and curiosity into new discoveries and insights about the way the world works. The empowered learner calls upon information/inquiry skills to connect with what he or she knows, asks intriguing questions about what is not known, investigates the answers, constructs new understandings, and communicates to share those understandings with others. These skills prepare students for lifelong learning and real-life success. Inquiry skills help students navigate the world.

The following diagram illustrates an inquiry process that reflects the cycle every learner follows when pursuing new ideas.

The Cycle of Inquiry and Learning

Inquiry in any subject area follows the same cycle, although the process may be adapted according to specific content needs. The following chart delineates the skills and strategies important for each phase of the inquiry process:



Skills and Strategies of the Inquiry Process

Connect

- Observe the natural world, experience interactions of people in the real world through texts, graphics, pictures, audio or video files, documentaries
- Connect to own interests and previous knowledge
- Gain background knowledge to set context for new learning by using both primary and secondary sources – mess around with the ideas

Wonder

- Ask questions that connect to own interests and ideas
- Make predictions, a tentative thesis statement, or educated guess (hypothesis) that can be tested through research

Investigate

- Design the investigation
  - Develop a search strategy
  - Design an experiment to test hypotheses, or
  - Plan data collection methods for field investigation, or
  - Develop method for testing existing design to create new design
- Perform the investigation
  - Find and evaluate information to answer questions, interview experts, test thesis, or
  - Collect and record data in systematic manner
- Think about the information to illuminate new questions and predictions

Construct

- Analyze and interpret the data
  - Design charts, tables, graphs, and other representations of observations
  - Interpret graphs and charts
- Explain results (what they are and why they occurred)
- Construct new understandings connected to previous knowledge
- Draw conclusions about questions and predictions
- Form own interpretations based on analysis of evidence from multiple perspectives
- Confirm or restate the thesis based on the evidence
- Restate hypothesis and explain whether hypothesis was supported or unsupported by the results of investigation
- Explain why hypothesis was supported or not supported

Express

- Express new ideas through a variety of formats to share learning with others
- Prepare and deliver presentation with visuals and analyzed data to express conclusion
- Apply understandings to a new context, new situation

Reflect

- Reflect on own process of learning and on new content understandings gained from inquiry
- Reflect on possible sources of error
- Decide how to improve project if repeated
- Ask new questions

Inquiry may seem like an overwhelming process that requires projects of extended length. Although an inquiry-based project in which students are responsible for skills at every phase of the process would, indeed, require at least a couple of weeks, teachers may scaffold some of the steps for their students to enable the entire class to complete smaller, inquiry-based projects successfully.

A good rule of thumb is to teach no more than one or two new skills for each project and let the students use their prior learning or scaffold the rest of the needed skills as these needs are made evident by the student's work.

Connect

Several approaches may be taken to the Connect Phase of inquiry as long as each student emerges with an understanding of the topic/essential question, recognition of what he or she already knows or thinks, background knowledge, and an excitement about the ideas to be investigated. It is at this phase that students start to build schema, the main concepts that will form the structure of their projects. All students, and especially English Language Learners, need to "bridge" the new topic of inquiry to what they already know or have experienced. Each aspect of connection is important for the students' later thinking processes.

Students need to have enough background information to understand the nature of the topic and essential question. Teachers can use multiple strategies to build background context, including providing overview texts or general encyclopedia articles, showing a video clip, taking students to a museum or performance, conducting a class discussion, and bringing an expert to the classroom.

Some teachers use a diagnostic assessment at this point in order to determine if students have misconceptions that will stand in their way as they try to learn new ideas. All of the research on mental models states that unless the fallacious mental models are brought to the surface, the holder of those wrong models will not change them even in the face of conflicting evidence.

One strategy is to offer an experience, model, text excerpt (usually from a primary source), or visual for students to make observations and become intrigued. Some experts in historical inquiry suggest using a primary source (text or visual) because students will develop their own interpretations to be tested rather than starting with and becoming locked into the interpretations of others. In the science classroom, a demonstration of a scientific phenomenon might inspire students to get engaged. Some teachers take students for a walk in the neighborhood with an observation journal for recording their thoughts and questions.

No matter what project, teachers should not shortchange the Connect Phase. Students who have time to "mess around" with ideas often become engaged in asking questions and pursuing answers. The connections they form during this early stage will sustain them through the more difficult phases of the inquiry process.

Wonder

Asking questions is the foundation of good inquiry; however, students often need a great deal of guidance to ask questions that lead them to high-quality inquiry. Teachers may use a number of strategies to build on students' natural proclivity to wonder and help them ask good questions. The questions should flow easily from the ideas stirred up by the Connect experience. A sample mini-lesson about writing good research questions in social studies is included in Appendix 2.

Question Starters and Prompts

To prompt factual and interpretive questions:

Who/What/When/Where?
Why does…?
How can…?
Who says…? What do others say…?
What caused. . . ? What is the effect of. . . ?
What was the point of view of. . . ?
What evidence supports. . . ?
What else. . .?
Why did. . .?

Help students write predictive questions:

What would happen if. . . ?
What would have happened if. . . ?
What might be the effect of. . . ?
What if. . . ?

Guide students to write focus questions that are narrowed from the broad idea by the following factors:

Subtopic: What aspect of the topic has led to the greatest controversy. . .?
Geography: Why was the situation different in this place?
Chronology: What factors made this decade the most exciting one in 20th century America?

In all cases, students should evaluate their own questions critically before starting their investigation:

- Can the questions be answered with a simple factual answer or a "yes/no?"
- Do the questions lead to the heart of the subject and answers to the unit's essential question?
- Are the questions intriguing in themselves, leading students beyond collecting what others have thought to developing their own interpretations and conclusions?
- Do the students care about finding out the answers?

Investigate: The Investigate Phase is the heart of any project-based learning assignment. In order to build independence and thoughtfulness into investigation, teachers and library media specialists use a combination of teaching and scaffolding. The main strategies and skills that students need to learn can be grouped into the following chronological processes:

Major Processes of Investigation	Key Lessons
Develop a search strategy	Academic vocabulary of key terms, effective Internet searching, recognition of types of resources needed
Find, evaluate, and select appropriate sources	Evaluation of websites; use of table of contents and index; navigation of websites to locate specific information; use of electronic databases
Evaluate information found in selected sources	Evaluation based on criteria of accuracy, validity, appropriateness for needs, importance, and social and cultural context
Take notes to answer questions	Reflective note-taking; summarizing; paraphrasing; identifying the main idea and supporting details; evaluating notes for completeness
Compile bibliography	Ethical and accurate citations; bibliographic style

Note: Some of the above processes and skills have been excerpted from "Standards for the 21st-Century Learner," American Association of School Librarians, 2008.

Note-taking is an essential skill for projects that students must continually practice. For tips on good note-taking strategies and guidance on reflective note-taking, see the template on Note-Taking Skills in Appendix 17.

As students conduct research, they need to cite the sources they consulted for their project and organize them in a bibliography. The bibliography acknowledges and gives credit to sources of words, ideas, diagrams, illustrations, quotations borrowed, or any materials summarized or paraphrased. In addition to listing the sources used, the bibliography offers the readers the opportunity to check student sources for accuracy or look for additional information on the topic. A complete and accurate bibliography inspires reader confidence in the project. For detailed tools on these subjects see Accrediting Sources and Creating a Bibliography in Appendix 18 and Appendix 19, respectively.

Effective Use of the Library and Online Resources

In an interdisciplinary approach among the school department and the school library media specialist, the teacher should acquaint students with the necessary skills to conduct effective and critical research for their investigations. Students should be introduced to a variety of research resources and tools, such as, but not limited to, books, magazines, encyclopedias, search engines, online databases, electronic library catalogs, videos, and other multimedia.

When accessing websites, students need to be critical of the sources and authors of information. Students should be taught how to evaluate the authenticity and content of websites. Some websites warn that their information might not be accurate, and some actually provide misinformation intentionally. Others which look like encyclopedias (such as Wikipedia) may have open databases which can be manipulated by anyone without verification of the content and should therefore not be considered absolutely reliable. Students need to be taught how to view all websites with a critical eye. Information should be verified with more than one type of resource.

Teachers should make themselves familiar with the Chancellor's Internet Acceptable Use Policy (IAUP) which is available on the NYCDOE website. Teachers should caution all students about the dangers of providing ANY personal information on the Internet.

Construct: The Construct Phase is the most neglected phase of inquiry. Although teachers want students to use their own thinking to draw conclusions and make decisions, few teachers actually provide lessons on the skills of constructing meaning. Teachers need to help students connect new ideas to what they already know and build schema by discovering clusters of new ideas and evidence. All middle school students, particularly those who struggle with literacy, are greatly aided when teachers provide templates that help them visualize the main ideas from their investigations and create an organization for their final presentation. Many web sites providing graphic organizers are available for students and teachers to use.

Thesis: A good thesis statement or hypothesis makes the difference between a thoughtful research project and a simple retelling of facts. Teachers need to model strong thesis statements on topics the students are familiar with (but not topics the students are likely to use) so that students gain skill in and understanding of the task. Before developing a thesis on any research topic, students need to collect and organize evidence, look for possible relationships between known facts (such as noteworthy contrasts or similarities), and think about the significance of these relationships. Once they do this thinking, they can begin to develop a "working thesis," an argument that they can support with evidence. The topic may change as students' research and write, so they may need to revise their thesis statement to more accurately reflect the main and supporting arguments of the written component of their project.

You will find a Sample Mini-Lesson on Developing the Thesis Statement of a Social Studies Project at Appendix 3 to this Guide and Appendix 4 is a Student Handout on Writing a Thesis Statement.

Express: During the Express Phase, students are expected to create their final product / performance / presentation and to present it to classmates, teachers, parents, or community members. Middle school students often have conflicted emotions about speaking or performing publicly – they love the attention and want to appear extremely confident and successful at the same time that they have limited experience and natural fears.

English Language Learners should be expected to present to their classmates, but teachers can provide several modifications to ensure success: students can be given special time to practice with a friend and receive feedback; portions of the presentation can be delivered in the student's native language; students can start with very small presentations (even one or two sentences) and build as their language proficiency increases; students can use many different formats and focus on the ones that allow them to communicate most easily.

Teachers, library media specialists, ESL teachers, and technology specialists will have to teach the presentation and communication skills required by the project and give students many opportunities to practice before the final presentation. Students should understand clearly the criteria for excellent oral presentations, how to use PowerPoint or other media effectively, the prediction of questions that may be asked by the audience and preparation of answers beforehand, and simple ways to connect with an audience (e.g., eye contact, careful listening, clear enunciation, modulated speed).

Reflect: The final phase of the inquiry process is a time of reflection and celebration. This phase is essential for students' metacognitive development. At the beginning of the Reflect phase, students may ask themselves:

- Was my product/presentation as effective as I could make it?
- How well did my inquiry process go? Were there particular times when I lost focus or enthusiasm? Why did that happen? What can I do to prevent that loss of momentum on my next project?
- How can I learn from the feedback I receive to improve my next project?

Several skills are important during this phase. Students need to develop evaluative criteria, participate in self - and peer-evaluation, and ask questions on content and process for continuing inquiry. Final reflections are about both content and process. Students need to ask themselves:

- What new understandings did I develop about the topic or idea?
- What did I learn about inquiry?
- What new academic vocabulary and skills did I master?
- What new questions do I now want to answer about the topic or idea?

Students can use the questions above as an outline for their reflective piece about their project. The reflection cements the learning and often motivates students to perform even better on their next project.

Part 4

MANAGING THE PROJECT

Requiring students to turn in interim products that demonstrate their ability to apply the skills they have been taught and show their progress on their projects is essential for middle school students. Critical to student success is the ability of the teacher to manage the components of the project. The strategies needed to support students through the inquiry process are:

- **Orient** students to the goals of the project on a regular basis as the project progresses. Continuously reinforce the goals of the project, often by referring to the essential question, to keep students focused and motivated. Communicate next steps to help students stay on task.
- **Communicate** with parents regularly, especially if students are not meeting interim deadlines.
- **Group** students appropriately. Students may work in small groups, individually or as a whole group. Groupings may change as the project progresses. Be aware of groups where not everybody is carrying his or her own weight. Students need to know that they can come to you for intervention if they can't work it out among themselves.
- **Organize** the project on a daily basis by continually defining the scope of inquiry. You are responsible for setting and enforcing deadlines, collecting artifacts from students as the project progresses, and offering the feedback that is necessary for keeping students on track toward successful completion of the project.
- **Manage** the workflow. This requires the usual collection of homework or other assignments at the right time. It also requires a constant watch on how the project is progressing and whether students are on track to complete the project successfully. If needed, provide additional information to give students the content needed to proceed.
- **Monitor and regulate** student behavior. Projects require students to move about the classroom and work independently. Students need time limits, directions for managing time, and deadlines to learn to manage independent time. You may have to adjust their use of resources and supplies until students are able to manage on their own.
- **Provide opportunities** for peer review and feedback throughout the process. Even if you do not have time to conference with every student at every phase of the project, you can enable students to practice and share their work and provide thoughtful reactions and suggestions to each other.
- **Clarify** at all points in the work. Projects involve multitasking and decision making, with students making choices about where they should put their time and energy.
- **Evaluate** the success of the project and help students recognize what has been learned – and what has not been learned, as a result of the project.

All students can be successful in project-based learning when teachers follow a careful process of designing, teaching, and managing the project. Of primary importance is constant monitoring of student progress, supportive structures and feedback, and time for students to develop the skills and do the work on their own. Students who successfully complete projects to become experts in a topic of interest carry that success to future endeavors.

Part 5

PROJECT-BASED LEARNING IN SOCIAL STUDIES

Introduction

Project-based learning in social studies empowers students to make sense and consider broad concepts and themes such as conflict, interdependence, and reform, among others.

The Social Studies Exit Project became a summer school resource for New York City middle schools in 2000. Since that time it has traditionally been utilized by many middle schools as a key part of the grade 8 instructional program. While schools can continue that practice, we recommend that students participate in a project-based learning experience by grade 7, though it is a valuable instructional component in grade 6 as well. The benefits of participating in focused, concentrated inquiry work on a self-selected topic in the social studies should be offered to all middle school students many times. In this way students will be exposed to multiple opportunities to interact with powerful social studies concepts and ideas through self-directed learning.

These powerful ideas and concepts become the focus of learning in social studies when projects emphasize the exploration and interpretation of historical events, persons or ideas, as opposed to the restatement of subject matter or information researched. Students connect with important ideas while they use and develop critical and other higher order thinking skills. A classroom that has project-based learning at its instructional core is a classroom alive with possibility and real, authentic learning.

The materials in this Section, when used in conjunction with the general materials in the first four Sections of this Guide, will provide you with extensive support for the implementation of a rich Project-Based Learning program in social studies for your school.

The Social Studies Project at a Glance

Student immersion in a specific topic of the social studies curriculum can lead to deep knowledge, understanding and appreciation of the subject matter. When middle school students commit to complete and present an in-depth research project in social studies, they engage in a meaningful learning experience that will prepare them with the critical skills needed for success in high school and the world of work and productive citizenship.

The NYC DOE Social Studies Scope and Sequence requires that all middle school students successfully complete at least one social studies project. The social studies project may be incorporated into the curriculum for grades 6, 7 and/or 8.

THE SOCIAL STUDIES PROJECT AT A GLANCE

Social studies projects are meant to assess the students' knowledge of social studies concepts and skills, such as the ability to:

- Analyze documents
- Critically interpret historical events
- Read non-fiction texts
- Utilize maps and globes

The project should attempt to question or interpret a historical event/person/ idea and not simply restate the subject matter.

Students should be able to select a topic of interest to investigate.

The project should include:
- research from multiple sources
- a written piece
- graphics or visuals that can be tables, graphs, charts, etc.
- oral presentation

The project may be done in cooperative groups, pairs, individually, or as a whole class.

