ARCHITECTS OF LEARNING

A Standards-Based, Project-Oriented Simulation in Which Students Apply Math Skills

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ISBN# 978-1-57336-361-7

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The nationwide movement for high standards has not only determined what students should learn, but also has mandated that students demonstrate what they know. ARCHITECTS OF LEARNING addresses Level III Standards in Mathematics, Language Arts, and Applied Learning.

For the purposes of determining Standards met, Interact consulted a Standards resource published by the Association for Supervision and Curriculum Development (ASCD), and the Mid-continent Research for Education and Learning (McREL). ARCHITECTS OF LEARNING meets the following standards set forth within *Content Knowledge: A Compendium of Standards and Benchmarks for K–12 Education*. This document gathers standards set by such organizations as the National Council for Teachers of English (NCTE) and National Assessment of Educational Progress (NAEP). Standards met by ARCHITECTS OF LEARNING include:

NCTM National Standards for School Mathematics

Number and Operations Standard

- Compute fluently and make reasonable estimates

Geometry Standard

- Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships
- Use visualization, spatial reasoning, and geometric modeling to solve problems

Measurement Standard

- Understand measurable attributes of objects and the units, systems, and processes of measurement
- Apply appropriate techniques, tools, and formulas to determine measurements

Problem Solving Standard

- Build new mathematical knowledge through problem solving
- Solve problems that arise in mathematics and in other contexts
- Apply and adapt a variety of appropriate strategies to solve problems
- Monitor and reflect on the process of mathematical problem solving

Communication Standard

- Organize and consolidate mathematical thinking through communication
- Communicate their mathematical thinking coherently and clearly to peers, teachers, and others
- Use the language of mathematics to express mathematical ideas precisely

Representation Standard

- Use representations to model and interpret physical, social, and mathematical phenomena

STANDARDS

Language Arts Level III (Grades 5–8)

Listening and Speaking

8. **Uses listening and speaking strategies for a variety of purposes**
   - Plays a variety of roles in group discussions
   - Asks questions to seek elaboration and clarification of ideas
   - Listens in order to understand topic, purpose, and perspective in spoken texts; organizes, summarizes, and paraphrases spoken ideas and details
   - Conveys a clear main point when speaking to others and stays on the topic being discussed
   - Makes oral presentations to the class
   - Uses appropriate verbal and nonverbal techniques for oral presentations

California Applied Learning Standards

Standard 1: Students will understand how to solve problems through a project design process. Students will design a product, service, or system to meet an identified need.

Standard 6: Students will understand how to apply communication skills and techniques. Students will demonstrate ability to communicate orally and in writing.

Standard 8: Students will understand the importance of teamwork. Students will work in teams to achieve objectives.

Gardener's Multiple Intelligences

Mathematical learners benefit from the application of skills.

Verbal learners benefit from the research, writing, and oral presentation tasks.

Kinesthetic learners benefit from the three-dimensional construction and model building.

Interpersonal learners benefit from the opportunity to share what they know.

Visual Spatial learners benefit from seeing their designs become realities.

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Although students often solve many math problems in a classroom, they rarely get the chance to apply math skills to class projects. ARCHITECTS OF LEARNING students plan, design, and construct three-dimensional models of pavilions in an educational theme park. As they participate in the process, students apply math skills to determine perimeter and area, draw to scale, and solve math problems that arise from their construction. As a culminating activity, student teams present their architectural models including the math strategies they used to create the model, problems they faced and solved, and the detailed dimensions of their pavilions. As "tour guides" they also present content relating to their theme to an audience of peers, parents, and invited guests.

Using multiple intelligences to show what they know engages students in the learning process and excites their interest and creativity. As a result of completing an involved, challenging, long-term project, students become more knowledgeable and achieve a heightened sense of accomplishment.

Specifically, ARCHITECTS OF LEARNING benefits students in the following ways:

Knowledge

- Architectural concepts through hands-on experiences
- The step-by-step process from idea through design to construction
- Subject area content
- Overview and implications of the Americans with Disabilities Act

Skills

- Using measurement to design and check design elements in a floor plan and model
- Using measurement to make models to scale
- Using math vocabulary to communicate math thinking
- Applying and describing problem-solving strategies in real-world context
- Applying mathematical skills to create models that meet specific guidelines
- Utilizing oral language and media skills in the presentation of projects to an audience
- Drawing and reading floor plans
- Following directions and building to specifications
- Working cooperatively with other students to make decisions, solve problems, and complete tasks successfully

Attitudes

- Appreciate that knowledge attained in mathematics classes has real-world applications
- Proudly complete a multi-layered project through patience, determination, and cooperation
- Attain personal growth through collaboration, risk-taking, and self-evaluation
- Recognize the need to make all buildings handicap-accessible

PURPOSE

OVERVIEW

During ARCHITECTS OF LEARNING, students simulate architectural design teams as they plan, design, construct, and present three-dimensional scale models of pavilions in an educational theme park. The project represents shared team ideas and decisions. ARCHITECTS OF LEARNING encourages students to synthesize and apply their learning as they prepare a presentation to impart to others what they have learned.

Phase 1: Warmups **2–3 days**

The whole class experiences warmup activities to both introduce architectural concepts and to promote healthy team dynamics. Students read an essay on Architecture and choose team names.

Phase 2: Investigations and Problem Solving **2–10 days**

Team members investigate area, perimeter, and scale. The tasks include both individual and group activities. The first five investigations may be optional if students have recently completed a thorough study of area, perimeter, and scale. The sixth investigation teaches students how to present their problem-solving strategies, an important skill needed for the unit's final presentation. (Phase 2 also includes a two-day challenge problem.)

Phase 3: Plan and Design **3–4 days**

The teacher either assigns a theme or allows the students to determine a theme. In a whole class discussion, students divide the theme into major topics of study. Each pavilion of the theme park will house one topic supporting the theme. The architectural teams then self-select, choose randomly, or are assigned a topic. Teams assume their roles (Chief Architect, Clerk of the Work, General Contractor, Interior Designer, or Landscape Designer) and collaborate to decide what information they will present. They may need to research and collect the information from classroom resources, library resources, and the Internet. Depending on your course objectives, students may also begin work on a research paper.

The architectural teams decide what their pavilion will look like and where they will be sited on the project platform. They cooperate to draw *general* floor plans for the structure they will construct. As an added challenge, teams must consider building codes from the Americans with Disabilities Act (ADA) as they design their floor plans.

Phase 4: Construct the Project **3–4 days**

Team members fully assume the tasks of their roles. Each day the teams develop a daily agenda to complete their architectural tasks cooperatively and on time. They follow directions to create a three-dimensional scale model and detailed floor plans. Each member of the team must solve a problem related to his or her role. Students also prepare to present their strategies and solutions to these problems as part of their final presentation. After completing the structures members decorate outside walls and finish landscaping the property around the models.

Phase 5: Prepare Presentations **2–3 days**

In teams students prepare an oral architectural presentation that consists of a "tour" of their floor plan and model. Students prepare a detailed description of the dimensions of the pavilion, a recounting of the problems they faced and solved during the construction, and a short explanation of what might appear in each room of their pavilion.

Phase 6: Present, Debrief, and Assess **2 days**

As teams put on their presentations, other students and the audience evaluate them. On the following day(s) in a class debriefing, students relate experiences and reflect on their successes and frustrations as they worked through the ARCHITECTS OF LEARNING process. The teacher also recognizes achievement, both individual and cooperative, by awarding certificates.

Accommodating Special Needs Students

Like all Interact units, ARCHITECTS OF LEARNING provides differentiated instruction through its various learning opportunities. Students learn and experience the knowledge, skills, and attitudes through all domains of language (reading, writing, speaking, and listening) and through kinesthetic activities. Adjust the level of difficulty as best fits your students. Assist special needs students in selecting activities that utilize their strengths and allow them to succeed. Work together with the Resource Specialist teacher, Gifted and Talented teacher, or other specialist to coordinate instruction.

OVERVIEW

INTEGRATING ARCHITECTS OF LEARNING

TEACHING TIP

Students can use ARCHITECTS OF LEARNING for the study of any curriculum topic. The unit provides the incentive and the framework for students to show what they know.

14–26 Days

ARCHITECTS OF LEARNING is primarily a math simulation. However, it is ideal to use as a cross-curricula activity to reinforce content in other subjects. It can be used by a single teacher who teaches multiple subjects or by a team of teachers who share a group of students. Teachers can use ARCHITECTS OF LEARNING to focus student learning on social studies topics such as world geography or ancient civilizations, or science topics such as marine biology or environmental science.

1. **Scheduling ARCHITECTS OF LEARNING**
   Your students may participate in ARCHITECTS OF LEARNING activities daily, once or twice a week, or as part of a collaborative model.
   a. **Daily in Math Class**
      - Dedicate one 45-minute period every day for approximately three weeks.
      - A daily concentrated time schedule may prove the most focused, productive way for your students to complete this unit successfully.

   b. **Weekly in Math Class**
      This works best with block scheduling of 60 to 90 minutes. With class periods of only 45 minutes, dedicate two periods a week so that the construction is not drawn out too long.
      - Schedule activities for a Thursday or Friday. Students look forward to the ARCHITECTS OF LEARNING work at the end of the week.
      - Timing the unit completion with an open house or parents' night provides an excellent opportunity for showcasing student learning and accomplishments.

   c. **Collaborative Model**
      Students work on different aspects of the simulation in different classes during multiple periods each day.
      - The math teacher may present Phases 1 and 2 before or while other teachers introduce content.
      - The timeline may be shortened dramatically.
      - Benefits include maintaining a high level of interest among the students and team collaboration among the teachers.