The project presentations may be given to classmates, other classes, parents, and/or school/ community officials

Depending on the topic researched, the project may address some or all of the components below as well as others:

- Reviewing Essential Questions to identify a topic of interest for research
- Developing a research question
- Locating and using resources
- Creating a project time-line
- Note-taking
- Organizing information
- Writing Process: Drafting, Revising, Editing
- Creating a bibliography
- Creating a graphic representation of research
- Developing appropriate presentation format (aligned to written component)
- Developing the oral presentation
- Creating speaking notes/script
- Aligning presentation to written and graphic components
- Planning for use of visuals in presentation

Social Studies Explorer Logs

While students are actively engaged in the daily assignments and activities that support project-based learning in social studies, they should also frequently write and reflect on their learning. A good way to do this is to encourage students to create and maintain Explorer Logs. Explorer Logs are a type of social studies notebook. In this notebook or log, students can write their reflections, thoughts, questions and interpretations on what they are learning. They can also use the explorer logs for drawing, outlining and planning for their projects.

How to use the Explorer Logs:
Introduce Explorer Logs by purchasing "special" cloth bound notebooks and distribute one to each student. You can use plain 5" x 8" notebooks and allow students to cover the notebooks with pictures or images that relate to the word *explorer*.

As an option, students can also create electronic Explorer Logs or E-logs.

Encourage students to write in their Explorer Logs every day. The writing should occur immediately after the lesson or project work-time. Some questions to inspire reflection and metacognition are:

- What surprised you about what you learned today? Why?
- What one thing stays in your mind about what you learned today? Why?
- Do you have a burning question about something you learned today? Write about the question.
- Did anything confuse you?
- Did your new learning conflict with or disagree with something you already knew?
- Do you feel strongly about something you learned today?

Teacher Background for Reading as an Historian

Good social studies teachers are changing the focus of teaching history from a set of known facts to a process of investigation, modeled on how actual historians work. Students can learn that history is open to interpretation. Students can be taught to approach history like historians who analyze multiple primary and secondary sources and artifacts related to a single event, thereby questioning earlier conclusions drawn from them. (See the sample mini-lesson in Appendix 20 and the student handout in Appendix 21 on how historians conduct research.)

The writer's purpose can also influence the organizational structure of a document. For example, a propaganda leaflet may use a compare/contrast structure to illustrate opposing viewpoints. Primary and secondary sources may vary from the sequential narrative form that students see in textbooks to using structures such as problem/solution, main idea with supporting details, or compare/contrast.

The use of a variety of documents, rather than one book, requires additional cognitive skills of the reader. Thus, students need to be aware of the source information provided with the documents, in addition to their context. Also, rather than unquestioningly accepting facts, as students often do with textbooks, readers of multiple documents may face different interpretations of the same event based on contradictory evidence. The documents themselves can have varying degrees of reference; for example, a secondary source may refer to a primary source. Therefore, a student must be able to mentally organize a large amount of disparate and conflicting information and make literal sense out of it.

Developing a Research Question

Once students have selected a topic or theme that aligns with the instructional goals for the grade level, provide them with an opportunity to define the topic. This can be accomplished by reading a general overview, such as an encyclopedia article. Students can create a one-page outline that identifies the key points from the article.

Sample Topics – Grade 6

- Geographic factors that influenced the development of the Ancient River Valley Civilizations
- The global interactions of the Silk Road
- The fall of the Roman Empire
- Africa's tribal and clan identity vs. national identity
- Middle Eastern economy today
- Asian trade and cultural diffusion

Sample question and thesis statement for topic: The global interactions of the Silk Road

Q: What effect did the global interactions of the Silk Road have on the development of understanding among cultures?

TS: The global interactions of the Silk Road led to ….

Sample Topics – Grade 7

- Cultural interactions and conflicts between Native Americans and Europeans
- New York and Slavery
- The limitations of the Articles of Confederation
- The Bill of Rights today
- Territorial expansion and Native Americans
- The Women's Rights Movement
- The 13th, 14th and 15th Amendments

Sample question and thesis statement for topic: The Bill of Rights today

Q: What does it mean to be free?

TS: The Bill of Rights protects the freedoms of …

Sample Topics – Grade 8

- Immigration push-pull factors
- Societal impact of industrialization
- Era of Boss Tweed and Tammany Hall
- Rise of leisure time in the 1920s
- FDR's New Deal
- Causes of World War II
- The Civil Rights Movement
- Superpower rivalry during the Cold War

Sample question and thesis statement for topic: Superpower rivalry during the Cold War

Q: How do competing views of power and morality lead to global conflict?

TS: The conflict of competing political views in the 1950s resulted in …

Student Guide to Research

Valid Social Studies Project research should reflect a variety of sources and formats. Printed text, visuals, and electronic resources are the most frequently used sources of information. Many students rely heavily on the Internet as the source for research. The Internet, however, is not a substitute for the library. It is a tool best used **in addition to** traditional research sources. Many students mistakenly believe that "everything" is available on the Internet. The library and the Internet have their own unique resources, benefits, and limitations. Provide your students with resource guidelines that require them to research multiple perspectives using a variety of sources.

When interpreting and evaluating a source, direct the students to consider the following questions:

- Is this source valid?
- Whose voice or perspective is represented in this source? Whose voice is omitted?
- Who created the document? For what purpose? For what audience?
- What was the context for the creation of the document?

LIBRARY RESEARCH

Advantages

- There are professional books, newspapers, magazines, and other resources that have been edited and reviewed prior to their publication.
- The resources have all been individually selected by a trained professional.
- The library provides free access to journals, magazines, newspapers, encyclopedias, and other print reference works.
- Knowledgeable reference librarians will help locate resources.
- A universal cataloging system classifies and organizes all resources, so that anyone can find everything in the library.
- The library often has archived materials—newspapers and magazines—that date back many years.

Disadvantages

- Library books take time to order and be available on the shelves.
- Resources can be checked out by other patrons and, therefore, may not always be available.
- A library's publications cannot provide up-to-the-minute news and information the way websites can.
- The library closes after hours and may not have weekend hours.
- Libraries are not always well-funded and up-to-date.

INTERNET RESEARCH

Advantages

- The Internet offers a complete multimedia experience, with text, video, interactive features, audio, hyperlinks, and graphics all in one place.
- Online resources can be accessed 24 hours a day, 7 days a week, in a very short amount of time.
- Websites can be constantly updated to provide breaking news and timely information.
- The Internet provides access to many full-text newspapers, magazines, journals, and encyclopedias.
- Some sites feature rare books, documents, and special collections that traditionally have only been available in research libraries.

Disadvantages

- There are over 4 billion unique, publicly accessible Web sites and only 6% of these have educational content.
- Anyone can publish a Web page and no one oversees the Internet to check that the information is correct, current or able to be authenticated.
- Not all websites are appropriate for students.
- Google, the largest search engine, has indexed fewer than 18% of the available pages.
- The average life span of a web page is 75 days.

Adapted from: http://warriorlibrarian.com/RESEARCH/libresearch.html and http://www.classzone.com/books.

Using Documents in the Social Studies Project

Through the use of documents in the study of a historical era, students will see the time period presented to them "…both as a whole, and as individual slices representing different elements of the era ." This skill, which is assessed on the New York State social studies examinations from grades five to eleven, enables students to critically interpret the events of a particular period and analyze them from multiple perspectives.

The different types of documents your students will encounter as they research their social studies projects may include written documents, photographs, posters, charts/graphs, maps, cartoons, video/motion pictures, and sound recordings. It is important that the students understand that each document is both a separate entry, and part of a larger "story."

Once the type of document has been identified, it needs to be placed within its proper historical context. Look for the format of the document (typed, drawn or handwritten), the letterhead, language used on the document, seals, notations, or date stamps. Use these questions as a guide as students examine the document.

- What kind of document is this?
- What is the date of the document?
- Who is the author (or creator) of the document?
- For what audience was the document written?
- What was the purpose or goal of the document? Why was it written?
- List two things from the document that tell about life at the time it was written.
- Write a question to the author that is left unanswered by the document.
- Tell how the document reflects what is going on during this period.

Primary and Secondary Sources

What are Primary Sources?

Primary sources enable the researcher to get as close to the truth of what actually happened during a historical event or time period. Primary sources are the evidence left behind by participants in, or observers of, an historical event. The following are generally considered primary sources:

- Diaries, journals, speeches, interviews, letters, memos, manuscripts and other papers, in which individuals describe events they either saw or participated in, offer firsthand accounts. Many people can experience the same event, but their retelling of the event may be different based on their perspective or point of view. Learning about the same event from different sources helps us to appreciate diverse voices and understand history more fully.
- Memoirs and autobiographies are generally less reliable since they are usually written long after events occurred and may be distorted by bias, dimming memory or the revised perspective that may come with hindsight. On the other hand, they are sometimes the only source for certain information.
- Records of organizations and agencies of government (e.g., minutes, reports, correspondence) can serve as an ongoing record of the activity or reveal the thinking of that organization or agency. Many kinds of records (births, deaths, marriages; permits and licenses issued; census data; etc.) document conditions in the society.
- Published materials (books, magazine and journal articles, newspaper articles) may have been written at the time about a particular event. While these are sometimes accounts by participants, in most cases they were written by journalists or other observers. It is important to distinguish between material written at the time of an event as a kind of report, and material written much later, as historical analysis.
- Photographs, audio recordings and moving pictures or video recordings provide documentation about what happened.
- Artifacts of all kinds, which include physical objects, buildings, furniture, tools, appliances, household items, clothing, and even toys, enable students to connect with the reality of the past.
- Ideas and images conveyed in the mass media, and even in literature, film, popular fiction, self-help literature, and textbooks can serve as sources of the culture and psychology of a time period.

What are Secondary Sources?

A secondary source is a work that interprets or analyzes an historical event or phenomenon. It is generally at least one step removed from the event and is not written by witnesses to the event. Textbooks and encyclopedias are two examples of secondary sources.

[1]*James Percocco, Using Primary Sources: A Guide for Teachers and Parents (Primary Source Media, 1995).*

Maps

Maps and nautical charts allow students to see what the world was like at different periods in history, and how geography and natural and man-made features have changed over time. They also show how changes in technology have led to greater accuracy and sophistication from the past to the present. Using maps can provide clues that help students to place an event within its proper historical context.

Student Use of Maps

The different parts of a map, such as the map key, compass rose, and scale help to analyze colors, symbols, distances, and direction on the map.

Decide what kind of map you are studying: raised relief map, topographic map, political map, contour-line map, natural resource map, military map, bird's-eye view map, artifact map, satellite photograph, pictograph, weather map, another type of map. Each type of map was created for a different purpose.

Examine the physical qualities of the map:

- Is the map handwritten or printed?
- What dates, if any, are on the map?
- Are there any notations on the map? What are they?
- Is the name of the map-maker on the map? Who is it?

All of these clues will help students keep the map within its historical context.

- Read the title to determine the subject, purpose, and date.
- Read the map key to identify what the symbols and colors stand for.
- Look at the map scale to see how distances on the map relate to real distances.
- Read all the text and labels.
- Why was the map drawn or created?
- Does the information on this map support or contradict information that you have read about this event? Explain.
- Write a question to the map-maker that is left unanswered by this map.

Political Cartoons

Political cartoons and cartoon strips present a personal perspective on history. Both formats use humor or exaggeration to comment on an historical event or person. Political cartoons are usually about government or politics. They often comment on a person or event in the news. Political cartoons reflect the artist's opinion, or belief, about a current issue. Similarly, political cartoons try to persuade people to see things in a certain way. The ability to analyze a political cartoon helps students to better understand different points of view about issues during a particular time period.

NAST, 1870

Student Use of Political Cartoons

- Pay attention to every detail of the drawing. Find symbols in the cartoon. What does each symbol stand for?
- Who is the main character? What is he doing?
- What is the main idea of the cartoon?
- Read the words in the cartoon. Which words or phrases in the cartoon appear to be most significant, and why?
- Read the caption, or brief description of the picture. It helps place the cartoon in a historical context.
- List some adjectives that describe the emotions or values portrayed or depicted in the cartoon.
- Ask: "What do I think is the cartoonist's opinion? Why?"

Posters and Advertisements

Posters and advertisements are a visual window into the past. Many advertisements are printed as posters. They are created to persuade individuals or groups to support an idea or cause. By looking at posters, students can understand what issues were important during different times in history. Examples of posters are the ones that were used on the home front in the United States during World War I and World War II.

An advertisement is a way to try to sell something. Historical advertisements provide information about events or products. By reading these advertisements, students can learn about the daily life and culture of people in different countries and in different historical periods.

Generally, effective posters use symbols that are unusual, simple, and direct. When studying a poster, examine the impact it makes.

- Look at the artwork. Observe and list the main colors used in the poster. What does the artwork show?
- Determine what symbols, if any, are used in the poster. Are the symbols clear (easy to interpret), memorable, and/or dramatic?
- Explore the message in the poster. Is it primarily visual, verbal, or both?
- Determine the creator of the poster. Is the source of the poster a government agency, a non-profit organization, a special interest group, or a for-profit company?
- Define the intended audience for the poster and what response the creator of the poster was hoping to achieve.
- Read the caption. What does it tell you about the historical context?

Pay attention to every detail in the advertisement. Look for answers to *Who? What? When? Where?* and *Why?*

- Determine the main idea of the advertisement by reading all slogans, or phrases, and by studying the artwork.
- What is the poster / advertisement about?
- When is it happening?
- Where is it happening?
- Who is the intended audience? Identify the people who the advertisement is intended to reach.
- Why is it being advertised?
- Describe how the poster reflects what was happening in history at that time.

Final Thoughts for Teachers on Social Studies Project-Based Learning

Social Studies projects are a dynamic way to help students pursue the adventure of learning history, geography, economics, and so much more. Rather than struggle to teach huge amounts of materials with the goal of "covering" the curriculum, the projects let students dig deep and begin to understand how social studies and history are vital parts of living in a democracy. To understand and see the relevance of social studies or history, students need to "do" history and these projects allow students to "do."

Noted researcher Sam Wineburg said it best: "Questions are the tools of creation… they dwell in the gap between one's present knowledge and the circumstances of the past.….Students should enter into a world of drama – suspending their knowledge of the ending in order to gain a sense of another era – a sense of empathy that allows the student to see through the eyes of people who were there."

> *History is the present, that's why every generation writes it anew.*
>
> — E.L. Doctorow

> *History is, indeed, an argument without end.*
>
> — A.M. Schelesinger, Jr.

> *"History" is a Greek word which means, literally, just "investigation."*
>
> — Arnold Toynbee

> *History isn't really about the past… It's about defining the present and who we are.*
>
> — Ken Burns

> *We cannot escape history*
>
> — Abraham Lincoln

> *Nowhere is it ordained that history moves in a straight line.*
>
> — Barack Obama

> *History is herstory, too.*
>
> — Anonymous

> *People are trapped in history and history is trapped in them.*
>
> — James Baldwin

Part 6

PROJECT-BASED LEARNING IN SCIENCE

Introduction

Tapping into our students' natural curiosity is the first step toward real science learning. Project-based learning in science nurtures this natural curiosity by sending our students on a journey of discovering and experimenting with the mystery and wonder of science. We want to encourage our students to watch and wonder about forces and living things and to ask WHY?

Project-based learning experiences in science motivate students to understand the world differently and ponder why things are the way they are. Students learn much more easily when there is excitement for the subject or topics. This does not mean that we make the science curriculum less challenging, but rather that we focus on deep learning. It means we stress that science is, more than anything, about questions and amazement.

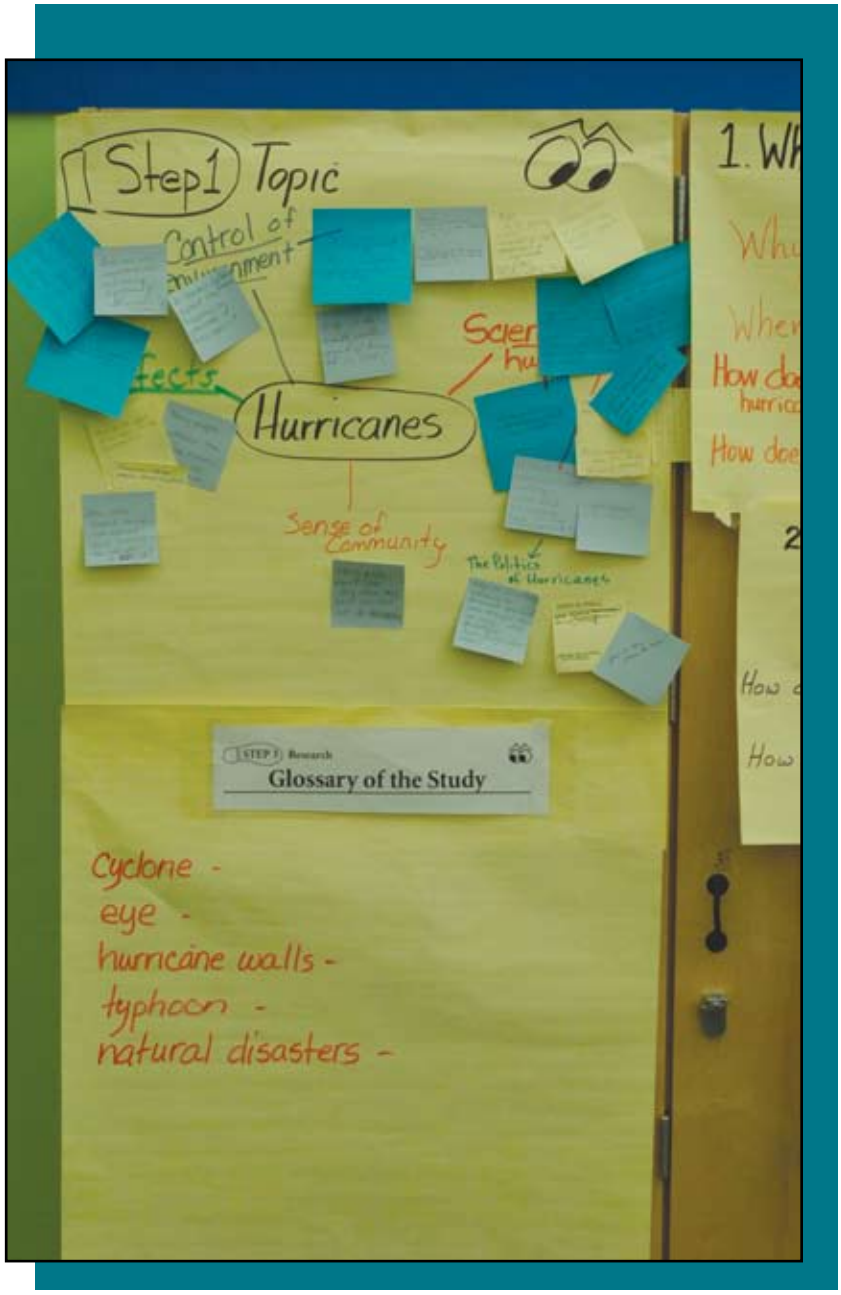
The Science Exit Project became a summer school resource for New York City eighth grade students in 1999. Since that time it has been utilized as a key part of the grade eight science scope and sequence. A project-based approach to learning is in keeping with the notion that student immersion in a specific area of the curriculum, in an in-depth fashion, can yield deep understanding of a subject area.

Students will remember the challenges—as well as the rewards—that come with completion of their projects. They will also gain a deeper understanding of content and process. They will find the research and investigation skills they learned to be useful as they continue their studies in high school and college and pursue their role as lifelong learners.

The materials in this Section, when used in conjunction with the general materials in the first four Sections of this Guide, will provide you with extensive support for the implementation of a rich Project-Based Learning program in science for your school.

Picking a Topic / Making Observations

Before students decide on a topic and testable question, students must first find something that they want to learn and explore in greater detail.



An observation is the use of the five senses (hearing, sight, smell, taste and touch) to perceive something. Anything, living or non-living, can be a source for students to make observations.

Students will use their Science Exit Project journals (discussed later in this section) to record their observations as they visit different science institutions and explore the world around them. Their observations will be recorded in words, pictures and diagrams. Students should include questions with their observations about what makes them curious, wonder, or want to learn more.

Ideas students should keep in mind when making observations.

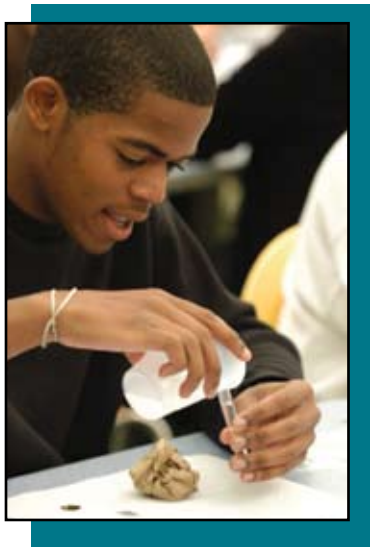
- What made you notice it?
- What does it look like?
- How does it behave?
- Did you ever see something like that before?
- Are you familiar with it?
- Can you make a connection with something else?
- What intrigues you to question or learn more?

After students have explored different areas of science, have them answer the following questions.

- Are there any possible ideas or topics that you want to explore further?
- How can these lead to a science investigation?

Teachers may opt to assign a topic / specific area of investigation or allow the students to select any topic that fits within the range of science. (Remember though that a broader range of investigation might entail greater teacher time and effort than more focused assignments.)

Types of Research Projects



Students will receive detailed instruction and support from their science teacher to complete one of the following types of research projects:

Controlled Investigation (Primary Research)

Students manipulate the variable being studied. **Students will:**

- Identify a problem
- Collect background information
- Make an hypothesis
- Determine the materials used
- Design the procedure, including identifying which factor will be varied and what to be controlled
- Ensure that the tools being used are appropriate for the investigation
- Determine how, when and where measurements will be taken
- Collect data and represent the data in multiple ways (charts, graphs, diagrams)
- Replicate the procedure at least three times
- Analyze the data collected
- Form a conclusion based on the data collected and the stated hypothesis
- Be prepared to ask new questions based on the results of the investigation

Examples of Controlled Investigation are:

Plan and implement an experiment to:

- Determine the effect of various coatings on the corrosion of a metal.
- Determine the effect of energy, such as light or heat, on the growth of aquatic or land plants.
- Mimic the effects of acid rain on the environment. Students can explore how liquids of varying pH affect the growth of plants.
- Determine the effect of soil samples from various areas of their neighborhood on plant growth.

Field Investigation (Primary Research)

There are different types of field investigations; these include, but are not limited to, organism behavioral studies, field transects and geological field studies. Students will study the natural or man-made environments or the behavior of any organism such as animals, plants or others. Students will gain practical experience and knowledge through firsthand observations. For all organism behavioral studies, the student is a non-intrusive observer in the environment (i.e., does not interfere in any way with the organism or the environment). Students will answer a question by making and recording observations. **Students will:**

- Identify a problem
- Collect background information
- Make an hypothesis
- Design a schedule of observations to be made
- Identify the data that will be collected
- Identify the method for the collection of data.
- Construct an ethogram (for organism behavior), a transect chart or other appropriate data table
- Observe and record the data
- Collate and represent the data in multiple ways (charts, graphs, diagrams)
- Analyze the data collected
- Form a conclusion based on the data collected and the stated hypothesis

Examples of Field Investigation are:

- Identify variables that affect tree growth in the neighborhood around the school and correlate the variables with observable tree characteristics.
- Observe and record, and then compare and contrast, the behaviors of a male and female animal.
- Test different water sources (such as tap water, bottled water and rainwater) for contamination.
- Observe and record the location of an area within a fish tank or a habitat of an animal. Form an hypothesis, based upon this collected data, as to why that animal might frequent that area of the habitat as opposed to another area.

Design Investigation (Primary Research)

Students use their understanding of scientific principles to design and construct a product that meets an identified need. **Students will:**

- Identify a need
- Obtain, from a variety of sources, information about that need (background research).
- Determine the criteria for success (testing, relevant parameters)
- Propose several possible designs for products that might meet that need, taking into consideration constraints such as cost, time, trade-offs, and materials needed
- Create an optimal design (for example, small scale model or a schematic) and explain why it is optimal
- Develop detailed plans for ways that the selected design could be tested
- Test the design and gather data
- In the case of projects in which it is not possible to test the design, develop a plan to evaluate the design over time to see if it does meet the identified need and then create a realistic hypothetical data set that could be used to analyze the effectiveness of that design
- Analyze the data collected and revisit the design and revise if necessary

Examples of Design Investigation are:

- Design and construct a hydroponic greenhouse for growing vegetables without soil.
- Design and construct a plant growth chamber, based upon modifying existing greenhouse/growth environments.
- Design a pet toy and hypothesize on its frequency of use, based upon observations of an animal with an existing pet toy. Remember even here we do not experiment on vertebrates.
- Design and create a school-wide recycling program which will include the data collection of the amount of recyclable and non-recyclable waste.

Secondary Research Investigation

Students will use data obtained by others to answer a question. Data sets are numerical data that have been generated by previous research. The questions should address “How has X been affecting Y over Z years?”
Students will:

- Identify a problem
- Collect background information
- Make an hypothesis
- Design a research plan that identifies the data that are to be collected and the sources of those data
- Obtain the data
- Make sure that the data sets are comparable in terms of units, contents, years or other factors
- Reorganize the data that are being used into tables and graphs
- Analyze the data based on the question being asked and the hypothesis stated
- Form a conclusion based on the data collected and the stated hypothesis
- Identify further questions

Examples of Secondary Research Investigation are:

- Determine long term trends and patterns from weather data.
- Determine trends in hurricane occurrences from records of hurricanes.
- Determine the trends of earthquake magnitudes and frequencies from earthquake records.
- How has the rise in tolls affected the air quality index in New York City?

Science Journal Writing

A science journal enables students to be accountable for their own learning process. It helps in developing writing skills and enhancing communication skills in science. Journal writing also helps students understand how real-world problems can be solved. Scientists regularly use daily journal writing as a means of understanding their thought processes. Journal writing further expands and develops students' abilities to reflect on their own thinking processes.

Purpose of the Science Journal

Teachers should decide on a specific purpose for their student journals. Teachers may choose to have two separate journals – one for exit-project-related investigations/ experimentation/ field trips and one for classwork. This guide will include science journal writing on science exit project investigations; classroom journal writing is equally important but will not be discussed in this guide.

What should students write in their journals?

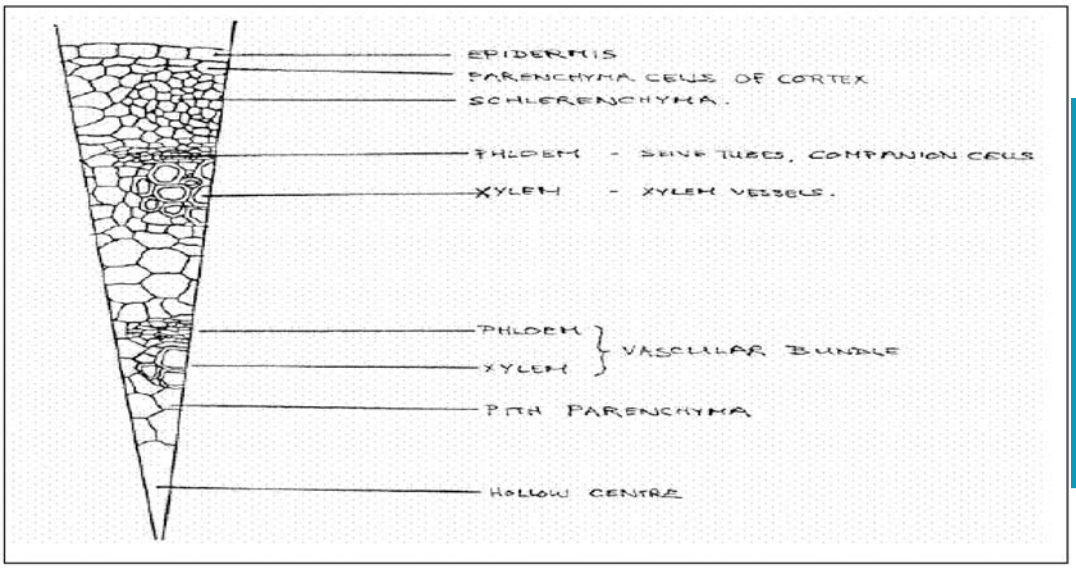
- Scientific observations
- Thoughts/reflections about observations
- Questions
- Exploration of ideas, questions, and thoughts
- Data collected in experiments
- Connections between observations and science concepts learned
- Notes on experiments
- Labeled graphs, data charts, drawings, images, photographs and/or diagrams with comments
- Sketches on observations from a field trip or lab set up
- Pressed samples or rubbings of gathered objects
- Reflections on reflections

Students are encouraged to record observations, take notes on and sketch anything related to their investigations. Students can write their personal ideas of their observations using words and diagrams. Some of the collected samples can also be included in the journal. Teachers may want an envelope or a re-sealable plastic bag to be stapled to the back of the journal as a means of storing the collected samples.

Students should be taught the differences between facts and opinions (objective vs. subjective statements). In addition, students should be motivated to use all senses in their observations where appropriate.

Illustrations

Encourage students to sketch and draw simple diagrams. Teachers should explain to students that they do not have to be artistically ambitious in their drawings, but that drawings should be labeled as accurately as possible. However, collaboration with the art teacher might at times be possible.



Guidelines for a microscope drawing:

1. Drawings, including labels, name and other information, should be done in pencil.
2. The title of the drawing is simply the name of the object being looked at.
3. The drawing should be as large as possible (at least 1/3 of the page) and should be kept to the left of the center of the page.
4. All labels must be printed and are to be lined up on the right hand side of the drawing. Use a ruler for label lines.
5. The drawing should be an outline of what is seen. Do not include additional structures just because you think you should see them.
6. Do not shade or sketch. All lines should be solid and complete.
7. The final calculation needed when using the microscope is to calculate the magnification of your drawing. (This is a way of calculating how many times larger the drawing is in relation to the estimated size of the object.)

How should students begin their voyage of journal writing?

Teachers should provide examples of journal entries.

The following is an example of a lesson on journal writing:
The teacher begins by describing an object without revealing its identity. By doing this exercise, students begin to understand the importance of including a variety of details in their descriptions. Teachers can choose to pair up students and give student (A) an object. Student A will be asked to keep the object hidden from the partner (B). While Student A is describing the details of the object, Student B can draw the object and take a guess at its identity.

In order to practice journal writing, general observations on class, animal behavior or plant growth can be made and recorded. Using these examples for discussion, students can determine the final list of the types of details which should be included in their journals. Students can include this final list in their journal.

When should students write in their journals?

Teachers should encourage students to write in their journal as often as possible to record ideas and observations. Students can write in their journal at every stage of their investigation. They can draw or sketch what they see and write down their impressions.

What types of details could be recorded in the science journal?

Students are expected to write questions (for example, questions about observations, the experiment or the ongoing exit project investigations). Teachers could lead small group discussions with students to help them identify close-ended questions and open-ended questions relative to their investigations. Students can learn to write questions that involve higher critical thinking skills. Some of these questions may transform into further investigations. Students should understand that journal writing is integral to a real scientist's work.

Special Note for Teachers

The main purpose of the journal is for students to be able to reflect on their own learning process. Journals don't need to be corrected and graded. However it is good to provide feedback. Teachers can write comments on self adhesive memo pads to respond, for example, to difficulties in comprehending specific scientific phenomena and concepts.

Teachers are encouraged to critique journal writing as "work in progress." Teachers can offer suggestions, constructive remarks, questions and encouragement. Students can record their observations and write their own responses to those observations.

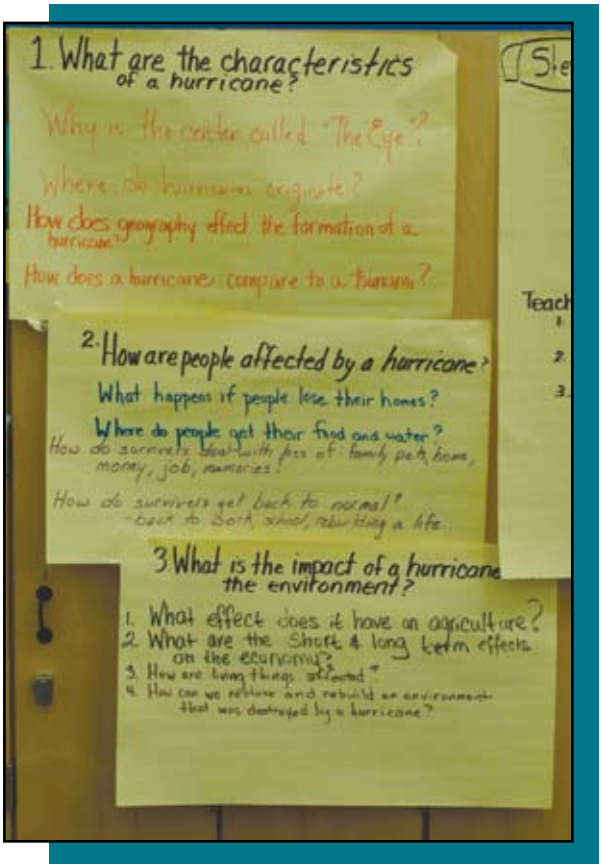
Establishing a Science Exit Project Portfolio

Students should create a print and/or electronic portfolio in which all drafts of work are maintained, including but not limited to, any kind of data/tables, maps, photocopies, and pictures / photographs / images.