2. **Ensuring Success for your Students**
   a. Prepare your students to succeed by ensuring they understand the concepts of area, perimeter, and scale.
   b. Allow sufficient time for the investigations of Phase 2: Investigations and Problem Solving to ensure students can express their problem-solving experiences clearly.

c. Be certain students understand the requirements of the constructions and have the skills to build to scale.
d. Reinforce the importance of teamwork, not only in the classroom but also in the world of work. Use the COOPERATIVE GROUP WORK RUBRIC often enough to provide the feedback necessary to keep students on task.

3. **Identifying a Theme for a Math Only Project**
   a. **Student Selection:** As a class, students choose a theme that's of interest to them. This may include anything from skateboards to a sports hall of fame.
   b. **Teacher Selection:** The teacher chooses a theme based on a current event or special happening (e.g., Olympics) or assigns a theme related directly to mathematics with topics that include strands of math study (statistics, geometry, algebra).

4. **Identifying a Theme as Part of Integrating Curriculum**
   a. Choose a topic that your class is studying or has studied in your social studies, science, or literature curriculum.
   b. Collaborate with team teachers to choose a topic that students are studying in another teacher's class.

5. **Sample Project Integrating Math and Social Studies**
   The following procedures outline a study of the ancient history of China as an example for incorporating ARCHITECTS OF LEARNING into an integrated-curriculum unit: The step outline begins with Phase 3 after students have completed warmup activities and investigated/reviewed math skills. These directions are written as steps and are directed at the integrating teacher. The Phase 3 Daily Directions beginning on page 51 provide detailed instructions for the math teacher. Obviously teachers will have to collaborate to determine the best schedule for integrating content and construction.

Step 1: Choose the general *content area* from a unit of study that students are reading in a textbook or have studied previously. For the sake of this example, students had read a textbook chapter on the ancient civilization of China.

If more appropriate for your students, consider building a school campus or museum complex instead of a pavilion project.

Research papers are an important component of student learning. The research that students complete for their pavilion interior naturally forms the basis for a research report. Depending on your teaching objectives, assign a research paper during the Plan and Design phase or immediately after the oral presentations as a review of information learned.

When teachers use ARCHITECTS OF LEARNING as a culminating activity for students who have recently studied content, it is an especially powerful learning experience. It causes students to revisit the information and present it to an audience of peers, teachers, and parents.

The step outline begins with Phase 3 after students have completed warmup activities and investigated/reviewed math skills.

Phase 3: Plan and Design

Phase 3: Plan and Design

Lead the students to not only list the topics that were in the textbook and your curriculum focus, but also some unanswered questions that students want to explore further. Spend ample time brainstorming topics to study. Provide one general topic for each team. The list in Step 2 is just an example of what a class might compose when considering Ancient China or some other civilization.

During Phases 3 and 4 (through Step 7) ensure that students are sharing responsibilities and fulfilling their roles. Give feedback orally or by assessing teamwork using the ***COOPERATIVE GROUP WORK RUBRIC****.*

Check that students include all the essential information you required. Encourage students to go beyond the class information to add interesting information that was not part of your original unit.

Step 2: Ask the class to suggest, from their knowledge base, what *topics* they would need to include in an exhibition of ***Ancient China***. The objective is to identify information for students to present such as:

- Transportation and communication
- Aesthetic expression
- Dress and customs
- Politics and economics
- Community design and structure
- Everyday life of the people

Content: Determine what minimal content your students must include and *make a check sheet for each team's topic*. Encourage students to gather and present more than the minimum on your sheet. Require that students show you informally what they will present before they start building.

Media Center: Work with your school's media center to provide the following resources that pertain to the curricular content you have selected:

- Library or classroom research resources (textbooks, reference books, encyclopedias, maps, atlases, etc.)
- Internet access

Step 3: Once you and the class have identified the specific topics important to the study of Ancient China, define the overall simulation task. Tell the students that ARCHITECTS OF LEARNING is a simulation where each team designs an exposition pavilion as part of an educational theme park campus. Here the general public can come for an educational, entertaining in-depth study of Ancient China.

Step 4: Introduce the directions for the architectural project. Review the team roles, and ask the students to determine who will assume which role. Distribute the Student Guides or display a transparency of the **Pavilion Project** on page 8 of the Student Guide. Read with the students (see sample on page 7).

Step 5: During social studies class, allow time for students to plan and research the topics using classroom resources, library references, and the Internet if available. You may require students to prepare a research report or just note cards and an oral report on their topic. Provide support and assistance as needed.

Step 6: Students design their pavilion and draw their floor plans. The added challenge is that their pavilion must comply with the codes established under the Americans with Disabilities Act.

Pavilion Project (*Ancient China*)

Your architectural team will create a pavilion that is part of a theme park similar to a world's fair exposition. Here the general public can come to learn important information about *Ancient China*.

As members of an architectural team, your goal is to plan, design, and build a model of your pavilion that will be both educational and entertaining for children and adults.

In your pavilion you must provide space to exhibit information about your topic, as well as provide an environment for visitors' comfort. You have an unlimited budget for technology. You may install state-of-the-art equipment. Your designs must exhibit your topic *The Great Wall*.

Also all teams must design their pavilions to be in compliance with the Americans with Disabilities Act. All teams will have basic requirements such as restrooms, fire exits, and a presentation area. Your team will select a Special Area card and will then design an additional service area within your pavilion. This might be a snack bar, gift shop, first aid clinic, etc.

Throughout the simulation, your team will meet, make plans for the day's work, and solve problems. It will be essential that you record your problem-solving strategies and the solution to these problems because the records will be part of your final presentation.

There is a size limit for the pavilions. The project board represents the actual theme park property. If the scale is 1 inch equals 10 feet, the project board represents property that is *480'* by *480'*. We need to put *five* pavilions on this space. We also need space for walking, parking, and maybe a common area that the buildings are set around.

After you finish the floor plan and construction, your team will site your pavilion model on a landscaped project board. Together you will present this project and your problem-solving experiences to an audience of prospective investors.

You must follow the construction instructions carefully and work together to finish the *Ancient China* Pavilion Project successfully.

TEACHING TIP

The Student Guide includes this Pavilion Project information. Students will fill in the blanks on their own copies as the class receives the assignment or determines the scope of the project on Day 1 of Phase 3.

TEACHING TIP

Because the project board size is up to the individual classroom teacher and the size of the class determines the number of teams, you will have to fill in the numbers for the teams. Show the teams the relative area that they will have for their pavilions on your class project board.

Phase 4:
Construct the Project

Step 7: Students build their pavilion models following their floor plans and the specific directions given on the individual roles' TASKS. Although the **Chief Architect** is in charge of the whole project, as the project reaches certain points, the other roles assume some of the leadership. Landscape Designers work on the project board.

Phase 5:
Prepare Presentations

Facilitate the successful presentation of students' accomplishments by offering speaking instructions and ample practice time. See ***Daily Directions, Phase 5: Prepare Presentations****.*

Step 8: Students may begin planning their formal presentations as they construct their model. The presentation has three parts. Teams must:

1. Prepare a tour of the model including detailed dimensions
2. Prepare a description of the problems they faced and solved while constructing the model, including each role's individual architectural project math problem
3. Provide information about the topic that will be housed in the model

By the end of Phase 5, or on the teacher's timeline, the students will have written out their tour, recopied their problem-solving sheets, and listed detailed dimensions of their pavilion.

Phase 6:
Present, Debrief, and Assess

Step 9: On the last day of the simulation students give an oral, multi-media presentation to an audience of their peers and guests. The audience provides feedback on the clarity, accuracy, and amount of information presented.

Sample Presentation

a. **Social Studies Component:** In an integrated project on *Ancient China,* a specific pavilion could educate visitors on the Great Wall of China. The student guide/host can include important, specific information about the Wall during the "tour" of the model.

b. **Math Component:** Students present the pavilion, its dimensions, a retelling of the problems they faced and solved, and a record of their strategies and solutions.

Step 10: Take time during the next day or two to debrief. Include discussion of the rubrics, the projects, the oral presentations, and students' team experiences. Allow students the opportunity to evaluate their effort, their accomplishments, and their learning.

6. **Optional Activities:** These activities give students additional opportunities to show what they know about the content studied.
   a. Teams may prepare an artifact and tell its significance to the topic and theme. In the *Ancient China* example, the artifact could be a fabricated "brick" from the Great Wall.
   b. Teams may create a stage performance to go along with their architectural presentation. This short performance can be a speech, play, tableau, song, poem, etc., that relates to the content presented in their models. In the *Ancient China* example, the stage performance might be a man telling his son, who is just beginning to work on the Wall, about the history of the Wall. He tells his son how his father, grandfather, great-grandfather, and great, great-grandfather had also worked on the Wall.