The completed Science Exit Project Portfolio can now become a portion of the students' overall science portfolio. This portfolio will travel with them next year and will enable them to scaffold their work and build upon the existing project for a more in depth investigation.

Components of Scientific Inquiry and of a Science-Formatted Report

Traditionally, scientists use the term "scientific method" to describe the structured order and process of a scientific investigation; scientific inquiry uses the traditional steps of scientific method to create a long-term investigation. (The New York City Performance Standards [S5] Scientific Thinking and [S8] Scientific Investigation, which are core motivators for this project guide, are derived from the New York State Intermediate Science Core Curriculum for Math, Science and Technology [Standards 1, 2, 4, 6 and 7].) Since there are many ways that students study the natural world, not all inquiries follow the same steps in the same order. However, most follow a pattern and include similar components.



There is, for example, the "5 E's" instructional model (engage, explore, explain, extend and evaluate) which is adopted from the Biological Science Curriculum Study (BSCS):

- Engage: Focuses on student attention by stimulating their thinking and causing them to access prior knowledge.
- Explore: Students have an opportunity (with sufficient time allotted) to think, investigate, test, make decisions, solve problems, collect information and draw conclusions.
- Explain: Students analyze their explorations and their understanding becomes clearer and more solid. Misconceptions are modified and the actual concept is better grasped.
- Elaborate/Extend: Student comprehension becomes more evident and grounded as students are expected to provide more detailed responses and to apply their conceptual knowledge to real-world situations.
- Evaluate: Teacher and students assess student performance and/or a conceptual understanding of topics discussed.

The traditional scientific method is one way of approaching and reporting about a science problem/investigation. Students should be taught about and become thoroughly familiar with each of the components of the scientific inquiry listed below and use them as one possible approach. This section will cover the steps of the scientific method, as well as the criteria for creating a science report. Remember that the components listed below are suggested for the exit project report; criteria may vary with different teachers.

Overview of Scientific Investigation

It must be accepted that a scientific investigation operates on certain core tenets. A science experiment must have a purpose, such as furthering knowledge, solving a problem, or answering a question. Science must follow a logical progression of steps. It must be replicable, not only by the original scientist, but by all other scientists who care to repeat the experiment. Science must be shared.

The scientific method asks and answers specific scientific questions by making observations and doing experiments. Even though we show the scientific method as a series of steps, keep in mind that new information or thinking might cause a scientist to back up and repeat steps at any point during the process.

Step 1: Ask a question. Questions are the foundation of all science. Most good questions come from observation of the world around us. A desire to understand phenomena or consequences or function leads to questions. Encourage the student to produce journal questions, even if the student does not understand how the question could be answered or how the question fits into the scheme of the student's ideas. The questions will help to form a purpose for the project.

Step 2: Do background research. The background research may be obtained from a variety of sources. Some examples of reliable sources for background research might be: the Internet, the library, an encyclopedia, magazines, journals, newspapers, interviews with experts, or other media.

Step 3: An hypothesis is an educated guess, based on observation. Usually, an hypothesis can be supported or refuted through experimentation or more observation. An hypothesis can be disproven, but not proven to be correct or true.

For example: If you see no difference in the cleaning ability of various dish-washing detergents, you might hypothesize that the cleaning effectiveness is not affected by which detergent you use. You can see that this hypothesis can be disproved if a food stain is removed by one detergent and not another. On the other hand, you cannot prove the hypothesis. Even if you never see a difference in the cleanliness of your eating utensils after trying a thousand detergents, there might be one that you haven't tried which could be different.

Step 4: Design and perform an experiment. This step varies based upon the type of exit project students are doing. Obviously, they cannot design an experiment if they are doing secondary research. In a field investigation, there is no experimentation, but students can outline a plan for data collection methods. In a design project, students need to show a method of testing or collecting data from the existing design and show how it can be applied to their design. The experimental steps should be listed methodically and with great care and rigor, so as to ensure reproducibility.

Step 5: Collect and record data. In a design project, it is not always possible to collect data. Here the student would describe how data "might be" collected and tested and should provide a realistic hypothetical set of data to work within for the rest of the project. In a secondary research project, students must ensure that all data collected correspond chronologically and that all data are in corresponding units (aids and more information on collecting and recording data are in the Appendices of this Guide).

Step 6: Create graphs and analyze the data. Students should design charts, tables, graphs, and other representations of observations in conventional and creative ways to help them address their research question or hypothesis. Most students in the eighth grade are familiar with bar graphs and pie charts; however, further support might be required. For the analysis, the students explain their results and interpret graphs and charts. Encourage the students to explain **WHY** they got the results they did.

Step 7: Form a conclusion. Here the students restate their hypothesis and explain whether their hypothesis was supported or unsupported by the results of their investigation. Students should include an explanation of why it was supported or not supported.

Step 8: Reflect on the entire experiment. The students offer conjecture as to what may have been possible sources of error in their project. If they could repeat the project again, what they would do differently to improve the project? If the project raised new questions (next steps) for the students (which a good project should), what new questions arose?

The Science Report

Here are some overall guidelines for the appearance of the report. These are suggested in order to give the students a sense of uniformity and consistency and to give them an idea of what a formalized report should look like (i.e., more in line with national science contest requirements). Each section shown below should be started on a fresh page. If the sections do not fill up a page, inform the students that it is acceptable to leave blank space as they move from section to section.

A further suggestion would be to teach students to write in third person scientific format, which means avoiding the use of personal pronouns such as "I", "My", "We" or "Our."

The Cover Page – The cover should have a three-inch border on the top and one-inch borders on the sides. It should be center-justified.

Descriptive title
by
Student Name
Other Group Member Name 1
Group Member Name 2

MS # School Name
Mr. (or Ms., Mrs.) Science Teacher's Name
Class 8__ __

From this point on, the entire rest of the report should have a one-inch margin on all sides, top, bottom, right and left. Remind students not to forget to put footnotes in their report or it could be considered to have been plagiarized.

Section 1 – ***Abstract*** – a very brief one-paragraph description of the entire project. Be sure that it includes one sentence each about the purpose, the hypothesis, the procedure, the results and the conclusion. Even though this is the second page, it is the last thing that the student actually writes.

Section 2 – ***Purpose*** – in this section the students describe their project or investigation. This is not the hypothesis, but more about their guiding question or reason for deciding on this project or investigation.

Section 3 – ***Background Research*** – bulleted list of facts only (no paragraphs). Each fact should be footnoted.

Section 4 – ***Hypothesis*** – The student states his or her hypothesis. Traditionally students are taught to complete an "If…then…." statement; however, they might want to use the "expected…because" model.

Sample Hypothesis for a Controlled Investigation - *The hypothesis is that _____ is expected to cause _____, because _____.*

Sample Hypothesis for a Field Investigation - *The hypothesis is that a _____ is expected to _____, because _____.*

Sample Hypothesis for a Design Investigation - *The hypothesis is that making (or changing) _____ is expected to cause (or be better than) _____ , because _____.*

Sample Hypothesis for Secondary Research Investigation- *The hypothesis is that _____ has been causing changes in (or is related to changes in) _____ over the past _____ years, because _____.*

Section 5 – **Materials** – A bulleted list of everything used in the project, listed in detail.

Section 6 – ***Procedure*** *–* A step-by-step numbered list of everything done in the project and in what order. Inform the students that it is like writing a recipe. It should be written so that someone else can follow exactly what they did. Remind them that one of the basic components of "good science" is that the experiment is repeatable.

Section 7 – ***Results*** *–* Here the students present their results only; they do not interpret them, they just say what they discovered. All charts, drawings, diagrams and graphs should be included here.

Section 8 – ***Analysis*** *–* In this section the students explain their results and interpret graphs and charts. Encourage the students to draw upon outside knowledge, and use scientific concepts to explain WHY they got the results they did.

Section 9 – ***Conclusion*** *–* Students restate their hypothesis and explain whether their hypothesis was supported or unsupported by the results of their investigation.

Section 10 – ***Reflection*** *–* Students consider possible sources of error in their project. If they could repeat the project again, what they would do differently to improve the project? If the project raised new questions (next steps) for the students (which a good project should), what new questions arose?

Section 11 – ***Bibliography*** *–* A detailed bibliography of all sources; books, articles, Internet and other online resources should be included here.

Section 12 – ***Footnotes or Endnotes*** *–* References showing the particular source (including page number) of specific information provided in the investigation. This is especially relevant in secondary research.

Section 13 – ***Glossary*** *–* A dictionary of terms so that an audience can understand words with which they might not be familiar.

Appendix *–* Any "full page" documents the student wants to attach. For example a blank copy of a data collection sheet, an ethogram, copies of photographs or illustrations.

Legal Considerations for a Science Exit Project

Should a student inquiry project involve work with animals, the following law may apply:

New York State Education Law §809(5): Treatment of Live Vertebrate Animals

Education Law §809 (5) provides that no school district, school principal, administrator, or teacher shall permit the performance of certain specified types of lessons or experimental studies on live vertebrate animals in the school or during an activity conducted under the school's auspices. These activities are prohibited whether or not they take place on school premises. For example, a teacher may not allow a student to conduct the prohibited experiments on live vertebrate animals for a school sponsored science fair even if the experiment is conducted at a research institution.

Under certain circumstances, the Commissioner may grant a waiver from this restriction upon a school's submission of a written program plan. The school district must obtain a waiver *before the lesson or experimentation begins*. Instructions for applying for such a waiver and the appropriate forms are provided by visiting the following website: http://www.emsc.nysed.gov/ciai/mst/science/809_5waiver.htm

Recording and Storing Information

Record keeping is essential to good research and inquiry. The computer is one of the best tools for record keeping, storage and retrieval. Science journals or logs are also good ways to record information. Students must be taught to record all information, particularly since they never know how any given piece of information can be used to help them in their final project.

Encourage students to get comfortable with spreadsheets on the computer. Remind them to save their data often and recommend the use of some external storage medium whether it be a CD, DVD or thumb-drive. Students might simply e-mail themselves a copy of their report and store it in their e-mail mailbox. (Remember that the final report must be computer typed.) For those students who do not have a computer at home, remind them of times when school computers are available and that every public library also offers free computer time.

Basic questions need to be answered in order to determine the best method of recording and storing information. What is the frequency of the data to be stored? Will the student be making observations or making measurements every 15 seconds or every week? Obviously, the object or phenomena being observed or measured will dictate the recording interval. Additionally, the data itself will help to determine the appearance of the data collection sheet. Will the data be given as simple measurements or will each response be a written description?

Students should keep work in progress in a physical or electronic portfolio specifically for this research project. Encourage the students to use the Self-Assessment Rubric (found at Appendix 22) as a method of ongoing self-assessment. It will also help students to keep track of where they are, what pieces need more work, and ways to manage their time.

Urban Advantage

Urban Advantage (UA) is a standards-based partnership program in middle school science education designed to improve students' understanding of scientific inquiry through collaborations between the NYC Department of Education and eight NYC science-rich cultural institutions. UA provides extensive teacher professional development, science materials and equipment, and student and family vouchers for free access to UA partner institutions that include the **American Museum of Natural History, Brooklyn Botanic Garden, New York Botanical Garden, New York Hall of Science, Queens Botanical Garden, Staten Island Zoological Society,** and **the Wildlife Conservation Society's Bronx Zoo** and **New York Aquarium.** UA has a clearly defined purpose: to improve NYC middle school students' understanding of scientific inquiry through the implementation of the eighth grade science exit project experience. The Exit Project information that follows (guidelines for creating the Science Exit Project poster and project examples) has been developed by UA.

Creating the Science Exit Project Poster

- The display should be mounted on a display board that can sit on top of a table and stand up by itself.
- The display should fit into a space approximately 36 inches high and 48 inches wide.
- The display should have writing that is large enough to read easily. Please see the sample display layout, which follows this outline, for suggested organization.
- The display should include the sections listed below.

Sections on the Science Exit Project Poster

Title: The title should state both the independent variable and the dependent variable. ***Sample format:*** "The effect of (the independent variable) on (the dependent variable)."

Question: The question describes the focus of the investigation. The question should ask how the independent variable will affect the dependent variable. The question should be written so that someone else can easily understand it. **Sample format:** "How will (the independent variable) affect (the dependent variable)?"

Hypothesis: An hypothesis predicts the effect that changing the independent variable will have on the dependent variable in the investigation. It predicts the effect that the change purposely made in the independent variable will have on the dependent variable. The hypothesis should make a statement about what the student thinks will happen and why ("because…"). **Sample format:** I think (independent variable) will affect (dependent variable) and I expect (predicted result) because (describe the scientific reasons of why you expect this relationship between the variables; include scientific concepts that relate to this prediction). **Sample format:** If (summarize investigation or action being planned, i.e., changing the independent variable) then (predict result, i.e., effect on dependent variable) because (describe the scientific reasons of why you expect this relationship between the variables. Include scientific concepts that relate to this prediction).

Background Information: Describes the student's reasoning behind the hypothesis – why is this relationship between the variables expected/predicted and not a different relationship? Students should use this space to answer the question: "What did I read that makes me predict this outcome?"

Experimental Design: Using the five components below, describe the design of the investigation:

1. **Independent variable:** the variable that the student changes on purpose. (In a field study we describe the IV as the category(ies) that the student chooses. In a secondary research project, we describe the IV as the variable that the student lets change and does not keep constant.)
2. **Dependent variable:** the variable that may change as a result of changes purposely made in the independent variable.
3. **Constant variables:** the variable(s) in an investigation that are kept the same and not allowed to change or vary.
4. **Control group:** Controlled experiments are often the only type of exit project that have a control group. They are the part of an experiment that serves as a standard of comparison. A control is used to detect the effects of factors that should be kept constant, but which vary; the control may be a "no treatment" group.
5. **Number of repeated trials:** the number of times that a level of the independent variable is tested in an investigation, or the number of objects or organisms tested at each level of the independent variable.

Procedure: List materials and provide a detailed and logical step-by-step description of procedures.

Results (Data Table and Graphs): Got Data? The data in this section are the basis on which the student will claim that the hypothesis is or is not supported. The exit project gives priority to evidence in the form of empirical observations. The data should be shown in a table and in charts and graphs. The student(s) make their own observations for the following types of projects: controlled experiments, field studies and design projects. The student(s) use observations reported by other investigators when they do secondary research.

Data Analysis/Discussion: The priority of this section is for a student to summarize the trends or patterns in the data with the goal of determining whether the hypothesis was – or was not – supported by the data. In this section students communicate their finding or claim and back it up with their data. Further, Urban Advantage also emphasizes the importance of connecting the students' results to the scientific knowledge already available on the topic.

The student's claim, the data used to support the claim (evidence) and the reasoning used to relate claim and evidence (the connections to scientific knowledge) can be considered a complete scientific explanation that should form the core of a discussion/conclusion. Also important are reflections on possible sources of experimental error and suggestions for further investigations.

Conclusion: A concise re-statement of the explanation already proposed in the discussion – specifically, a statement including the student's claim (whether the hypothesis was – or was not – supported by the data), the evidence, and the reasoning used to relate claim and evidence (the connections to scientific knowledge).

Adapted from: Cothron J., R. Giese, and R. Rezba. Students and Research. Dubuque: Kendall/Hunt; 2000.

Urban Advantage's Suggested Sections and

Question
How will... affect...?

Hypothesis
if... then... because...

Background Information (related to the hypothesis) Use this section to explain the scientific thinking behind the hypothesis (the "because..." part of the hypothesis

Experimental Design

Write the 5 components of Experimental design here.

Title
The effect of... on...

Student's name and school

Procedure

List materials and describe procedures step-by-step

Layout of the Science Exit Project Poster

Results
Data table
Graphs

Got Data?
Exit Projects are all about students using data to answer their questions.
In the section Data Analysis/Discussion and the Conclusion the student makes a Claim based on this Data.

Data Analysis/Discussion

Construct a scientific explanation including:
- Claim, Evidence, Reasoning

Also include:
- Reflections on possible sources of experimental error.
- Suggestions for further investigations

Conclusion

A concised re-statement of the explanation already made in teh Data Analysis/Discussion:
(a) whether their hypothesis was - or was not - supported by the data. (b) the evidence, (c) the reasoning used to relate claim and evidence (the connections to science knowledge)

Literature cited

Controlled Experiment Science Exit Project

When Becky visited the Brooklyn Botanic Garden with her class she was impressed by the tall sunflowers she observed growing in the Children's Garden. She did some research on sunflowers and decided that she wanted to investigate which growing conditions would support the growth of the tallest sunflowers. Becky did not have any place to plant sunflowers outdoors but her teacher had a Grow Lab, so Becky understood that she would be growing plants indoors under lights rather than outside in a field under the sun as she had seen at the botanic garden. She knew that plants needed light, water, air, a place to grow and something to grow in, such as soil, and that each type of plant had a particular temperature range that it preferred for growth. In the course of her background research, Becky read about organic farming and she became interested in the use of compost and other organic fertilizers for growing crops. She decided she wanted to test the effect of organic matter, compost in particular, on the germination and growth of sunflowers. Because the soil mixes she found at the nursery and real soil from the school yard all had different ingredients, Becky decided to make her own soil mixes so that she could control the amount of organic compost and non-organic materials very closely.

Becky called the Brooklyn Botanic Garden for advice on soil mix materials. They advised that she use a vermicompost made by worms as her organic component and perlite, an inert 'volcanic' rock as her non-organic component. Becky hypothesized that if the soil contained more compost, the seeds would germinate sooner, plants would grow taller, and the plants would make flowers earlier. She decided to plant some seeds in compost alone, some in the perlite alone, and some in mixtures of the two that contained different amounts of compost and perlite. The 3 mixtures she created were: 75% compost/25% perlite; 50% compost/50% perlite; and 25% compost/75% perlite. This resulted in her planning for 5 different sets of pots. Becky used 3 pots for each soil mixture and 3 pots each for compost and perlite alone. In each of the 15 pots she planted 3 seeds.

Experimental Design of Science Exit Project

Title: The effect of compost on sunflower seed germination and plant growth.

Research Question: How does the amount of compost (organic material) in a soil mixture affect the germination and growth of sunflowers planted from seed?

Hypothesis: If sunflower seeds are planted in a soil mixture that contains 50% compost and 50% perlite then they will grow taller than those seeds in the other soil mixtures because the organic materials in compost provide the plants with nutrients that are beneficial to growth and the perlite will retain water and provide air spaces for the roots to grow.

Independent Variable: Amount of compost added to soil mixture (%)					
Change in independent variable:	100 % Compost	75 % Compost 25 % Perlite	50 % Compost 50 % Perlite	25 % Compost 75 % Perlite	100% Perlite
Number of repeated trials:	3 pots 3 seeds per pot	3 pots 3 seeds per pot	3 pots 3 seeds per pot	3 pots 3 seeds per pot	3 pots 3 seeds per pot

Dependent Variable: Height of stem (centimeters)

Constant Variables: Number of hours of light, amount of water and frequency of watering, type of pots, type of sunflower seeds, temperature, humidity

Field Study Science Exit Project I

An Urban Advantage class visited the Bronx River with their teacher to study living and non-living features of the wetland. After exploring different portions of the river, a group of 8th graders notice a waterfall. They approach their teacher and propose to investigate the relationship between dissolved oxygen levels of the water and the location above or below the waterfall for their exit project. The students hypothesize that the oxygen levels below the waterfall generally will have higher levels than above the waterfall, because of the increased stirring of water as it flows over the falls. The students decide to sample four sites along the river: 20ft *above* the waterfall, 10ft *above* the waterfall, 10ft *below* the waterfall, and 20ft *below* the waterfall. Students decide to test oxygen levels three times at each location. They repeat this testing at the same locations on the river two additional days.

Experimental Design of Science Exit Project

Title: The effect of location along the Bronx River on oxygen level of the water.

Research Question: How does the water fall on the Bronx River affect the water's oxygen levels?

Hypothesis: If dissolved oxygen levels are measured both above and below the water fall, then the concentration of dissolved oxygen will be higher below the water fall because churning of the water exposes more water to the air, which adds more oxygen.

Independent Variable: Locations along the Bronx River (meters from waterfall)				
Change in independent variable:	20 feet above waterfall	10 feet above waterfall	10 feet below waterfall	20 feet below waterfall
Number of repeated trials:	3 tests 3 different days	3 tests 3 different days	3 tests 3 different days	3 tests 3 different days

Dependent variable: Oxygen level of water (milligrams O_2 per liter)

Constant Variables: Type of test kit; river

Field Study Science Exit Project II

While on a class trip to the zoo, a group of students noticed the sea lions were popping up out of the water. They began wondering if that was their common level of activity throughout the day or if it was related to something else such as feeding schedule. On three separate days, students planned to observe the sea lions' activity one hour before feeding time and again 10 minutes before feeding time. They observed the sea lions for 10 full minutes using instantaneous sampling every minute. The behavior was be marked "I" for inactive (not moving around) or "A" for active (moving around).

The students also used the following system to record their activity:

I (Inactive): majority (more than 50% of the sea lions in the exhibit) were inactive (not moving around).
A (Active): majority (more than 50% of the sea lions in the exhibit) were active (moving around).

Experimental Design of Science Exit Project

Title: The effect of proximity of feeding time on activity level of sea lions.

Research Question: How does proximity to feeding time affect the activity level of sea lions?

Hypothesis: If we measure activity level of sea lions close to their feeding time and not close their feeding time, then the activity level of the sea lions should be higher close to the feeding time because the animals are anticipating getting food.

Independent Variable: Number of minutes prior to feeding time		
Change in independent variable:	70 minutes before feeding time	10 minutes before feeding time
Number of repeated trials:	3 observations	3 observations

Dependent Variable: Activity level of the sea lions (inactive or active as described above).

Constant Variables: location, species of animals, number of animals, time of day, intervals (every 1 minute for 10 minutes).

Secondary Research Science Exit Project

An Urban Advantage teacher has just completed a plate boundaries unit in which she introduced the IRIS website which lets students search for earthquake data, map, graph and download it. After researching plate boundaries of different types, a group of 8th graders approach their teacher and propose to investigate the relationship between type of plate boundary and magnitude of earthquakes for their exit project. The students hypothesize that earthquakes occurring at transform boundaries generally will be of greater magnitude than earthquakes that occur at ridges, because when plates are sliding past each other they store more mechanical energy than plates that are simply diverging. The students determine the time frame for their study; they include only earthquakes for 1 year (2007), and have identified one ridge and one transform fault off the Pacific South American coast that they will compare for their project. Using the IRIS web site, they set the search parameters to the settings described above, download the data, then calculate and compare average Richter magnitudes for all the quakes at the transform boundary vs. the ridge.

Experimental Design of Science Exit Project

Title: The effect of plate boundary type on magnitude of earthquakes.

Research Question: How will the type of plate boundary affect the magnitude of earthquakes occurring along that plate boundary?

Hypothesis: If we compare the magnitudes of earthquakes that occur along transform plate boundaries to those that occur along divergent plant boundaries then we will find that the average magnitude for transform plate boundaries will be greater than that for divergent plate boundaries because when plates are sliding past each other they store more mechanical energy than plates that are simply diverging.

Independent Variable: Type of plate boundary		
Change in independent variable:	Transform plate boundary	Divergent plate boundary
Number of repeated trials:	Number of earthquakes recorded at 1 boundary in 1 year	Number of earthquakes recorded at 1 boundary in 1 year

Dependent Variable: Magnitude of earthquakes (0 to 9 on the Richter Scale)

Constant Variables: One year's earthquakes per boundary type; all values taken from one database.

Design Science Exit Project

Ms. Hussain introduced her students to a unit on force and motion by giving them the opportunity to experiment with making and launching their own straw rockets. She challenged the class to create a rocket that could travel a distance of 15 meters in the shortest period of time. John's team discussed all the ways that they might change the rocket design so that it could cover the distance faster. They made a list that included: change the length of the rocket's body tube, change the number of fins, change the length of the fins, change the type of paper used to construct the rocket model. The group hypothesized that a lighter rocket with a larger fin would travel the farthest distance because a heavier rocket would slow down the flight and it wouldn't fly as far before it dropped out of the sky. They predicted a larger fin would be more aerodynamic. The group decided to test one variable at a time, each variable being one aspect of the rocket's construction they would change.

They agreed that in Test #1 they would change the length of the rocket's body tube. For Test #2 they decided to change the number of fins. In Test #3 they tried various fin lengths and in Test #4 they constructed the model out of different types of paper. After testing these four variables, the students made a rocket whose length, number of fins, length of fins were the measurements that gave the best results in each of their tests and they used the paper type that built a rocket that traveled the distance of 15 meters in the shortest period of time. They then tested the rocket with this final design to see if they had indeed built a rocket that could reach the 15 meter distance in as short a period of time as possible.

Experimental Design of Science Exit Project

Test #1: Changing the length of the rocket's body tube.
Title: The effect of body length on the distance a rocket travels.

Research Question: How will body length affect the distance a rocket travels?

Hypothesis: A shorter body length will allow the rocket to travel a longer distance because there will be less drag on a smaller rocket due to its smaller surface area.

Independent Variable: Length of the rocket body (centimeters)					
Change in independent variable:	5 cm	10 cm	15 cm	20 cm	25 cm
Number of repeated trials:	5 trials	5 trials	5 trials	5 trials	5 trials

Dependent Variable: Distance rocket travels (centimeters)

Constant Variables: weather conditions, setting, launcher, fin size, number of fins, type of material used to make rocket

After Test #1: the students repeated the steps above but modified the experimental design of the experiments to investigate:
Test #2: Changing the number of fins on the rocket.
Test #3: Changing the length of fins on the rocket.
Test #4: Changing the types of paper used to construct the rocket.

APPENDIX 1 *REACTS* Taxonomy

[Adapted from Stripling, Barbara K. and Judy M. Pitts, Brainstorms and Blueprints: Teaching Library Research as a Thinking Process. Englewood, CO: Libraries Unlimited, 1988.]

A Taxonomy of Research Reactions

Recalling	Level 1
Explaining	Level 2
Analyzing	Level 3
Challenging	Level 4
Transforming	Level 5
Synthesizing	Level 6

RECALLING – LEVEL 1

- Recalling and reporting the main facts discovered
- Making no attempt to analyze the information or reorganize it for comparison purposes

Verbs: arrange; cluster; define; find; identify; label; list; locate; match; name; recall; recount; repeat; reproduce; select; sort; state

Sample Assignments:

- Select 5-10 accomplishments of the person you have researched. Produce a "Hall of Fame" (or "Hall of Shame") poster with a photocopied picture and list of accomplishments for the person you have researched.
- After your class adopts a second- or third-grade class, write a letter to your assigned student recounting five interesting facts you discovered in your research.
- List five "Do's and Don'ts" about a social issue that you have researched.
- Find facts about your subject for each category determined by the class. Contribute your facts to the "Fact File" on your class's web page.
- Select pictures from discarded magazines, make photocopied pictures, or find appropriate pictures on the Web to produce a collage or picture essay that portrays your researched subject.
- Based on your research, state five questions a television reporter might ask if he/she were preparing a feature news story on your subject. Answer the questions. (Students could work in pairs; their interviews could be videotaped.)
- Arrange words important to your research in a crossword puzzle.
- Define key words about your research subject. Embed hot links in your Web page to your definitions in a class glossary page.

EXPLAINING – LEVEL 2

- Recalling and restating, summarizing, or paraphrasing information
- Finding examples, explaining events or actions
- Understanding the information well enough to be able to put it in a new context

Verbs: apply; cite; complete; convert; demonstrate; describe; document; dramatize; emulate; estimate; expand; explain; expound; express; generalize; give examples; illustrate; imagine; paraphrase; portray; prepare; present; produce; propose; restate; review; search; show; solve; speculate; summarize; support; survey; translate; use

Sample Assignments:

- Dramatize a particularly exciting event associated with your research in an on-the-spot report.
- Express through dance or music your research subject's emotions related to an event in his/her life.
- Illustrate important features about your research by using clip art or a computer drawing program.
- Write and present a CNN News report about a particular event or person you researched.
- Keep a journal in which you present your reactions, thoughts, and feelings about your research.
- Show the events of your research on a map and explain the importance of each event.
- Complete each of the following statements based on your research: My research made me wish that. . . ; realize that. . . ; decide that. . . ; wonder about. . . ; see that. . . ; believe that. . . ; feel that. . . ; hope that. . . .
- Cut out newspaper or magazine ads that would have interested an historical figure you have researched. Explain their importance to the historical figure.
- Express the interests and accomplishments of an historical figure you have researched through a fictional diary mounted on your class's Web page. Portray your figure's characteristics by linking to Web sites that would have been important to your person's life and work.
- Prepare a job application or resume for a person you have researched.
- Keep an explorer's log book to express your impressions as you investigate the sights and way of life in another country through research.
- Research the music of the area you are studying. Summarize your findings in an oral presentation containing recorded musical examples and visual aids.

ANALYZING – LEVEL 3

- Breaking a subject into its component parts (causes, effects, problems, solutions)
- Comparing one part with another

Verbs: analyze; apply; arrange; associate; break down; categorize; change; characterize; classify; compare; compile; construct; contrast; correlate; diagram; differentiate; discover; discriminate; dissect; distinguish; divide; examine; experiment; extend; group; infer; interpret; manipulate; map; modify; organize; outline; plan; question; reconstruct; relate; represent; revise; rewrite; scrutinize; select; separate; sequence; sift; simplify; solve; transplant; uncover; utilize; verify

Sample Assignments:

- Create a timeline for the events which led up to the situation you researched. Correlate social, political, religious, educational, technological events.
- Transplant an event or famous person (e.g., a philosopher, leader, doctor, artist, musician, scientist, author) from one time period, country, or ecological system to another time or place. Explain the changes that would occur in that person's life, work, or artistic style.
- Construct a carefully organized Web page to examine a social issue.
- Characterize your researched historical person in an obituary which makes clear his/her role in the conflicts of the day.
- Compare your lifestyle and neighborhood to those of people living in the time you have researched.
- Write a letter to the editor scrutinizing a local issue. Support your opinions with specific details from your research.
- Rewrite an historical event from two different points of view.
- Write a recipe for an historical event by researching, analyzing to pick out the main ingredients, and sequencing them in order with mixing instructions.
- Organize and create a travel brochure (on paper or on the Web) to attract visitors to the place or time period you have researched. Include all information that one would need to know plus fascinating details that would draw visitors.
- Use a graphic organizer to outline the main ideas of your subject visually, showing relationships between ideas and supporting points.
- Analyze socially and politically motivated works of art related to the historical period you are researching.