7. **Sample Project Integrating Math and Science**
   a. The procedures to incorporate ARCHITECTS OF LEARNING into an informational science unit are the same as those for social studies. Only the topics are different.
   b. **Sample Topics:** If the major content study were *Threats to the Environment,* the students might design pavilions that relate to
      - Air pollution
      - Oil spills
      - Water pollution
      - Erosion and soil depletion
      - Trash and littering
   c. **Optional Activities**
      - **Sample Erosion Artifact:** Two containers—one with grass, one with just soil. Demonstrate soil erosion when you pour water on each.
      - **Sample Erosion Performance:** Make a poster that illustrates how much soil is lost annually in the USA by environmentally destructive farming methods and recommend better farming techniques that preserve soil.

8. **Sample Project Integrating Math and Literature**
   ARCHITECTS OF LEARNING can be used with a literature unit as well. If students were studying a particular author or genre, each pavilion might represent a separate book. Or the theme park could represent fictional books and each pavilion would represent a certain kind of fiction, including historical fiction, realistic fiction, science fiction, fantasy, and mysteries.

Any content can be organized to use this simulation. Think of music, art, home economics, health, and physical education.

SETUP DIRECTIONS

1. **Before you Begin**
   Read this entire Teacher Guide and the Student Guide. See **Integrating ARCHITECTS OF LEARNING** (page 4) for ideas, sample topics, and step-by-step procedures. Throughout the Teacher Guide, Interact employs certain editorial conventions to identify materials.
   a. One *Day* on the **Unit Time Chart** is the length of a normal *class period*—45 minutes to one hour.
   b. Teacher reference pages are named in **Bold**.
   c. All transparency masters and student handouts are listed by name, using ALL CAPITAL LETTERS.
   d. In preparing materials, *Class set* means *one per student*.
   e. Student-created materials are named with plain text, beginning with capital letters (e.g., the Project).

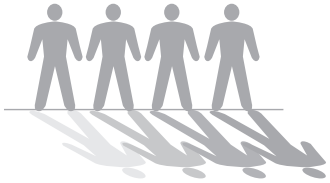
14–26 Days

2. **Planning your Schedule**
   You control the timeline for ARCHITECTS OF LEARNING, based on your requirements for students to master content, construct models, and create/present oral presentations. **Scheduling ARCHITECTS OF LEARNING** (page 4) describes a daily, weekly, and a collaborative model for implementing this unit.
   a. Refer to the **Unit Time Chart** for a general idea of how long the unit will take when using this as primarily a math unit.
   b. Study the **Daily Directions** as you plan how much time you will spend to complete each phase. If your students have mastered area, perimeter, and scale you may skip some lessons in Phase 2. However, it is essential that all students complete the Phase 2 problem-solving activities.

Classroom experiences vary greatly based on grade level, student abilities, classroom time available, and the content of the curriculum area selected.

All of these time frames are estimates, as it is very difficult to determine what your specific situation will be. The author's experience is that each class is unique in the way students listen to directions, work independently, collaborate as a team, etc.

3. **Grouping Students**
   ARCHITECTS OF LEARNING works *best* with six teams or fewer. However, the unit can work with any number of teams. The more teams, the more time needed to present student work. There is little or no effect on the simulation itself. Each team consists of five roles; teams of four or five members work best. You, as facilitator of learning in your classroom situation, can best determine how many students will work well together. Some suggestions:
   a. Create teams of students with a variety of ability levels and strengths.



Groups

b. Remember that a strong aspect of this program is to develop positive team dynamics and promote self-confidence. Take some risks when deciding grouping, but create teams that will succeed with minimal behavioral issues.

4. **Student Roles**
   Students work in teams of five, with a Chief Architect, Clerk of the Work, General Contractor, Interior Designer, and Landscape Designer.
   a. Role responsibilities are defined in the Student Guide and on individual handouts (TASKS) detailing the design and construct process.
   b. Students remain in their roles throughout the simulation.
   c. Allow students to choose their roles; suggest that they vote or make random selections if there are any disagreements.
   d. Remind students that there are both individual and shared tasks. Although the **Chief Architect** has overall leadership responsibility, other team members will assume leadership when their part of the project is being prepared.

TEACHING TIP

Role responsibilities may seem overwhelming for some students at first. Monitor progress daily and provide support as necessary. As students work together they will find increasing success and grow more confident.

5. **Materials**
   Prior to beginning ARCHITECTS OF LEARNING, obtain the following items:

   Throughout the Unit
   - Architectural blueprints — *several examples (optional)*
   - Measuring tape or yardstick* — *at least one per team*
   - Overhead projector — *one*
   - Pocket folder or large manila envelope — *one per team*
   - Rulers — *class set*
   - Scissors — *class set*

   Phase 1
   - Camera (instant or regular film) — *one (optional)*
   - Cardboard (approximately 8" x 8") — *one per team*
   - Masking tape (no more than 1" wide) — *one roll per team*
   - Modeling clay (non-hardening) *or* mini marshmallows — *enough for each team to make one pea-sized ball for each intersection of their construction*
   - Newspapers — *a large stack*
   - Shopping bag (large paper) — *one per team*
   - Toothpicks (2.5" long, round) — *60 per team (minimum)*

*Because students are working with a scale in inches and feet, use standard measuring tapes or yardsticks, not meter sticks.

TEACHING TIP

If the toothpicks you find measure only 2.25", adjust the length of the newspaper rolls in Phase 1, Day 1. See Daily Directions for more specific information.

SETUP DIRECTIONS

Phase 2

- Business envelope (small) or plastic sandwich bag — *one per team*
- Chart paper, butcher paper, or large pieces of manila paper — *four class sets + 15 sheets per team*
- Construction paper (12" x 18") — *three per team*
- Graph paper (1/4" grid) — *12–13 per student (Phase 2)*
- Heavy string (at least 21') — *one per team (or have students cut from a large ball of string)*
- Markers or crayons — *one set per team*
- String (30" length) — *class set*

Phase 3

- Computers with Internet access — *one per team (optional)*
- Drawing paper (white) — *three sheets per team (optional extension)*
- Library references (selected content area) — *enough for class (optional)*
- Graph paper (1/4" grid) — *at least three per team*
- Newsprint or butcher paper (30" square) — *one per team (minimum)*
- Paper (to cover the project board for the models) — *two pieces*
- Project board (4' x 4') — *one (plywood, paneling, foam core, beaverboard, etc.)*
- Shopping bag (large paper), cardboard box, or plastic storage bin — *one per team*

Phase 4

- Cleanup facilities (sink, sponges, paper towels, etc.)
- Construction paper (several colors) — *two sheets per team*
- Graph paper (1/4" grid) — *at least three per team*
- Modeling clay (hardening) — *several tubs*
- Paintbrushes (1/2" or smaller) — *two per team*
- Paintbrushes (2") — *two per team*
- Poster board (white or buff 22" x 28") — *two per team (Precut one piece per team into 2-inch strips using a paper cutter.)*
- Tempera paint (red, yellow, blue, white, and black) — *enough for students*
- Transparent tape — *one to two rolls per team*
- Utility knife — *one for teacher use*
- Watercolor markers (preferable) — *enough for students*
- White glue — *one per team*

Phase 5

- Index cards — *four or five per student*
- Pointer stick — *one (optional)*
- Transparencies (blank) and overhead pens — *as needed*

TEACHING TIP

Poster board is the material of choice. Construction paper or manila folders are not heavy enough and corrugated cardboard is too heavy for the structures' walls. Provide poster board as large as possible to minimize the amount of piecing together as students construct their walls.

If poster board is not available, students may collect cereal boxes as a replacement material. If time is short, students may use actual cereal boxes for "pre-fab" buildings. Encourage them to cut more than one and splice them together to create interesting ells and additions.*
*(*ell — a wing of a building at right angles to the main structure)*

6. **Preparing Materials**
   Two-inch Poster Board and Drawing Paper Strips: If possible use a paper cutter to cut the strips. The cutter provides a straight edge on both sides of the paper.
   Special Area Cards Cut out SPECIAL AREA CARDS and laminate. Be sure you have one per team.

7. **Reproducible Masters**
   Duplicate the following in the quantities indicated in *Italics.*
   Throughout the Unit
   - IMHOTEP COINS — *three sheets per team (optional)*
   - COOPERATIVE GROUP WORK RUBRIC — *four or more team sets*
   - GRID (1/4") — *as needed*

   Phase 2
   - AREA SQUARES — *class set*
   - INVESTIGATION #1: Area — *class set*
   - PROBLEM-SOLVING RUBRIC — *transparency (optional)*
   - INVESTIGATION #2: Area of Rectangles — *class set*
   - PROBLEM-SOLVING FORMAT: Sample #1 — *class set*
   - PROBLEM-SOLVING FORMAT: Sample #2 — *class set*
   - INVESTIGATION #3: Area of Triangles — *class set*
   - INVESTIGATION #4: Perimeter — *class set*
   - AREA & PERIMETER QUIZ — *class set*
   - INVESTIGATION #5: Scale — *class set*
   - INVESTIGATION #6: Problem Solving — *class set*
   - INVESTIGATIONS PRESENTATION RUBRIC — *as needed*
   - INVESTIGATION #7: Designing a Theater — *class set* (*optional*)
   - ADA GUIDELINES — *one per team*

   Phase 3
   - SAMPLE DAILY AGENDA — *transparency (optional)*
   - SPECIAL AREA CARDS — *one card per team*
   - DAILY AGENDA FOR FIRST DAY — *one per team + transparency (optional)*
   - DAILY AGENDA— *one per team per day of construction + transparency (optional)*
   - CHIEF ARCHITECT'S SUPERVISORY NOTES — *one per team*
   - CLERK OF THE WORK'S TASKS — *one per team*
   - GENERAL CONTRACTOR'S TASKS — *one per team*
   - INTERIOR DESIGNER'S TASKS — *one per team*
   - LANDSCAPE DESIGNER'S TASKS — *one per team*

Look carefully to see if there are multiple copies of the same rubric on a page. For example, there are four COOPERATIVE GROUP WORK RUBRICS on a page, and two ARCHITECTURAL PROJECT RUBRICS on a page.