CHALLENGING – LEVEL 4

- Making critical judgments about subject based on internal or external standards
- (Standards may be student's own, or teacher or class may decide criteria. "I didn't like it" or "I don't believe it" are not enough)

Verbs: appraise; argue; assess; compare; criticize; debate; defend; determine; discriminate; evaluate; grade; investigate; judge; justify; modify; prioritize; rank; rate, refute; review; support; value; weigh

Sample Assignments:

- Produce a critical review (of a book, movie, dance performance, or play) which can be printed in a local paper or aired on local television or radio stations.
- Write a scene for and act as an attorney and argue to punish or acquit an historical character or a country for a crime or misdeed.
- Determine as a movie producer whether or not to make a film of an actual historical event, with justification for the decision.
- Defend your judgment that a research subject (if it is an invention, machine, or some other item or document) should be placed in a time capsule to be dug up in 100 years.
- Judge the merits of a researched subject by conducting a mock trial.
- Debate the issues of a controversial research topic with a classmate who researched the same topic. Alternatively, assume the personas of two artists, musicians, choreographers, or playwrights and debate their different points of view or styles.
- Evaluate the information available in print and electronic format on your topic, based on clear evaluation criteria. Compile an annotated bibliography of valuable sites and sources.
- Investigate a societal problem. Prepare a report card on the issue that assigns a grade for each proposed or attempted solution (look at the cost, feasibility, probable success, ease of implementation). Justify your grades.
- Evaluate the accuracy of an historical or teen-problem novel by comparing the "factual" information in the novel with the facts you discover through research. Refute the nonfactual information in a letter from "Dear Abby."
- Create an editorial cartoon about your researched subject that makes clear your judgment about the subject.
- Research dances and music of the period and compare to contemporary examples.
- Defend censorship in music in an editorial from a parent's viewpoint.
- Defend freedom from censorship in music in an editorial from an adolescent's viewpoint.

TRANSFORMING – LEVEL 5

- Bringing together more than one piece of information, forming own conclusion, and presenting that conclusion in a creative new format

Verbs: blend; build; combine; compile; compose; conclude; construct; convince; create; decide; design; develop; dramatize; elaborate; express; forecast; formulate; generate; imagine; modify; persuade; plan; predict; pretend; produce; propose; revise; speculate; structure

Sample Assignments:

- Design and produce a television commercial or a whole advertising campaign that presents your research results to the class.
- Create a board game that incorporates the major conclusions you reached about your researched subject.
- Write a poem or short story that expresses your new knowledge or insight.
- Dramatize a famous historical event. The dramatization should make clear your interpretation of the event.
- Predict your reaction to your research subject as a resident of the future.
- Compose a speech that an historical person might deliver about a present-day national issue. Compose a speech that a current public person might deliver about an historical issue.
- Compile a series of self-portraits your research subject would have painted demonstrating his/her growth and development.
- Become a person in the historical era you have researched; elaborate from that perspective about a specific event, problem, invention, scientific theory, or political situation in a letter to someone.
- Predict what your researched person would take on a trip. Design the itinerary. Pack that person's suitcase and present each item to the class with an explanation of significance.
- Research a specific event, person, or aspect of the culture of an historical or modern era. Write and produce a segment for a morning news show on your topic.
- Pretend you are living in a particular place or historical era. Research a subject that is important to that time or place. Develop an article about that subject as though you were living there, to be added to a class newspaper or magazine.
- Design a hypermedia program or a Web page about your researched subject that allows others to follow several different paths through your information.

SYNTHESIZING – LEVEL 6

- Creating an entirely original product based on a new concept or theory

Verbs: build a model program; create; design; develop; devise; generate; hypothesize; invent; propose; theorize

Sample Assignments:

- Develop a model program to address a social problem that you have researched.
- Invent a new animal; explain its effect on other animals and on the environment.
- Create a new country and hypothesize about the change in the balance of power in the world.
- Design a new building, machine, process, experiment based on theories developed from your research.
- Develop proposed legislation to address national, state, or local issues.
- Devise an ethical code for present-day researchers or scientists which could regulate their activities in a particular field.
- Develop a community project that addresses an issue of local concern.
- Design and carry out a science project that builds on the previous knowledge that you have discovered through research and tests a new concept or theory.
- Build an architectural model of a community that offers/addresses a solution to a social problem you have been researching.
- Invent a new way of moving that addresses a social conflict you have researched, and devise a group dance in this style. Generate an inventory of the movements and the rules governing dancers' interactions. Hypothesize how people would be affected if this kind of dance became popular.
- Design and create a school-wide recycling program which will include the collection of recyclable and non-recyclable waste.

APPENDIX 2 *Sample Mini-Lesson:* ***How to Write a Good Research Question***

Motivation:
Ask students to think of a "burning" question they have about a social studies topic studied.
Chart student responses.

Mini-Lesson

- Select one student's "burning" question and map it back to the broad topic, narrowed topic, etc. A good research question:

  - Exists within a broad topic (e.g., The Civil War, Women's Rights, etc.).

  - Narrows the topic by focusing on a specific aspect of the broad topic (e.g., African American Soldiers' Role in the Civil War, Women's rights in the early 20th century).

  - Asks about a specific aspect of the broad topic (e.g., How did African American Soldiers contribute to the outcome of the Civil War?, Why did women's rights surface at this time in history?)

- Remind students that a good research question addresses an issue, problem, or controversy and is generally answered with a conclusion, otherwise known as a thesis. The thesis or conclusion is based on an analysis and interpretation of relevant information and materials. A good research question is not a question that can be answered by a single fact or a single source.

- Explain that each student will use the guide above to develop a research question based on his/her selected topic.

- Ask students to select various topics of interest and practice identifying a broad topic, narrowing the topic and then asking a good research question about the topic. Have students discuss and analyze each other's questions.

APPENDIX 3 *Sample Mini-Lesson:* ***Developing the Thesis Statement of a Social Studies Project***

Motivation:
Introduce the lesson by telling students that, although the idea of writing a thesis statement sounds difficult, it is really just a way of stating what they will set out to prove as a result of their research.

Mini-Lesson

- Explain that writing a thesis statement involves taking a careful look at their original research question against all the research and information they have gathered. Students will need to review their research, notes, and questions to make an initial statement based on where the research is taking them.

- Model by sharing the example: if a student were conducting research on African-American soldiers during the Civil War and the research question were "How did African-American soldiers contribute to the outcome of the Civil War?, the thesis statement might be:

  During the Civil War, African-American soldiers made Union victory possible.

- This thesis statement will now guide the research so that it is focused on using the available information to demonstrate and show that this statement has validity.

- Students should be given time to work independently to review their notes and come up with a few thesis statements that could work for their project. (20 minutes)

- Once students have a few ideas for thesis statements, they can share them with a partner or small group. Partners can react to and evaluate each other's statements, ask clarifying questions, etc. (10 minutes)

- If some students are having difficulty crafting a thesis statement, work with them as a small group and provide additional examples using their topics and research.

- Students who are able to successfully craft a thesis statement should begin to organize their notes in preparation for writing a first draft.

APPENDIX 4 *Student Handout:* ***Writing a Thesis Statement***

A thesis statement is a strong statement that you can prove with evidence. It is not a simple statement of fact. A thesis statement should be the product of your own critical thinking *after* you have done some research. The thesis statement will be the main idea of the entire project. It can also be thought of as the *angle or point of view* from which you will present your material. A good thesis statement makes the difference between a thoughtful research project and a simple retelling of facts.

Before developing an argument on any topic, you have to collect and organize evidence, look for possible relationships between known facts (such as surprising contrasts or similarities), and think about the significance of these relationships. Once you do this thinking, you will probably have a "working thesis," a basic or main idea, an argument that you can support with evidence.

The thesis statement should be specific—it should cover only what will be discussed in the project or paper and should be supported with specific evidence. The topic may change as you write, so you may need to revise your thesis statement to reflect exactly what you have discussed in the project or paper.

Thesis Statement Exercise

Write out the main idea from your project or paper (the point you want the reader to get) in 25 or fewer words.

Ask yourself: What is the essential question? How can I answer that question?

Ask yourself: Can I sum up the main idea of my project in a nutshell? See if you can reduce the main idea to a sentence or two.

Ask yourself: As I read my paper, have I supported the thesis? Where? How?

APPENDIX 5 *Sample Mini-Lesson:* ***Developing the Graphic Component of a Social Studies Project***

Motivation:
Ask the students to brainstorm all the different ways that social studies information can be relayed. Chart their responses. (Some responses might include advertisements, posters, TV commercials, charts, graphs, maps, political cartoons, text book, Internet, etc.)

Mini-Lesson

Ask students to review the charted responses and consider which types of information can best be represented in a particular format. For example, statistical information is best represented in a chart, table or graph as opposed to a written paragraph. Political commentary might be best represented using a political cartoon.

- Provide students with the *How to Interpret Informational Graphics* student handout, Appendix 6.
- Ask students to consider the following questions:
  - What information or symbols will I include in my graphic?
  - What materials will I use to create my graphic?
  - What kind of specific research do I need to do to prepare my graphics?
  - Does my graphic support the ideas expressed in other parts of my project?
  - How will I use this graphic in my oral presentation?
- Have students begin to work on creating their graphic components.

APPENDIX 6 *Student Handout:* ***How to Interpret Informational Graphics***

Informational graphics are visuals, such as maps, charts, tables, graphs and timelines, that give you facts at a glance. Each type of graphic has its own purpose. Being able to read informational graphics can help you to see a lot of information in a visual form.

When Interpreting Informational Graphics…

1. Identify the type of graphic shown.
2. Read the title to determine the subject, purpose, and date of the graphic.
3. Read all the text in the graphic.
4. Pay attention to every detail such as symbols, keys, labels, and colors used. Use these details to interpret the data, or information, provided.

Tables show numerical data and statistics in labeled rows and columns. The data are called variables because their values can vary.

To interpret or complete a table…

1. Read the title to learn the table's general subject.
2. Then read the column and row labels to determine what the variables in the table represent.
3. Compare data by looking along a row or column.
4. If asked, fill in any missing variables by looking for patterns in the data.

Graphs, like tables, show relationships involving variables. Graphs come in a wide range of formats, including pie graphs, bar graphs, and line graphs.

To interpret or complete a graph…

1. Read the title to find out what the graph shows.
2. Next, read the labels of the graph's axes or sectors to determine what the variables represent.
3. Then notice what changes or relationships the graph shows.
4. Some graphs and tables include notes telling the sources of the data used. Knowing the source of the data can help you to evaluate the graph.

Timelines show the order of events as well as eras and trends. A time line is divided into segments, each representing a certain span of time. Events are entered in chronological order along the line. When reading a timeline:

Take into account not only the dates and the order of events but also the types of events listed. You may find that events of one type, such as wars and political elections, appear above the line, while events of another type, such as scientific discoveries and cultural events appear below it.

APPENDIX 7 *Sample Mini-Lesson:* ***Preparing an Effective Oral Presentation for a Social Studies Project***

Motivation:
Ask students what makes them pay attention when someone is speaking publicly or making a speech. Ask them to think about the qualities of good public speaking. Generate a short list based on student responses.

Mini-Lesson

- Discuss the essential elements of a good oral presentation. These essential elements should include:
  - speaker maintains eye contact
  - speaker knows the content
  - speaker speaks clearly and at a good pace
  - speaker varies voice and tone according to where emphasis is needed
  - speech flows easily from one thought to the next
  - there is a controlling idea holding the entire speech together
  - major/important ideas are repeated
  - there is a strong conclusion that relates to the central theme or idea
- Distribute *Keys to Preparing an Oral Presentation,* Appendix 8, student handout, and review with class.
- Model the process of creating a simple outline for the oral presentation.
- Have students develop an outline for their individual oral presentations using the guidelines provided.

APPENDIX 8 *Student Handout:* ***Keys to Preparing an Oral Presentation***

Know What You Are Talking About
You have worked hard and the amount of research that you completed on your project should be reflected in the oral presentation. Review your written component and select only the most essential ideas, facts and supporting evidence to share with the audience. Check your facts and be prepared to answer any questions.

Highlight the Theme
Your oral presentation should have a single purpose – to present the findings of your research question in an engaging and convincing way. Make sure that the audience knows the thesis statement or question at the beginning of the presentation and continue to support that thesis statement or question throughout your presentation.

Prepare Your Script
The oral presentation should include the four basic parts: opening, body, summary and closing.

- The Opening: The opening of the oral presentation sets the stage for what is to follow. Introduce yourself and your topic in an engaging way. Ask the audience to consider your question or pose a problem. Offer a very brief summary of the points to be covered.

- The Body: Use this part of your presentation to discuss the major points of your research. Be sure to include strong facts, necessary details and compelling evidence for each major point that you make. Remember to refer to your graphics/visuals at the necessary points throughout your presentation.

- The Summary: This portion should be brief yet strong. Here is your chance to reinforce the central theme and purpose of your presentation. Emphasize or restate the most essential points and big ideas in this section.

- The Closing: At the conclusion of your oral presentation, ask if anyone has any further questions and be prepared to answer questions from the audience. You may wish to anticipate the questions by having available additional information regarding each main point that you presented.

Rehearse – Rehearse – Rehearse
Transfer your final script onto index cards (4”x 6”, or 5” x 8”). The cards can be used to practice your oral presentation. The more you practice, the less dependent you will be on the index cards. At the time of your oral presentation you should only refer to your notes occasionally and not read directly from them.

Present
Remember the qualities of an effective speech. Good presentation skills include speaking at a normal pace, speaking clearly, speaking with knowledge and authority, maintaining eye contact with your audience, stressing and emphasizing the really important points, and showing your audience that you know what you are talking about. If the audience has questions, make certain they are addressed, and of course, thank your audience members for their time and attention.

APPENDIX 9 Sample Rubric for the Written Component

4 Exceeds Standard	3 Meets Standard	2 Approaches Standard	1 Below Standard
Follows assigned format.	Follows most of assigned format.	Has some components of assigned format.	Does not follow assigned format.
Carefully organized.	Good overall structure.	Satisfactorily organized.	Poorly organized.
Clearly displays student's personal understanding of historical impact. Supports opinions.	Shows some personal understanding of historical impact. Partially supports opinions.	Shows little understanding of historical impact. Supports few opinions.	Shows no understanding of historical impact. No evidence of support for opinions.
Demonstrates an excellent understanding of written English: grammar, spelling, punctuation and sentence structure.	Good understanding of written English, some grammatical errors.	Many grammatical errors.	Grammatical errors make it impossible to understand.
Uses multiple sources of information in developing an accurate written project. Annotated bibliography explains how sources were used.	Uses several sources of information in developing an accurate written project. Contains bibliography.	Uses few sources of information, ineffective use of research materials. No evidence of using sources listed.	Shows evidence of little or no research. No bibliography.
Displays evidence of mastering major issues.	Displays evidence of understanding major issues.	Displays little evidence of understanding major issues.	Displays no evidence of understanding major issues.

APPENDIX 10 Sample Rubric for the Oral Component

4 Exceeds Standard	3 Meets Standard	2 Approaches Standard	1 Below Standard
Follows assigned format.	Follows most of assigned format.	Has some components of assigned format.	Does not follow assigned format.
Effective use of graphic component.	Uses graphic component.	Has graphic, but makes little or no reference to it.	No graphic.
Displays mastery of English language (or native language) through clear communication of ideas. Very few grammatical errors.	Good understanding of English language (or native language) demonstrated through clear communication of ideas, some grammatical errors.	Ideas somewhat unclear, many grammatical errors.	Ideas are vague and unclear, impossible to comprehend because of poor grammar and communication.
Presentation logically developed, with definitions and examples, accurate details.	Good presentation connecting ideas, several examples used, some inaccuracies.	Some ideas not well connected or developed, many inaccuracies.	Most ideas not connected or developed, details and facts completely inaccurate.
Fully engages the audience, excellent eye contact, explains presentation, does not read to audience.	Engages the audience most of the time, generally maintains eye contact, mostly explains.	Does not engage the audience most of the time, has poor eye contact, reads presentation.	Does not engage the audience at all, makes no eye contact with audience, reads presentation or fails to complete presentation.
Fully addresses major issues.	Somewhat addresses major issues.	Does not address some major issues.	Fails to address any major issues.
Well developed sense of closure.	Develops sense of closure.	Little sense of closure.	No sense of closure.

APPENDIX 11 *Sample Rubric for the Graphic/Visual Component*

4 Exceeds Standard	3 Meets Standard	2 Approaches Standard	1 Below Standard
Follows assigned format.	Follows most of assigned format.	Has some components of assigned format.	Does not follow assigned format.
Graphic representations are included that strongly support ideas/ opinions.	Graphic representations are included that generally support ideas/ opinions.	Some inaccuracies and irrelevant graphics used.	Extraneous and inaccurate graphics with little relevance; no graphics.
Shows much evidence of research and conclusions drawn.	Shows evidence of research and conclusions drawn.	Shows little or some evidence of research.	Shows little or no evidence of research.
Reflects s deep understanding of the topic; questions/ ideas are clearly addressed.	Reflects an understanding of the topic; questions/ ideas are slightly vague.	Reflects a beginning understanding of the topic; questions are unclear.	Shows no understanding of the topic; no attempt to answer questions.
Graphics are organized and shown in a logical, sequential manner.	Display is mostly organized in a logical way.	Display is somewhat organized.	Graphics poorly organized and difficult to understand.
Graphics are effectively used in oral presentation.	Graphics are used in the oral presentation.	Little use of graphics in oral presentation.	Graphics are not used in oral presentation.