If your district does not supply 1/4" grid use the duplication master provided.

If your class has more than six teams, provide extra SPECIAL AREA CARDS. The complex will be larger and can support more gift shops, snack bars, etc.

- ARCHITECTURAL PROJECT PROBLEM — *one of each per team*
- ARCHITECTURAL PROJECT RUBRIC — *one per team + one to post + transparency (optional)*

Phase 4

- PAVILION DIMENSIONS— *one per team*
- SAMPLE FLOOR PLAN — *transparency or to post (optional)*

Phase 5

- ORAL PRESENTATION RUBRIC: Content — *class set + several to post + enough for half the audience members*
- ORAL PRESENTATION RUBRIC: Presentation — *class set + several to post + enough for half the audience members*

Phase 6

- ARCHITECTURAL TEAM EVALUATION — *class set + enough for audience members*
- AWARDS — *as needed*

8. **Preparing Project Boards**

Your students will work at a scale of 1" : 10'.

a. Provide one project board for the entire class to share. This allows plenty of room for each team to successfully build their pavilion and landscape their property, as long as you have no more than six teams. Use a piece of plywood or some other material that is solid and unlikely to warp.

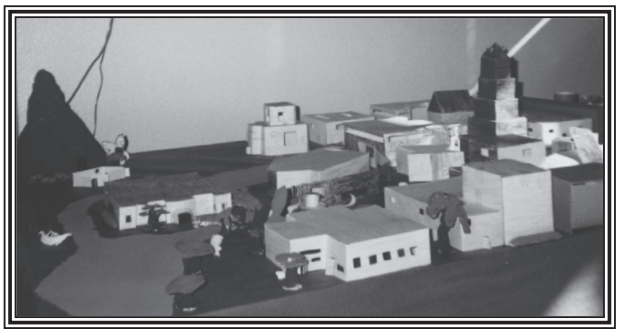
b. Provide enough room around the project board for students to be able to walk around all sides in order to paint their property, attach their models, landscape around their structures, and present their projects.
   - Using the suggested scale of 1" : 10', a 4' x 4' half-sheet of plywood translates to a finished area of 480' x 480' for the entire class project.
   - Daily directions tell you how to divide space on your board.
   - Mark the boundaries of each team's project area on the project board.
   - Use a large table, such as a library table, underneath the project board.

TEACHING TIP

You may have a project board of any size, larger or smaller than a half-sheet of plywood. You may use foam core, beaverboard, or paneling for your property base.

TEACHING TIP

The author's students constructed buildings with a variety of wall heights. Use this option if appropriate for your students.



9. **Constructing Finished Landscapes**
   Set aside an area within the classroom with modeling material, paints, brushes, white glue, and clean-up facilities.
   a. Select a modeling material that is easy to use, dries quickly, and can be painted or colored with markers.
   b. Art clay can be used for landscape elements, but it is fragile, falls apart easily, and doesn't attach very securely to the project area.
   c. Students may use actual pieces of twigs, leaves, sand, pebbles, etc. to decorate their landscapes.
   d. Advise students to make flat bottom surfaces for trees, bushes, benches, etc., to facilitate gluing the objects to the project board.
   e. Students should not paint surfaces that they plan to glue.

10. **Preparing your Classroom**
    Before beginning the unit set up a large bulletin board to display anything relating to architecture—pictures of buildings, floor plans from magazines, etc.
    a. Students need a work area large enough to lay out floor plans, cut poster board, fabricate landscape elements, etc., during the unit.
       - A double student desk or space on an uncarpeted floor is usually adequate for any work.
       - It is helpful if teams can have a meeting area in the room, separate from the other teams, to avoid interference or distraction between design teams.
    b. Provide as much room as possible around the bulletin board and project board for audience members to study the floor plans and models on the day of the oral presentations.
    c. Consider contacting local architectural firms to see if they can supply you with floor plans or other items to help build student interest. There may even be an architect who is willing to become an active consultant during the project!

11. **Classroom Management**
    It makes sense that students move through Phases 3, 4, and 5 at the same rate. Keeping to a schedule simulates deadlines in the real world of work. If necessary, allow students to move through these Phases at different paces. However, keep a chart on the board and require students to check in with you every day.
    a. Depending on how capable your students are of working independently, monitor the progress of each team and review their activities as needed.

The author recommends Crayola Modeling Magic™. This material makes great trees, bushes, flowers, or anything else created to add interest to team project areas. It has a fairly short shelf life, so do not plan to store for a long time.

b. You and the **Chief Architects** work together to encourage quality work and workload equity among team members.
c. Circulate to help teams make their decisions and, if necessary, resolve any difficulties in completing their goals.

TEACHING TIP

Sometimes moving the models can be problematic, and the acoustics in a larger room are poor. The author strongly advises that you invite whatever number of people you can comfortably fit into your classroom.

12. **Preparing for Formal Presentations**
Formal oral presentations of team projects are an important culmination to showcase and validate student work. Plan how best to accomplish within the limits of your classroom and schedule.
a. Decide how many audience members you can comfortably accommodate, and then design and send/deliver invitations.
   - Invite other classes, administrators, support staff, and anyone else at the school.
b. Formal invitations and careful selection of a peer audience will provide an encouraging and enthusiastic audience.
   - Audience members simulate prospective investors or members of the town's planning board.
   - Audience members evaluate and score team projects and oral presentations using rubrics that you distribute.
c. If your schedule allows for a second, evening presentation, plan that one especially for parents and community members.
   - If possible, contact newspapers and television stations by sending them a press release. They won't always attend but, when they do, it is an incredibly exciting experience for the young architects who have worked so hard on their projects.

13. **Debriefing**
After the architectural team presentations, facilitate a debriefing class discussion. Give students their evaluations of their projects and oral presentations.
a. Encourage them to reflect on their learning and assess their performance.
b. Self-evaluation of experiences, assignments, challenges, and accomplishments is extremely valuable and enables students to integrate and synthesize their learning.
c. You can use the debriefing time to reward teams and individuals for their achievement. See **Setup Directions #15**, **Incentives and Awards**.

14. **Extensions**
    a. **Math:** Require that students include different polygon shapes as part of their pavilion designs or assign specific dimensions or impose specific difficulties to overcome.
    b. **Science:** Require that students include passive solar collectors, wind generators, etc. At the conclusion of the unit invite someone from the electric company to visit and evaluate the conservation plans and provide information regarding the cost of heating and lighting the buildings.
    c. **Art:** In conjunction with the art teacher, have students design posters announcing the new exhibition space or design a logo for the T-shirts, hats, bookmarks, etc. to sell in the gift shops.
    d. **Architecture:** Have students prepare section drawings and elevation drawings of their pavilion.

15. **Incentives and Awards**
    Educators disagree on whether competition in the classroom is ultimately beneficial to students. Although many Interact products include an element of competition, competition is optional in ARCHITECTS OF LEARNING. If you feel your students will enjoy the competition and will work harder to achieve in this setting, then use the following incentives. If, however, you feel that competition would be counterproductive in your classroom, forego the competition and give awards only at the end of the simulation.
    a. **Incentives:** As students complete activities with rubrics, distribute IMHOTEP COINS, named for the ancient Egyptian architect who designed a pyramid almost 5,000 years ago. Reward a team with four coins for every *Exemplary* (individual or team) and two for every *Expected*. Do not give coins to teams until they have earned an *Expected* score.
    b. **Awards:** At the debriefing, give teams awards for their presentations, number of coins accrued, cooperation, beauty/design of model, cleverness/thoroughness of problem solving, overall performance, and/or any other special recognition.

Run the duplication on gold paper, or color the coins bright yellow with crayons or markers.

Tell students to glue their coins to their team folders, or provide a place on the bulletin board to staple the coins. Your mark book with scores of Expected and Exemplary will give you a back-up record of most rewards. Be sure to record Cooperative Group Work awards as well.

ASSESSMENT

ARCHITECTS OF LEARNING offers many opportunities for assessment. Teachers can determine students' mastery of perimeter, area, and scale by administering the AREA & PERIMETER QUIZ in Phase 2. The final formal presentation provides the opportunity for both individual and team assessments in three areas—tour information (both mathematical and content), finished projects, and oral presentation skills. Be sure that students understand that the audience will participate in the evaluation of their oral presentations.