APPENDIX 12 *Sample Science Exit Project Rubric (Page One)*

Dimensions Categories	The Project	Conceptual Understanding of Science	Scientific Process	Written Work	Oral Presentation
Components In Scoring	Collects data to assist in completing a project. Uses appropriate techniques to collect data (e.g., surveys). Evaluates information for completeness and relevance. Shows evidence of research. Uses word processing, graphics, database, and spreadsheet programs to produce project and related material.	Utilizes key concepts in life, earth and/or physical science. Uses scientific concepts accurately to explain observations and/or make predictions. Represents the concept in multiple ways (ex. words, charts, diagrams, graphs or artwork).	States identified problem. States an hypothesis. Explains procedures and observations accurately. Records and organizes data clearly in ways which can be verified by others. Includes clear and accurate graphic representations of collected data (numbers, tables, graphs, artwork, diagrams etc.) States a conclusion that explains observations and inferences. Reflects and defends conclusions and recommendations.	Uses several sources of information in addition to an encyclopedia in developing a research report that may include a brochure, narrative procedure or guide as part of the project. Overall structure has a clear introduction, development and conclusion. Connects, compares and contrasts concepts. Supports concepts with examples, definitions and references to texts. Cites all sources in footnotes. Uses graphics/art to enhance work. Demonstrates an understanding of the English language in written form: grammar, spelling, punctuation and sentence structure.	Organizes presentation in a logical way. Uses notes or other visual aids to structure presentation of project findings. Presents examples, definitions and direct references to text to support concepts. Responds appropriately to questions. Shapes content and information to achieve a specific purpose. Demonstrates an understanding of the rules of the English language in oral presentation (grammar, paragraph and sentence structure, usage). Speaks clearly for more than one minute but not more than two minutes

Sample Science Exit Project Rubric (Page Two)

Dimensions Categories	The Project	Conceptual Understanding of Science	Scientific Process	Written Work	Oral Presentation
4 Exceeds Standard	Excellent project. All components included and the work goes beyond what is expected	Excellent use of scientific concepts to accurately explain observations/ predictions. An array of words, charts, graphs, diagrams or artwork used. All components included, going beyond what is expected.	Excellent presentation. The work includes all steps in the scientific process clearly and accurately using an array of graphic representations. Work goes beyond what is expected.	Excellent overall structure carefully organized from beginning to end. The work connects an array of concepts and supports findings. All components included and work goes beyond what is expected.	Excellent presentation. An array of visual aids used to support ideas. The presentation includes all the components and goes beyond what is expected.
3 Meets Standard	Good project. All components included and meet set expectations.	Good conceptual understanding of key scientific concept shown in multiple ways. All components included and meet set expectations.	Good evidence of the scientific process. All steps follow accurately using multiple representations All components included and meet set expectations.	Good overall structure. Clearly organized work connects multiple concepts. All components are included and meet all set expectations.	Good presentation. Several examples and visual aids used to support ideas. The work includes all of the components and meets all set expectations.
2 Approaching Standard	The project includes many components which meet set expectations.	An understanding of key scientific concept shown in at least one way. Many components included but may not meet set expectations.	Some evidence of the scientific process shown. Many steps included using more than one graphic representation. Many components included that meet set expectations.	Overall structure organized but with some lapses in order. Only one core concept addressed. Most components included and meet set expectations.	Presentation approaching standard. Some examples and visual aids used to support ideas. The work includes most components which meet set expectations.
1 Significantly Below Standard	Project needs overall improvement. Work includes few components that meet set expectations.	Poor understanding of science concepts. Work is unclear or inaccurate. No graphics used to support ideas.	Evidence of the scientific process is missing major components. Components included are inaccurate or unclear.	Poor overall structure and difficult to follow. Few components are included which meet expectations.	Presentation needs improvement. Few examples and visual aids used to support ideas. Some components included. Work meets some expectations.
				Total Score:	

APPENDIX 13 *Science Exit Project: Journal Rubric*

	4 Exceeds Standard	3 Meets Standard	2 Approaches Standard	1 Below Standard	Score
Table of Contents	All pages and descriptions correct	Mostly correct	Many errors	Missing	
Observations	Observations are clearly written, sketches and diagrams are included	Observations are clearly written, but sketches and diagrams are not included	Some clarity with observations, but sketches and diagrams not included	Lacks observations or not written clearly, lacking sketches and diagrams	
Daily Entries During Investigation	Well detailed daily entries with data	All daily entries included but not well detailed	Missing daily entries, lacking in some of the details	Missing daily entries, little or no details	
Data Analysis, Conclusion, Results	Clearly written with all information included	Clearly written with most information included	Some clarity with most information included	Not clearly written with little or no information included	
Exit Project Reflection	Clearly written with all topics addressed	Clearly written with most topics addressed	Some clarity with most topics addressed	Not clearly written with most topics not addressed	
				Total Score:	

APPENDIX 14 Checklist for Student Project Success

Projects offer you the chance to learn on your own and become expert in a subject that interests you. Projects also require careful organization and steady work in order to complete them successfully, without last-minute scrambling. Consider the tips below to help you stay on track and produce high-quality products, presentations, and performances.

Tips for Successful Completion of Projects

ORGANIZATION AND STUDY SKILLS

(check when completed)

- ☐ ***Do you understand the project and what you have to do to be successful?***
  Make sure you understand the assignment and all the pieces that are due as a part of the assignment.

- ☐ ***Have you completed a long-term plan for completion of all the parts to your assignment?***
  If you have a long term assignment, make a plan for completing each part. Ask your teacher to help you think of all the parts to complete. For example, Do the research by ____ date. Take notes by ____ date. Write your first draft by ____ date, etc. Keep track of the parts you complete to track your progress. Plan to complete the entire assignment early.

- ☐ ***Do you have a clear picture of your due dates?***
  Write down due dates for all short-term or long-term assignments. Review these dates often to make sure you stay on track.

- ☐ ***Does your plan include work every night?***
  Work a little bit on your project every single night; if you skip a night it will just mean more for next time.

- ☐ ***Do you have partners or friends to help you stay on track throughout the project?***
  Choose your study buddies and partners for projects carefully – remember the goal is to be responsible for your learning and to succeed.

- ☐ ***Have you gathered the supplies that you need?*** Make sure you have the materials you need for any projects that are due (special papers, presentation boards, covers, etc.).

Tips for Successful Completion of Projects (cont'd)

INVESTIGATION SKILLS

☐ ***Have you found a topic that you really want to learn about?***
Find a topic or research question that interests you. Look for the connections to your own life.

☐ ***Do you know the steps to follow to investigate your topic?***
Follow a research process and complete each step carefully before moving on to the next step (for example, be sure you have a good topic or research question before you spend a lot of time looking for information).

☐ ***Do you have an organized way to keep track of your work as you complete each part of the investigation?***
Carefully document your work throughout the process so that you don't waste time trying to find or remember what you already did. For example, write down as you go along:

- Your topic and questions
- The key words and search strategy that seem to be the most successful
- Full bibliographic information on every source you use
- Notes organized by source or by question/subtopic
- Outline or graphic organizer of the way you plan to present your information
- Rough draft
- Revised final draft.

☐ ***Do you know what a good final product / presentation / performance looks like? Have you looked at the rubric?***
Take care with the presentation of your final work. Even the best information and thinking are less successful if they are presented in a sloppy or disorganized manner.

☐ ***Have you given yourself time to practice your final presentation or performance?***
If you are making an oral presentation of your project, practice out loud several times before you have to present. Write reminders of your main points on index cards so that you can easily refer to them during your presentation. Relax – remember, you're the expert on this project.

APPENDIX 15 Sample Project Conference Sheet

Group member names: _____

Class: _____ Conference date: _____

Project process step:

Current direction of students:

Conference summary:

Follow-up:

APPENDIX 16 Sample Post-Conference Sheet

Name: _____ Class: _____ Date: _____

1. Where is your group in the project process?

2. What was discussed at today's conference?

3. Did today's conference help you?

□ yes □ no □ I don't know

4. Please explain your answer for question #3.

5. After today's conference, what are your next steps?

6. By the next conference, where do you want to be in your project process?

APPENDIX 17 Note-Taking Skills

Accurate notes are very important when you are creating your project. You can use a variety of different sources. Here are some tips that will help you when you are taking notes:

- Never write in complete sentences.
- Only list information that is important, for example key words or phrases.
- Write details that support the key ideas or phrases.
- Try to find the main idea of the text that you are reading and then write it in your own words.
- Always write the source, (book, article, website) where you obtained your information next to the notes that apply to it, so as not to confuse which source applied to which note.

Paraphrase: is when you rewrite or rephrase the words of an author.
Summarize: is when you use the main idea of one or several authors and write it into your own words.
Quote: is when you copy the exact words of an author and indicate that you are doing so by using quotation marks.

Reflective Note-taking: If you take notes carefully and react to them with your own thoughts and ideas, you will find that you can make sense of what you are reading. The reactions will prepare you for drawing conclusions and creating your final product without copying someone else's ideas. Use the following tips for reflective note-taking:

NOTES

Learning logs can be used any time you are responsible for writing down information (from library sources, interviews, lecture notes).

Write notes in your own words in the left column and react to those notes in the right column.

The purpose of a learning log is to help you learn to interact mentally and emotionally with your notes while taking them. Not only do you learn more while you are taking notes, but you also can identify areas where you need additional information or different perspectives.

REACTIONS

Reactions can include:

- Personal comments or feelings about the information (*I think companies that dump toxic waste should be heavily fined.*)
- Questions (*What are the laws on toxic-waste dumping? What source will give me another perspective on this issue?*)
- Notes about organization (*Use this information in my introduction.*)
- Connections to previous knowledge (T*oxic-waste dumping is worse than oil spills because it's intentional. I think this information is true because it agrees with 2 other sources.*)

APPENDIX 18 *Accrediting Sources*

Accrediting Sources: End Notes, Footnotes and Parenthetical Citations

Teachers are encouraged to collaborate with the ELA department to guide students in proper accreditation. Accrediting sources is used when students cite the sources that they used in their reports; the students inform the person reading the report where they got their information. Students may choose from:

- **Endnotes**
  Students place a subscripted number following the sentence or paragraph that they wrote that is based upon a researched source. At the end of the report, there is an endnote page which lists the numbers with the corresponding references.

- **Footnotes**
  Students place a subscripted number following the sentence or paragraph that they wrote that is based upon a researched source. At the bottom of the page, the number is listed and the corresponding source is credited.

- **Parenthetical Citations**
  Students will write the author's name and page number in parentheses following the sentence or paragraph they wrote that is based upon a researched source.

Teachers might explain accreditations in this way: "A good way of knowing when to credit someone is this…if the thing you're talking about did not come directly out of your brain, if you didn't 'invent' it, then it's not yours and must be cited." Students must give credit to sources when they:

- Cite direct quotations
- Paraphrase
- Use ideas from an author
- Use statistics from an outside source

Intentional plagiarism is:

- Copying someone else's work
- Cutting and pasting text from electronic sources without citing it properly

Unintentional plagiarism is:

- Paraphrasing without citing source
- Quoting excessively

In order to avoid plagiarism, students must cite their sources when they:

- Quote – copying the exact words from an author
- Paraphrase – rephrasing the words of an author
- Summarize – using the main idea of one or several authors.

APPENDIX 19 Creating a Bibliography

When doing research and writing a report, it is always necessary to name the source(s) of your information. It is important to note that *Google* is not a source; it is one search engine that can be used to find sources. Sources used in a project should be compiled into a list called a Bibliography or Works Cited. Sources in a bibliography should be listed alphabetically by last name of the author, or if no author, the first word of the citation. (Exclude "a", "an", and "the" when alphabetizing.)

Remember:
- Punctuate titles
- Double space between entries
- Allow 1" margins all around and single space after punctuation marks. Be consistent with spacing.
- Font is 10 or 12 (no larger) and simple (Times New Roman, Arial)
- Entry begins against the left margin. Indent (one tab or five spaces) the second and all following lines that belong to that entry (called a "hanging indent").
- Underline titles if the bibliography is handwritten.

Sample Bibliography Entries

FOR A BOOK:
Author's last name, first name. *Title of Book.* Place of publication: Publisher, copyright year.

Example:
Fogle, Bruce. *Training Your Dog.* New York: DK Publishing, 2001.

If you only used part of a book:
Fogle, Bruce. *Training Your Dog*. New York: DK Publishing, 2001, pp. 50-55.

FOR AN ENCYCLOPEDIA ARTICLE THAT IS SIGNED:
Article author's last name, first name. "Title of Article." *Name of Encyclopedia*. Copyright year. Volume number, page(s).

Example:
Clark, William W. "Gothic Art." *World Book Encyclopedia.* 2002.
Volume 8, pp. 277-278.

FOR AN ENCYCLOPEDIA ARTICLE THAT ISN'T SIGNED:
"Title of article." *Name of Encyclopedia*. Copyright year. Volume number, page(s).

Example:
"Golden Retriever." *World Book Encyclopedia*. 1999. Volume 8, p.255.

FOR A MAGAZINE OR NEWSPAPER ARTICLE:
Article author's last name, first name. "Title or Headline of Article." Name of magazine or newspaper. Date of magazine or newspaper, page(s).

Example:
McGill, Kristy. "A Baltic Scramble." Faces. May, 2003, p. 27.

FOR AN INTERNET ADDRESS:
Author's last name, first name. "Title of item." [Online] Available
http://address/filename, date of document or download.

Example:
DiStefano, Vince. "Guidelines for Better Writing." [Online] Available
http://www.usa.net/~vinced/home/better-writing.html, October 5, 2002.
This example of how to cite an Internet source was downloaded from this online source.

FOR AUDIOVISUAL MATERIALS:
Title of material. Type of material. Place of publication: Publisher, copyright date.

Example:
Bizet's Dream. Videotape. New York: Sony Wonder, 1998.

FOR A CD-ROM:
"Article title." CD-ROM title. CD-ROM. Copyright date.

Example:
"Titanic Disaster." Encarta 99 Encyclopedia. CD-ROM. 1999.

FOR AN INTERVIEW:
Name of person interviewed (last name first). Kind of interview. Date.

Example:
Watson, Cosmo. Personal interview. July 29, 2003.

APPENDIX 20 Sample Mini- Lesson: How Do Historians Conduct Research?

Motivation:

- Ask students what they think is involved if one is a historian. Discuss the job or work of an historian. Ask if students know the names of any famous historians.
- Next (on chart paper or whiteboard or Smartboard) create a K-W-L chart about historians.

Know	Want to Know or Wonder	Learned

- In K column, list what student said they *know* about historians.
- Ask students what they want to *know* or *wonder* about the work of historians.
- Record student responses on chart paper. Remember to return to the chart at the conclusion of the lesson to complete the last column "What I Learned." You can ask different students to add one new thing they learned about an historian.

Mini-Lesson

- To introduce the lesson, tell the students that they will discover the different ways historians conduct research and then they will discuss how those ways can be used to help complete their social studies projects.
- Have students read How *Do Historians Conduct Research*? (Appendix 21).
- After students have read the handout, give them time to discuss in groups to share new things that they learned about historians. Ask them to consider information that surprised them. Do they think that the work of an historian is difficult? Why?
- Refer back to the KWL chart, and ask students to share what they learned about historians that they did not know before. Record student responses on chart paper.
- Ask students to think about why the role of an historian is important. You might want to reference specific events in history that students have studied. How have historians written about or interpreted those events? What role do these interpretations play for readers and students of history? Encourage additional comments and student discussion.
- Explain that thinking like an historian is important when getting ready to participate in project-based learning in social studies. As each student works to complete each part of the project, they will think and act like real historians.
- Distribute various photos of artifacts to students and ask that they try to interpret the artifacts. Use the following guiding questions:

  - What is the artifact?
  - Can you tell who made it?
  - Can you determine its use/purpose?
  - What information can you get from observing the artifact?