1. **Formal Presentation Assessment**

Tour Information (*Teacher Evaluation*)

Math Content

Team Evaluation

The tour information should be complete and accurate. Students must have included the minimum information outlined on the ARCHITECTURAL PROJECT RUBRIC. Additional information adds to the quality of the project.

Individual Evaluation

Students present their problem solving experiences.

Other Content

Team and Individual Evaluation

The collaborating teacher should decide at the start of the unit what content must be included and prepare a check sheet for the students. The teacher should encourage students to complete more than the expected work.

Finished Projects (*Teacher and Audience Evaluation*)

Team Evaluation

Evaluate as a team on this aspect of the unit.

a. Floor plan
b. Three-dimensional structures
c. Cooperative group work

Oral Presentations (*Teacher and Audience Evaluation*)

Team Evaluation

Evaluate effectiveness of team presentation.

Individual Evaluation

Evaluate individual presentation skills.

2. **Standards-based Assessment**
   The philosophical difference between standards-based assessment and more traditional evaluation is the insistence that all students meet or exceed the *Expected* level of achievement. Standards-based instruction aims for high standards. Work that would be traditionally graded as C is really not standard and should be corrected or redone to ensure that students understand the concepts and skills required

3. **Making Assessments**
   ARCHITECTS OF LEARNING includes several rubrics for students to use when preparing their work and for your use in scoring student work that meets an established standard. Rubrics for finished projects and oral presentations are all based on a similar scoring format.

4. **ARCHITECTS OF LEARNING Rubrics**
   The Teacher Guide includes masters of the rubrics, two or four copies to a page. The rubrics clearly establish performance expectations for students. Use the rubrics throughout the unit to reinforce good work by students or to encourage students to work more carefully.
   a. COOPERATIVE GROUP WORK RUBRIC: Distribute copies to students frequently during the first few days of the simulation, then as needed as students work on their projects. The Student Guide includes this rubric.
   b. PROBLEM-SOLVING RUBRIC: The Student Guide includes this rubric.
   c. INVESTIGATIONS PRESENTATION RUBRIC: The Student Guide includes this rubric.
   d. ARCHITECTURAL PROJECT RUBRIC: Copy and distribute at least one per team. Post prominently in the classroom. The Student Guide does not include this rubric.
   e. ORAL PRESENTATION RUBRIC—**Presentation**: This is identical to the INVESTIGATIONS PRESENTATION RUBRIC. Have half the audience members refer to this rubric as they evaluate the team formal presentations.
   f. ORAL PRESENTATION RUBRIC—**Content**: This differs from the INVESTIGATIONS PRESENTATION RUBRIC in that it includes only content. Have half the audience members refer to this rubric as they evaluate the team formal presentations. The Student Guide does not include this rubric.

Teachers give students opportunities to correct or redo work until their work meets the standard, and offer more instruction and/or more time, if necessary.

For teachers who choose to translate rubric scores into traditional grades, an Expected *is a product or score comparable to a solid B or B+.* Exemplary *scores are comparable to A's.*

For students to truly understand and appreciate assessments, consistency in terminology and format is extremely helpful. To ensure that students are clear about expectations while they work on their projects, review each rubric as you distribute it and always keep a copy of each rubric posted on the bulletin board.

5. **Using Rubrics**
   a. Always distribute the relevant rubric *before* students begin to work.
   b. Be sure that students understand what they are expected to do and how they will be evaluated on every part of their work.
   c. Although you (and the audience) will complete the final presentation rubrics, also allow students to assess their own work. Discuss with a team or individual if there is a significant discrepancy between your and their assessments.

Using the Internet

If you have access to the Internet, your students will benefit from the wealth of information that pertains to the curriculum content area that you have selected for study. Before using the Internet, become familiar with your school's Acceptable Use Policy. Always preview any website you make available to your students. If your students do not have access to the Internet, you may access the Internet and build a notebook of information printed off the various websites you locate.

Interact's Resource List

Several recommended website addresses are listed on a Resource page available through the Interact web page. To find the ARCHITECTS OF LEARNING Resource Page, complete the following steps:

- Connect to the Internet
- Go to Interact's site at: www.teachinteract.com
- Type "**Architects of Learning**" in the search box
- Scroll down to "**related Web sites**"
- Click any links of interest
- Click the "**Back**" button to return to Interact's home page

UNIT TIME CHART

ARCHITECTS OF LEARNING

PHASE 1: Warmups

DAYS 1–3

Learning about architecture
Team naming
Newspaper Roll Constructions
Discuss expectations of cooperative group work
Building to Scale: Clay and Toothpick Structures
Student Guides
COOPERATIVE GROUP WORK RUBRIC
IMHOTEP COINS (optional)

PHASE 2: Investigations and Problem Solving

DAYS 1–3

Investigating area, area of rectangles, and area of triangles
Student Guides
AREA SQUARES
INVESTIGATIONS #1, #2, #3
PROBLEM-SOLVING RUBRIC
PROBLEM-SOLVING FORMAT: Sample #1
PROBLEM-SOLVING FORMAT: Sample #2
COOPERATIVE GROUP WORK RUBRIC (as needed)

DAY 4

Investigating perimeter
Student Guides
INVESTIGATION #4
COOPERATIVE GROUP WORK RUBRIC (as needed)

PHASE 2: Investigations and Problem Solving (continued)

DAY 5

Investigating scale
Student Guides
AREA & PERIMETER QUIZ
INVESTIGATION #5
COOPERATIVE GROUP WORK RUBRIC (as needed)

DAYS 6–8

Problem solving
Presenting solutions
Student Guides
INVESTIGATION #6
INVESTIGATIONS PRESENTATION RUBRIC
COOPERATIVE GROUP WORK RUBRIC (as needed)

DAYS 9–10 (optional)

Designing a theater
Student Guides
INVESTIGATION #7 (optional)
ADA GUIDELINES
INVESTIGATIONS PRESENTATION RUBRIC

UNIT TIME CHART

ARCHITECTS OF LEARNING

PHASE 3: Plan and Design

DAY 1

Discuss *Pavilion Project*
Class brainstorm and discuss theme topics
Review and assume roles
Teams design project areas and generate "bubbles"
Teams brainstorm and discuss pavilion contents
Student Guides

DAYS 2–4

Review roles and responsibilities
Review scale and building to scale
Review building codes for Americans with Disabilities Act
Lay out general shape of pavilions
Clarify expectations
Teams select special areas (snack bar, gift shop, etc.)
Set design rules for projects and for drawing floor plans
Teams design floor plans

Student Guides
ADA GUIDELINES
SAMPLE DAILY AGENDA
SPECIAL AREA CARDS
DAILY AGENDA FOR FIRST DAY
DAILY AGENDA
CHIEF ARCHITECT'S SUPERVISORY NOTES
CLERK OF THE WORK'S TASKS
GENERAL CONTRACTOR'S TASKS

PHASE 3: Plan and Design

DAYS 2–4

INTERIOR DESIGNER'S TASKS
LANDSCAPE DESIGNER'S TASKS
ARCHITECTURAL PROJECT RUBRIC
COOPERATIVE GROUP WORK RUBRIC (as needed)
Troubleshooting Design and Construct Directions

PHASE 4: Construct the Project

DAYS 1–4

Teams construct structures
Individuals complete detailed floor plans and recopy them neatly
Individuals solve problems and write Problem-Solving Formats
Teams finish landscaping project board
Student Guides
DAILY AGENDA
PAVILION DIMENSIONS
SAMPLE FLOOR PLAN
COOPERATIVE GROUP WORK RUBRIC (as needed)
Troubleshooting Design and Construct Activities

PHASE 5: Prepare Presentations

DAYS 1–2 or 3

Teams prepare oral presentations and presentation materials
Teams practice presentations
Student Guides
ARCHITECTURAL PROJECT RUBRIC
ORAL PRESENTATION RUBRIC

PHASE 6: Present, Debrief, and Assess

DAY 1

Teams present models, tours, and problem-solving experiences
Assessment by audience and teacher
Student Guides
COOPERATIVE GROUP WORK RUBRIC
ARCHITECTURAL PROJECT RUBRIC
ORAL PRESENTATION RUBRIC
ARCHITECTURE TEAM EVALUATION

DAY 2

Debriefing and Assessment
AWARDS

Newspaper Roll Constructions

10–15 minutes

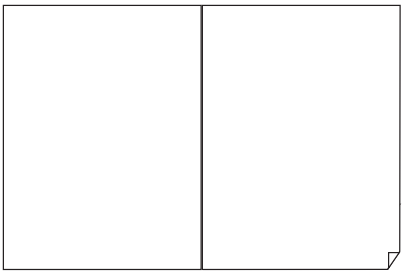
Teacher

Materials

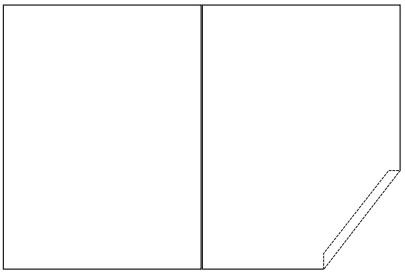
- Masking tape (no more than 1" wide) — *one roll*
- Newspapers — *a large stack*
- Scissors — *one pair*

Preparations

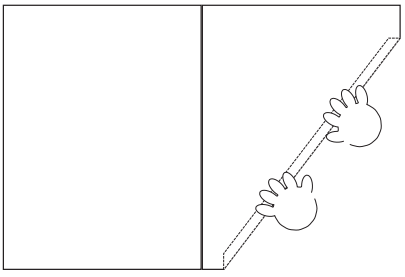
1. ***Prior to*** **Day 1** create 12 pieces of building material. Follow these step-by-step instructions:
   a. Place a double-size (not a single page) piece of newspaper on a flat surface. (The floor works well, but you may prefer a desk or table.)
   b. Starting in the bottom right corner, make a very small fold (about 1/8") in the direction of the opposite corner.



   c. Continue making several small folds in that direction until you can begin to roll the paper, making sure you hold the roll tightly with several fingers.



   d. ***Do not let go of the roll*** or the whole thing will unravel. If this happens, start over with a new piece of newspaper; it will be difficult to start over with the original piece again.



Envision your fingers to be like people rolling up a carpet tightly. The more you can spread out the fingers of both hands and apply equal pressure, the easier it will be to roll the entire sheet into a long, tight building piece.

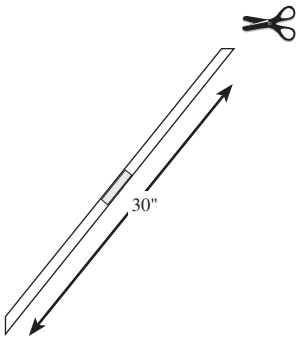
DAILY DIRECTIONS
PRIOR TO DAY 1—NEWSPAPER ROLL CONSTRUCTIONS

TEACHING TIP

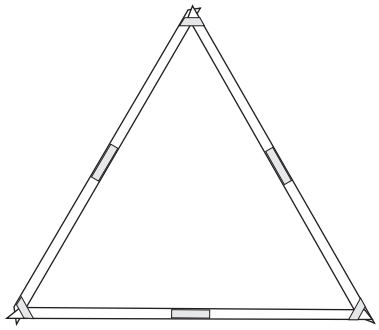
This process sounds more difficult than it is—once you have created one tightly-rolled piece, the rest are effortless!

Check the length of the round toothpicks you have purchased for the Day 3 activity. Most round toothpicks are 2.5". If the ones you purchase are 2.25", trim the newspaper rolls to 2.25' (27") long.

e. Use a small piece of masking tape to hold the roll together by taping the exposed corner to the roll.
f. Trim finished rolls at each end where they are thinnest so that they are 2.5' (30") long.



2. Use three rolls to build an equilateral triangle.
   a. Choose three nearly identical rolls and lay them out in a triangular configuration on the floor.



   b. Tape two rolls together by joining the overlapped ends with a piece of masking tape. Use only enough tape to make the connection secure; try not to add too much bulk.
   c. Do the same for the third piece, creating an equilateral triangle.
   d. Make three more of these triangles.

3. During class you will use these four equilateral triangles to demonstrate to students how to form a pyramid.

Day 1
Learning about Architecture

2–3 Days

Teams

Objectives

- Generate a list of what students know about architecture
- Introduce architectural concepts through hands-on experiences
- Promote personal growth through collaboration, risk-taking, and self-evaluation
- Work cooperatively with other students: making decisions, solving problems, and completing a task successfully

Materials

- Student Guides — *class set*
- Masking tape (no more than 1" wide) — *one roll per team*
- Newspapers — *a large stack*
- Scissors — *one or two per team*
- Shopping bags (large paper) — *one per team*

Procedure

1. ***Important***: You need a large area for building and displaying the structures. A hallway or covered outside area is the best place for the finished models. These structures must be able to stand undisturbed until the activities on Day 3 are complete.

2. Using a blank board or chart paper, write the word *Architecture* in the center. Ask students to contribute words or phrases that relate to what they know about that word.

3. Write the student responses all around the word *Architecture*; try to include all reasonable answers. Most likely, the words *design, plan, build,* and *structures* will be included in your list. If not, include them yourself.

4. Write on the board or chart paper the following definition of the word *Architecture*: *The science and art of planning, designing, and building structures*. Relate as many of the words and phrases given by the students to this definition as possible.

These oversized three-dimensional newspaper constructions introduce students to architecture and building and generate great interest not only for your students but also for the school community!

The space will need to allow at least six feet for each team to build the structure and at least three feet between student teams.

Architecture: The science and art of planning, designing, and building structures.

Refer to Integrating ARCHITECTS OF LEARNING (pages 4-9) if you will be collaborating with another teacher or content area. If appropriate add that this unit will be a collaboration or will integrate with another subject.

5. Read or tell:

   You are going to work within teams as ***architects*** to plan, design, construct, and present a three-dimensional architectural project. You will need to apply your math skills, your problem-solving skills, your cooperative group work skills, and your imagination.

   Let's start by finding out more about architecture and famous architects.

6. Move students into teams in the manner you have determined will work best for your class (see **Setup Directions #3**, **Grouping Students**.) Distribute the Student Guides. Ask students to put their name on the front cover of the Guides. Read the **Architecture** essay. You can ask students to read it silently, read it round-robin, or read it within each team. Conduct a class discussion about the content. A fun activity to do after reading content is to complete a *Did You Know?* activity:

   One student stands up to say, (addressing another student by name) "_____ *did you know* _____?" (The speaking student gives a fact from the reading.)
   The student who was addressed says, "Yes, I did but _____(now addressing a third student), *did you know* _____?"(Another fact.)
   Continue around the room until the content has been covered sufficiently.

7. Go back to the board or chart paper and ask students if they can add to what they have already written.

8. Ask students to meet with their team members for two-three minutes to choose a name for their architectural team. Encourage them to consider using some words or names from what they have learned about architecture.

9. After teams have selected their names, have students write their team name on their Student Guides.

10. Introduce the newspaper structure project. Describe and demonstrate the rolling technique with a new sheet of newspaper. Distribute newspapers, scissors, tape, and the shopping bags.
    a. Warn students that they ***must not let go of the roll*** or the whole thing will unravel. If this happens, they should start over with a new piece of newspaper; it will be difficult to start over with the original piece again.
    b. Have students use a small piece of masking tape to hold the roll together by taping the exposed corner to the roll.
    c. Students trim finished rolls at each end where they are thinnest so that they are 2.5 feet (30 inches) long.
    d. Remind students that it is important to measure and trim rolls to size.

11. The goal for each team is to make quickly, but carefully, at least 60 building pieces. Some individuals may complete more, others only a few. However, encourage all team members to help in construction. Those not actually rolling the paper may help by supplying tape, preparing paper to be rolled, etc.

12. Allow approximately 25 minutes for teams to complete the rolling of paper. Each team should keep track of how many pieces they have, ending with a pile of no more than 60 rolls.

13. Students may write team initials on rolls and stand them in the shopping bag for use tomorrow.

14. Students will definitely need time to wash the newsprint off their hands after completing the rolling and after picking up extra newspaper that has not been used or been discarded.

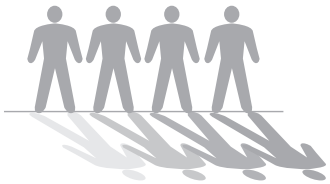
15. Collect Student Guides. If you are using incentives and awards, distribute IMHOTEP COINS now or at the beginning of the next class.

Suggest that the students envision their fingers to be like people rolling up a carpet tightly. The more they can spread out the fingers of both hands and apply equal pressure, the easier it will be to roll the entire sheet into a long, tight building piece.

Check the length of the round toothpicks you have purchased for the Day 3 activity. Most round toothpicks are 2.5". If the ones you purchased are 2.25", trim the newspaper rolls to 2.25' (27") long.

In every class there are some students who pick up the technique very quickly, others who learn by repeated demonstration and practice, and others who never succeed. How efficiently your students work will determine how much time they need for this activity.

If one team makes more than another does, they can share some of their pieces; this is not a competitive activity.



Team Activity

Day 2
Newspaper Roll Constructions

Objectives

- Introduce architectural concepts through hands-on experiences
- Promote personal growth through collaboration, risk-taking, and self-evaluation
- Work cooperatively with other students: making decisions, solving problems, and completing a task successfully

Materials

- Masking tape (no more than 1" wide) — *one roll per team*
- Newspaper rolls — *60 per team*
- Scissors — *one or two per team*
- Camera (instant or regular film) — *one (optional)*

Procedure

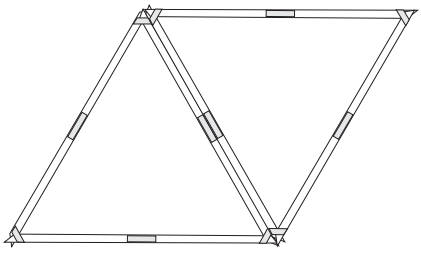
1. Using the three triangles that you created prior to class, demonstrate for the students how to make a triangle.

TEACHING TIP

For both #2 and #3 have each team complete each step after you demonstrate the technique.

2. Instruct each team, working together, to choose 12 newspaper rolls from their shopping bag. The rolls should be of similartightness.
   a. Choose three nearly identical rolls and lay them out in a triangular configuration on the floor.
   b. Tape two rolls together by joining the overlapped ends with a piece of masking tape. Use only enough tape to make the connection secure; try not to add too much bulk.
   c. Do the same for the third piece, creating an equilateral triangle.
   d. Make three more of these triangles.