APPENDIX 21 *Student Handout:* ***How Do Historians Conduct Research?***

An historian is a person who writes about or studies history. History is a written account or record of past events. There are various ways an historian can conduct research on a topic. Some of the methods that historians have traditionally used are described below:

Study Artifacts (Objects)

Historians can learn about the people from the past by examining objects (artifacts) they left behind. Historians often work with archaeologists (those who study ancient artifacts). Artifacts can be used to draw conclusions about how pre-historic (before people recorded history) people lived.

Conduct Interviews with People (Oral Traditions)

Historians can learn about past events by interviewing people who lived during a particular era. Oral traditions enable historians to obtain knowledge of the past that is transmitted by word of mouth.

Traditional Research

Historians can learn about past events by reading materials (books, magazines and newspapers) written by people who lived at the time and participated in or observed the event (primary sources) or by colleagues or peers acknowledged as experts on a specific topic (secondary sources).

Think:

What are the advantages or disadvantages with using each method of studying the past?

If you were a historian which method would you prefer and why?

APPENDIX 22 Student Self-Assessment Checklist: Science

Your Name _____ **Class**_____

To see how you are doing, use this sheet as a guide. It is similar to the sheet that your teacher will use when evaluating your work and determining your grade. It is also the sheet that other students can use while "peer-evaluating" your presentation.

Directions: When you complete one of the tasks listed, place a **check mark** ☐ in the box next to it, but only if you feel you've completed that task to the best of your ability.

There are four sections that you will be working on:

SECTION 1 - Science Understanding

(as shown in the written report and the oral presentation).

- ☐ I used topics and ideas that we discussed in class or on field trips to come up with a question that I could investigate.
- ☐ I explained my observations and my results by using science concepts, terms and ideas.
- ☐ I used more than one way of explaining my ideas – like words, pictures, diagrams, charts or graphs.
- ☐ I was able to make connections between what I learned from the project and other areas of science.

SECTION 2 - Scientific Process

(as shown in the written report and the oral presentation).

- ☐ I identified a problem and asked a question that I could investigate. (It was not a "yes or no" question.)
- ☐ I made an hypothesis that I could test. I did not already know for sure what the answer to my hypothesis would be. I also know that my hypothesis does not have to be supported by the data, because in science we can learn both when we get results we expect or when we get results we do not expect.
- ☐ I designed a plan and method to collect data to test my hypothesis.
- ☐ I conducted my research carefully and with scientific accuracy.
- ☐ I collected, recorded and organized data from my work.
- ☐ I made graphs, charts, tables or artwork that represent my data
- ☐ I made a conclusion that says whether my hypothesis was supported or not supported (either one is proper) based upon my data, that explains my observations and why things came out the way they did.
- ☐ I explained what I would do differently next time and I discussed any possible sources of error in my project.
- ☐ I looked back at my work and explained what I might have changed to make the project even better. *"If I were to do the project all over again, here is what I'd do differently this time....."*

SECTION 3 - The Written Report

- ☐ I used at least 3 different sources to collect my background research information, which I have written down in my bibliography.
- ☐ The report is written in a manner that makes sense. I made sure my report has:
  - an abstract
  - an introduction which includes the purpose and the reason why I chose this topic
  - an hypothesis
  - a materials and methods section
  - my actual data and an analysis/explanation of the data
  - a conclusion that refers back to my hypothesis with a discussion of my results
  - a reflection on the quality of my entire project
  - a glossary of terms
  - a bibliography
  - an endnote page (if needed)
  - any attachments (Appendices/Addenda)
- ☐ I compared concepts and showed the reader that I understood MORE THAN just what I researched about. I compared it to other things not in my research (...*"**this**" is similar to the idea of* " ***tha***t").
- ☐ I supported my ideas with examples, definitions and references back to other sources of information.
- ☐ I gave credit for anything that I did not learn by myself. If I didn't learn it from actually doing this project, then I showed where I got the information.
- ☐ I used graphics, charts or artwork to enhance my report.
- ☐ I have checked for grammar, spelling, punctuation and sentence structure. I have not included any street talk, slang, or text message abbreviations in my report.
- ☐ I have used a typewriter or a computer to print my report. It is ***NOT*** hand-written. (If I do not have a computer, I know that I could have used the computers in my classroom, the school library, the school computer lab or any New York City Public Library to write and print my report.)

SECTION 4 - The Oral Presentation

- ☐ I organized my presentation in a way that people can understand. I know that not everyone listening to the presentation is as much an expert on my topic as I have become.
- ☐ I used notes, index cards, or computer slideshows to make sure I followed my presentation in the correct manner and that I am giving accurate data. I did ***NOT*** read directly from my report, and I made eye contact with the audience.
- ☐ I gave examples, definitions and direct references and quotes to support my ideas.
- ☐ I was able to answer questions about my topic: ***I am the expert!***
- ☐ My audience was able to understand my concept.
- ☐ I used proper grammar and sentence structure. I did not use any "street talk" or "slang". I spoke slowly, loudly and clearly, so that I could be understood.
- ☐ I used some visual display such as: slideshows, trifold board, movie or other multimedia to make my presentation more interesting.

RESOURCES

Online Resources for Students

Search Engines

Google:	http://www.google.com
Ask Kids:	http://askkids.com
Dogpile:	http://www.dogpile.com
KidsClick:	http://www.kidsclick.org/
Lycos:	http://lycos.com
Metacrawler:	http://www.metacrawler.com
Scrub the Web:	http://scrubtheweb.com
Yahoo Kids:	http://kids.yahoo.com

Online Resources for Social Studies Project-Based Learning:

American Folk Art Museum
http://www.folkartmuseum.org

Brooklyn Historical Society
http://www.brooklynhistory.org/default/index.html

Bronx County Historical Society
http://www.bronxhistoricalsociety.org/

Children's Museum of Native America
http://www.childrensmuseum.webs.com/

El Museo del Barrio
http://www.elmuseo.org

Ellis Island Museum
http://www.ellisisland.org/

Gilder Lehrman Institute of American History
http://www.gilderlehrman.org

Historic Richmondtown, Staten Island
http://www.historicrichmondtown.org/

Lower East Side Tenement Museum
http://www.tenement.org/

Online Resources for Students

Museum of the City of New York
http://www.mcny.org/

Museum for African Art
http://www.africanart.org/

Queens Historical Society
http://www.queenshistoricalsociety.org

Schomburg Center for Research in Black Culture
http://www.nypl.org/research/sc/sc.html

South Street Seaport Museum
http://www.southstreetseaportmuseum.org/

Finding Data on the Internet
http://nilesonline.com/data/

National Atlas of the United States of America
http://nationalatlas.gov/

National History Day
http://www.nationalhistoryday.org/

StockMarketGame
http://www.smgww.org/

United States Historical Census Data Browser
http://fisher.lib.virginia.edu/collections/stats/histcensus/

Webquest
http://webquest.org/

Online Resources for Science Exit Projects:

American Museum of Natural History

http://www.amnh.org/

This world-famous museum has a variety of science exhibits, a space center and educational resources for students, teachers and families.

Bronx Zoo

http://www.bronxzoo.com/

The Bronx Zoo is one of the largest metropolitan zoos in the country. With award-winning, cutting-edge exhibits featuring over 4,000 animals, there is no other zoo in the world that offers such diversity, superb viewing, and world-renowned expertise.

Brooklyn Botanic Garden

http://www.bbg.org/

BBG is a 52-acre living museum where beauty blossoms among world-class plant collections and specialty gardens. It is admired as an urban horticultural and botanical resource.

New York Aquarium

http://www.nyaquarium.com/

The only aquarium in New York City and part of the largest network of metropolitan wildlife parks in the country, the New York Aquarium holds a special place in the mission of the Wildlife Conservation Society: to save wildlife and wild places around the globe.

New York Botanical Garden

http://www.nybg.org/

This is a grand museum of plants in the Bronx where students can experience the wonders of nature. They are a worldwide leader in studying the Earth's plant life.

New York Hall of Science

http://www.nyhallsci.org/

The New York Hall of Science is New York City's hands-on science and technology center. The Hall, located in the borough of Queens, features more than 400 hands-on exhibits. Students can explore the wonder and excitement of biology, chemistry and physics.

Queens Botanical Garden

http://www.queensbotanical.org/

The garden features rose, bee, herb, perennial gardens and more. Discover the benefits of a composting worm bin in your classroom: an excellent hands-on and inquiry-based activity to teach biology, ecology, environmental science, recycling, language arts, and more.

Staten Island Zoo

http://www.statenislandzoo.org/

The Staten Island zoo is the place to learn to love living things. They have animals, educational programs and much more available to students and the public.

Urban Advantage

http://www.urbanadvantagenyc.org/home.aspx

Urban Advantage is an NYC science-education initiative that supports middle schools, their teachers, students, and families through the excitement and process of scientific discovery and learning that takes place in eight renowned science-rich cultural institutions. Examples of exit projects created by NYC students can be found here.

Animal Diversity Web

http://animaldiversity.ummz.umich.edu/site/index.html

Animal Diversity Web (ADW) is an online database of animal natural history, distribution, classification, and conservation biology from the University of Michigan

Caltech's Space Radiation Laboratory

http://www.srl.caltech.edu/

This site allows students to explore solar wind, ions and particles in space.

CIESE

http://www.k12science.org/collabprojs.html

CIESE was founded in 1988 to improve K-12 science and mathematics education through the use of technology. It gives students the opportunity to join any of their Collaborative Projects.

CELLS *alive*

http://www.cellsalive.com/

CELLS alive represents 30 years of capturing film and computer-enhanced images of living cells and organisms for education and medical research.

Digital Library for Earth System Education (DLESE)

http://www.dlese.org/educators/k12.php

This area focuses on the special needs of K-12 educators and has tips for finding resources for K-12 classrooms, collections specifically designed for K-12 teachers.

Encarta Online

http://encarta.msn.com/encnet/refpages/artcenter.aspx

Here are more than 42,000 articles --from aardvark to zither.

Encyclopedia of Life

http://www.eol.org/

The Encyclopedia of Life (EOL) is a project to organize and make available online virtually all information about life on Earth. At its heart lies a series of Web sites—one for each of the approximately 1.8 million known species—that provide the entry points to this vast array of knowledge.

Environmental Protection Agency

http://www.epa.gov/

EPA leads the nation's environmental science, research, education and assessment efforts. The mission of the Environmental Protection Agency is to protect human health and the environment. Since 1970, EPA has been working for a cleaner, healthier environment for the American people.

Howstuffworks.com
http://www.howstuffworks.com/
The site explains how things we use work.

Lawrence Hall of Science
http://www.lhs.berkeley.edu/
Lawrence Hall of Science (LHS) is a singular resource center for preschool through high school science and mathematics education, and a public science center with exciting hands-on experiences for learners of all ages.

NASA Quest
http://quest.arc.nasa.gov/about/index.html
This site includes online resources such as live interactions with NASA experts, A/V programs via the Internet, lesson plans, collaborative student activities, etc.

National Oceanic Atmospheric Administration
http://www.noaa.gov/
NOAA is an agency that enriches life through science. Our reach goes from the surface of the sun to the depths of the ocean floor as we work to keep citizens informed of the changing environment around them.

Science Club
http://scienceclub.org//kidproj1.html
Offers suggestions for a variety of science projects, links and more.

Science Master
http://www.sciencemaster.com/
ScienceMaster is chock full of information, news, links, pictures, products and services, with the best content from NASA, the USGS, the EPA, NOAA and leading colleges and universities.

StarChild: A Learning Center for Young Astronomers
http://starchild.gsfc.nasa.gov/docs/StarChild/StarChild.html
Information and online movies related to the solar system and space exploration. A service of the High Energy Astrophysics Science Archive Research Center.

TryScience.org
http://www.tryscience.org/
This is the NY Hall of Science website. TryScience.org is your gateway to experience the excitement of contemporary science and technology through this on- and off-line interactive. The site also provides links to science museums around the world.

Watershed
http://watershed.syr.edu/
The New York State Watershed website is a vehicle to enter and store water quality data collected by students from streams near their schools.

Webquest
http://webquest.org/
A Web Quest is an inquiry-oriented lesson format in which most or all the information that learners work with comes from the web. Learn how to create your own Internet activities called Web Quests.

Online Resources for Educators

Avalon Project at Yale Law School Document Collection
http://avalon.law.yale.edu/subject_menus/major.asp
This major collection includes documents in law, history, and diplomacy from ancient times to the present.

Benchmarks for Science Literacy
http://www.project2061.org/tools/benchol/bolframe.htm
The AAAS Benchmarks for Science Literacy, Project 2061; used to develop the NYC Performance Standards in Science

Buck Institute for Education
http://www.bie.org/index.php/site/PBL/overview_pbl/
This site is run by a non-profit research and development organization that focuses on project-based learning.

Checklists to Support Project-Based Learning
http://pblchecklist.4teachers.org/
http://www.vermontsocialstudies.org/resources/proj_based_learning/assessment.html

Edutopia
http://www.edutopia.org/inquiry-project-learning-research
This site, run by the George Lucas Educational Foundation, offers a wealth of information on project-based learning, including videos of teachers and students at work.

Expeditionary Learning in Social Studies
http://www.elschools.org/design/CPB-2-5.pdf
This short article from Expeditionary Learning schools provides a framework for teaching inquiry-based science and social studies.

Getting a Grip on Project-Based Learning
http://www.ncsu.edu/meridian/win2002/514/
This is an article by Michael M. Grant about project-based learning, published in Meridian, a Middle School Computer Technologies Journal.

Global School Net
http://al.gsn.org/web/index.html
This site, funded in part by the U.S. Department of Education, has a tutorial for collaborative, online project-based learning.

Houghton Mifflin's Project-Based Learning Space
http://www.college.cengage.com/education/pbl/index.html
This site offers examples of PBL projects as well as background knowledge and theory, teaching concepts, and a teacher education station.

Inquiry in Social Studies Units
http://www.tki.org.nz/r/socialscience/curriculum/SSOL/years11-13_e.php
This site offers complete social studies units from an "Online Learning Centre" in New Zealand.

National Archives
http://www.archives.gov/education/index.html
This site runs the Digital Classroom, a gateway to resources about primary sources and training for educators.

National Education Association Foundation – Connecting the Bits
http://www.neafoundation.org/publications/connecting.htm
This site provides information about integrating technology into K-12 education, with a specific section on integrating technology into project-based learning.

National Science Education Standards
http://books.nap.edu/books/0309053269/html/index.html
This site has the National Science Education Standards (1995) used to develop the NYC Performance Standards in Science.

Project Based Learning
http://www.pbl-online.org/
This site is an online resource for developing project-based learning. It includes support for designing projects, a project library, research, and web resources on effective project-based learning.

A Review of Research on Project-Based Learning
http://www.bobpearlman.org/BestPractices/PBL_Research.pdf
This is a review of research on project-based learning by John W. Thomas.

RubiStar
http://rubistar.4teachers.org/index.php
This website supports the creation of rubrics for classroom use.

ThinkQuest NYC
http://www.tqnyc.org/
ThinkQuest New York City creatively brings together learning principles and technology for students and educators. ThinkQuest New York City offers exciting programming including the annual “ThinkQuest Challenge,” a contest for students to create educational websites to present their exit projects (and enter them into the competition). This site offers everything free of charge to NYC teachers, including how to create a website.

Virtual Schoolhouse
http://virtualschoolhouse.visionlink.org/index.htm
Virtual Schoolhouse offers a collection of principles and best practice from around the country on project-based learning.

Urban Advantage
http://www.urbanadvantagenyc.org/home.aspx
Urban Advantage (UA) is a standards-based partnership program in middle school science education between the DOE and eight New York City science-rich cultural institutions. Its framework consists of six research-based components designed to support schools, principals, teachers, students and their families, including high-quality professional development, classroom materials that promote scientific inquiry, outreach, and assessment.

Using Inquiry to Teach Social Studies
http://www.ehhs.cmich.edu/~tcsrj/newbyhiggs6.pdf
This is an article by Diane Newby and Peter Higgs about using inquiry to teach social studies.

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Project-Based Learning: Inspiring Middle School Students to Engage in Deep and Active Learning

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