3. After all teams have fashioned four triangles, demonstrate for students how to join four triangles together to form a triangular pyramid.
   a. Lay one triangle next to another so that one side of one triangle is lined up with one side of a second triangle.



b. Using masking tape, tape the two ends and the middle of the sides together.
c. Tape a third triangle to these two, keeping in mind that the ultimate goal is a pyramid.
d. When three triangles are taped together, attach the fourth.
e. Teams should have constructed one pyramid.

4. Explain that the pyramid will be the base of their newspaper roll structures.

5. Move teams, their pyramid, and remaining building pieces to the designated construction/display site.

6. Students now attach *all* the 48 remaining newspaper rolls to their pyramid base with tape only.
   a. The pyramid must stay on the ground.
   b. The structure must be freestanding (not attached to the ground).
   c. There is no right or wrong way to complete this project.

7. The main considerations for teams to keep in mind are:
   a. Stability and structural strength (The structure should be able to survive several days without falling.)
   b. Aesthetics (All team members should be pleased with the way the structure looks.)
   c. Cooperation (All team members must participate in the process.)

8. Allow approximately 20–30 minutes for completion of this project. Try not to interfere with teams' progress, but give verbal cues with 10 minutes remaining, five minutes remaining, etc., so that all teams finish attaching all their pieces on time.

9. If severe behavior problems occur that interfere with a team's success, use judgment in removing a student for a short time-out. Do not allow team members to interact with other teams. The successes and failures of each team will be discussed during debriefing at the end of the period.

10. After all teams finish their structures, let students have a few minutes to step back, look at their project, and view the other teams' structures.

Encourage students to resist using too much tape, as it creates unnecessary weight.

Allow at least six feet for students to build each structure and at least three feet between student teams.

Use the COOPERATIVE GROUP WORK RUBRIC as often as necessary to provide feedback. You may allow students to complete the activity first and then use the RUBRIC in conjunction with the criteria in # 7.

Write the three considerations on the chalkboard or chart paper and post in the work area.

Circulate among teams, encouraging students and observing team dynamics.

11. Take photographs of the students and their structures. (Allow students to be in the picture. This will help them appreciate the size of the actual structure.) It provides a photographic record of their work and can be useful when discussing scale later in the unit.

12. Bring students back to an area where all can meet to discuss the activity. Include the following debriefing questions in an open discussion:
    a. How well did your team work together? Were there leaders? Followers? Non-participants? Disrupters?
    b. If your team worked well, what made the difference? If a team did poorly, what advice do other teams have?
    c. What was easy about the construction process? What was difficult?

Usually, students from other classes will be very curious, but respectful, and not destroy the projects. More damage occurs from wind and moisture. This project is a lot like building sandcastles—the constructions don't last forever!

13. The teams' constructions outside the classroom must be able to remain standing undisturbed until the activities in Day 3 are complete.

14. If you are using incentives and awards, distribute IMHOTEP COINS now or at the beginning of the next class.

Day 3
Building to Scale: Clay and Toothpick Structures

Objectives

- Introduce architectural concepts through hands-on experiences
- Introduce building to scale
- Work cooperatively with other students: making decisions, solving problems, and completing a task successfully
- Promote personal growth through risk-taking, and self-evaluation

Materials

- Cardboard (approx. 8" x 8") — *one per team*
- Modeling clay (non-hardening) *or* mini marshmallows — *enough for each team to make one pea-sized ball for each intersection of their construction*
- Toothpicks (round) — *60 per team (minimum)*
- Ruler — *class set*
- Camera (instant or regular film) — *one (optional)*

Procedure

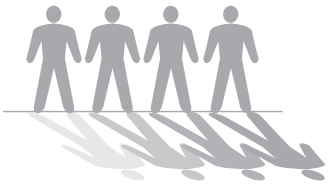
1. Today the students will build a scale model of the newspaper roll structure that their team made the day before. Encourage the students to complete this scale activity accurately and quickly. Suggest that they make a plan to work as a team to complete it within 15 minutes. You will need about 25 minutes to complete the remaining activities planned for this day.

2. Give every student a ruler and a toothpick.

   Today you are going to build a model of the large paper structure you built yesterday. Remember we trimmed the rolls to 2.5'. Measure one of your rolls right now to check. Now measure one toothpick. How long is that?

   If the roll is 2.5' and the toothpick is 2.5", then we can easily make a scale model. A scale model duplicates the paper model exactly except that it is smaller. Can anyone finish this statement? One inch on my model represents one _____ on the actual structure.

   Lead the students to discover the scale of one inch equals one foot. Write this on the board. Use the colon to show how it is sometimes written 1 inch : 1 foot.



Team Activity

This activity only "introduces" building to scale because the students can build the model without math. The scale for this project is 1" : 1'.

Working with modeling clay can be problematic with some student groups. Explain that throwing clay will not be tolerated. Another material that works, but not as well, is mini-marshmallows. Manage the marshmallows also, to ensure that students are not creating a health hazard by eating them after unwashed hands have handled them.

Students will find the toothpicks about 2.5" long

read or tell

3. Read or tell:

   The toothpicks cannot be readily taped at corners, so we are going to use modeling clay (marshmallows) to tie the corners together.

   Give each team a cardboard square and the allotted amount of modeling clay. Instruct students to do all construction on the cardboard to avoid getting oil from the clay on student work surfaces. Have each team make enough pea-sized balls from the modeling clay to match the number of intersections on their structure.

TEACHING TIP

If necessary, remind students to use their materials in a responsible manner.

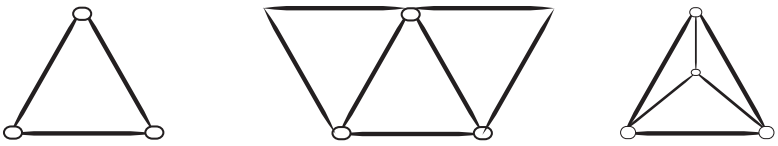
4. Distribute to each team as many toothpicks as the number of newspaper rolls they used in their structure minus the number you have already distributed (one per team member). Show the students how to duplicate the triangular pyramid they began with the newspaper activity. Tell them to stick the toothpicks halfway through the center of a clay ball; the clay will be the connector.

5. Move to the area where the large newspaper structures are standing. Tell students that they will construct their toothpick and clay scale model on site. Remind them to work quietly without disturbing other classes or traffic.

TEACHING TIP

Have the students check as they work to ensure that the model matches the big structure. The key is that the model must exactly replicate the actual structure and that the scale must remain the same throughout the construction.

6. Student teams should replicate the model. They may use tape to join toothpicks that replicate newspaper rolls that were joined mid-section in the paper model.



7. Give teams about 15 minutes to complete this task.

8. As each team finishes, have them place the structure with the cardboard base next to their paper structure without disturbing the other structures.

9. After all students have placed their structures on the project board, collect any unused clay (marshmallows) and toothpicks.

10. **Debriefing** Bring students back to an area where all can meet to discuss the activity. Include the following debriefing questions in an open discussion:
    a. How well did your team work together? Were there leaders? Followers? Non-participants? Disrupters?
    b. If your team worked well, what made the difference? If a team did poorly, what advice do other teams have?
    c. What was easy about the construction process? What was difficult?
    d. What have you learned about building scale models?

11. If possible, take pictures of the structures and their models. Have a student hold a ruler next to the sculpture for the photograph.

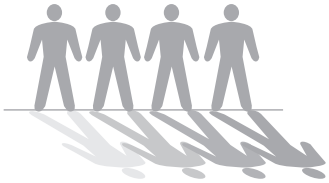
12. Take the models back into the classroom or put them in a locked showcase where other students cannot carry off the building materials. Leave the paper structures standing for a few more days for the rest of the school to admire.

This last question helps students to focus on the concept of scale, and gives you the opportunity to detect any misperceptions.

This photograph will allow students to make an estimate of the total height of their actual structure. If the model is 5.25" tall, then the structure is 5.25' tall. (Remind students that one-fourth of a foot is 3" so the actual structure is 5'3" tall.)

Students are often interested in bringing this toothpick project home to show family members. You can also photograph the structures with a digital camera and post them on the school web page. Encourage students to explain to their families what they have learned about scale.

2–4 Days



Teams

Problem Solving When describing the role of teachers to help students achieve the process standard of Problem Solving, NCTM makes several pertinent comments:

> "Research suggest that an important difference between successful and unsuccessful problem solvers lies in their beliefs about problem solving, about themselves as problem solvers, and about ways to approach solving problems (Kroll and Miller 1993). For example, many students have developed the faulty belief that all mathematics problems could be solved quickly and directly. If they do not immediately know how to solve a problem, they will give up, which supports a view of themselves as incompetent problem solvers. Furthermore, many students believe there is just one 'right' way to solve any mathematics problem. Not only do these students become dependent on the teacher or an answer key for verification of their solution, but they also fail to appreciate the excitement and insight that can come from recognizing and connecting very different ways to solve a problem. To counteract negative dispositions, teachers can help students develop a tendency to contemplate and analyze problems before attempting a solution and then persevere in finding a solution." (*Principles and Standards for School Mathematics* NCTM 2000)

> "For several reasons, students should reflect on their problem solving and consider how it might be modified, elaborated, streamlined, or clarified: Through guided reflection, students can focus on the mathematics involved in solving a problem, thus solidifying their understanding of the concepts involved. They can learn how to generalize and extend problems, leading to an understanding of some of the structure underlying mathematics. Students should understand that the problem solving process is not finished until they have looked back at their solutions and reviewed their process." (*Principles and Standards for School Mathematics* NCTM 2000)

With this in mind, ARCHITECTS OF LEARNING has a problem-solving component that requires students to not only solve a problem related to the model, but also to explain their strategies and insights to their peers. This procedure allows all the students to reflect on the different ways that each group may have approached those problems.

Allow your students time to solve their problems and require them to write out their process and solution. Allow class time for sharing of solutions and processes to maximize the benefits of "guided reflection."

Day 1
Investigating Area

Objectives

- Investigate area
- Use multiple strategies to solve problems
- Communicate problem-solving experiences
- Promote personal growth through collaboration, risk-taking, and self-evaluation
- Work cooperatively with other students: making decisions, solving problems, and completing a task successfully

Materials

- AREA SQUARES — *class set*
- INVESTIGATION #1: Area — *class set*
- Business envelope (small) or plastic sandwich bag — *one per team*
- Graph paper (1/4" grid) — *two per student*
- Overhead projector — *(optional)*
- Scissors — *class set*
- Team folders (pocket folders or large manila envelopes) — *one per team*

Procedure

1. Distribute one AREA SQUARES for each student, scissors, and one envelope/bag per team. Read the directions on the AREA SQUARES and allow students five minutes to neatly cut out the squares and put their initials on the backs.

2. Remind students to put their initials or name on all pieces of individual work, and their team name on all pieces of group work.

3. When the AREA SQUARES are ready, distribute INVESTIGATION #1: Area. Conduct the lesson with the class. Depending on your students' maturity and math skills, they may need to work step-by-step with you, or assign one of the team members to facilitate the lesson for the group.

The only confusing part of the lesson is the concept of a truly different shape. Using an overhead projector can make this clear.

*This first activity does not lend itself well to the **Problem-Solving Format**. Use the format on the second day.*

TEACHING TIP

In standards-based instruction, students must complete work that satisfies set criteria. There is a minimal level of work identified as Expected.

If you are using incentives, award four coins for an Exemplary *and two for an* Expected *score.*

Decide how best to store student work and materials. Sometimes individual students are organized enough to maintain team folders, but once construction starts, set aside a space for teams to keep their materials and partially-built structures.

ANSWER KEY

Remind students to clearly label the area (Area = 6 squares) for both Task A and Task B.

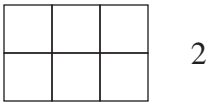
4. Require teams to complete work that is *Incomplete*. In order to ensure student understanding before introducing a new concept, make students redo, correct, or complete work until it achieves an *Expected* score.

5. At the end of the class, direct students to put all completed work, left-over graph paper, and the small envelope of AREA SQUARES in the large team folder. Store with Student Guides.

6. Answer Key for INVESTIGATION #1: Area.

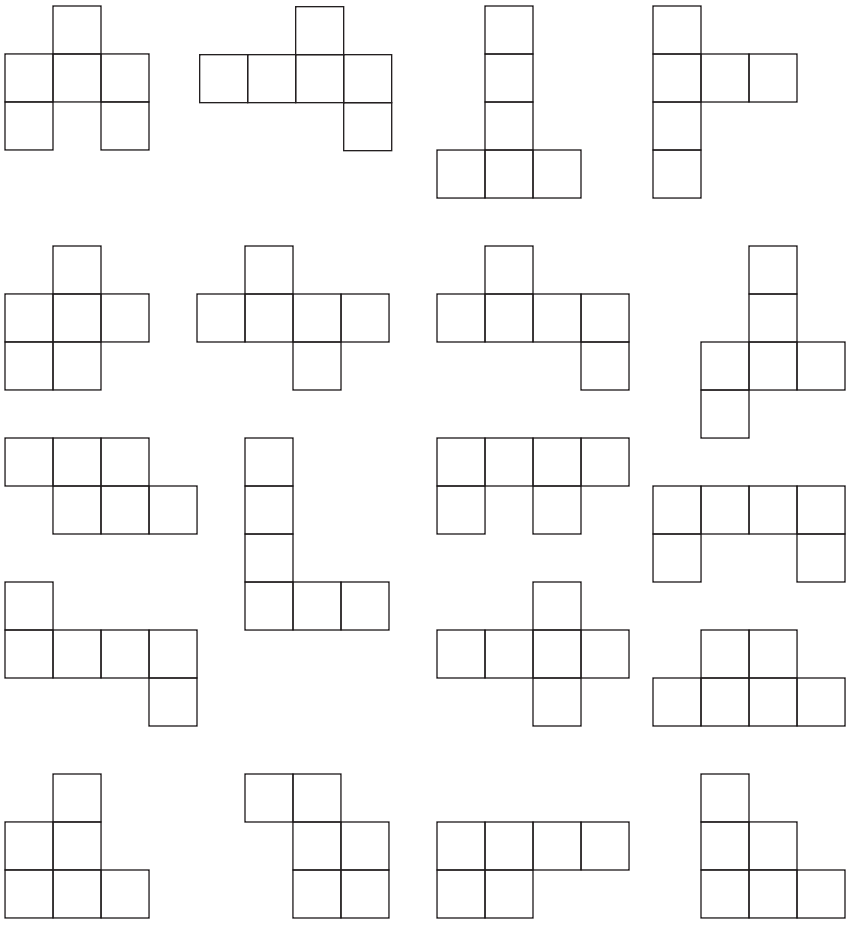
Task A

Area = 6 squares



Area = 6 squares

Task B



Task C Nine squares offer so many possible solutions that we do not provide an answer key.

Day 2
Investigating Area of Rectangles

Objectives

- Investigate area
- Use multiple strategies to solve problems
- Communicate problem-solving experiences
- Promote personal growth through collaboration, risk-taking, and self-evaluation
- Work cooperatively with other students: making decisions, solving problems, and completing a task successfully

Materials

- Student Guides — *class set*
- PROBLEM-SOLVING RUBRIC — *transparency (optional)*
- INVESTIGATION #2: Area of Rectangles — *class set*
- Chart paper, butcher paper, or large pieces of manila paper — *one or more per team*
- Graph paper (1/4" grid) — *class set*
- Markers or crayons — *one set per team*
- Overhead projector — *(optional)*
- Team folders — *one per team*

Procedure

1. Distribute team folders and ask students to reclaim their AREA SQUARES. (Initials on the backs should help.)

2. Distribute INVESTIGATION #2: Area of Rectangles and conduct the lesson with the class. Depending on your students' maturity and math skills, they may need to work step-by-step with you, or assign one of the team members to facilitate the lesson for the group.

3. Interrupt and ask your students to tell you what formula they created in #3 to make sure that students have correctly determined a formula for determining the area of a rectangle: *Area = L x W*. Stress the importance of the labels in *square* units because the label tells how many squares cover the surface.

4. Before they start **Task D**, review the **Problem-Solving Format** and **Rubric** in the Student Guide. *Note*: there is often more than one way to solve a problem. To encourage full participation by all students, walk around as teams work.

Do not share PROBLEM-SOLVING FORMAT: Samples #1 and #2 today. Wait until Day 3.

5. Distribute construction or chart paper.

6. At the end of the class, direct students to hand in the Task G, Part 2 chart paper for your evaluation and to put all other completed work and left-over graph paper in the large team folder.

Allowing students to self-evaluate helps them to understand the rubric process.

7. Informally evaluate their work for Task G, Part 2, but do **not** write the evaluation on the papers. The next day students will self-evaluate and then you will share your evaluation.

8. Answer key to INVESTIGATION #2: Area of Rectangles.
   2. 18 squares
   3. Area = (l x w) or (w x l)

Task D	20 sq.
Task E	20 sq.
Task F	28 sq.
Task G, Part 1	62 sq. in.

Day 3
Investigating Area of Triangles

Objectives
- Investigate area
- Use multiple strategies to solve problems
- Communicate problem-solving experiences
- Promote personal growth through collaboration, risk-taking, and self-evaluation
- Work cooperatively with other students: making decisions, solving problems, and completing a task successfully

Materials
- Student Guides — *class set*
- PROBLEM-SOLVING FORMAT: Sample #1 — *class set*
- PROBLEM-SOLVING FORMAT: Sample #2 — *class set*
- INVESTIGATION #3: Area of Triangles — *class set*
- Graph paper (1/4" grid) — *two per student*
- Overhead projector — *(optional)*
- Scissors — *class set*
- Team folders — *one per team*

Procedure
1. Distribute PROBLEM-SOLVING FORMAT: Sample #1 and PROBLEM-SOLVING FORMAT: Sample #2 and the team responses to Investigation # 2, Task G from the day before.

2. Discuss the fact that the area problem could be solved by using multiplication and subtraction or by using multiplication and addition.

3. Spend time discussing the insights. In both cases this is where the students unlocked the puzzle of the problem.

4. Direct students to the **Problem-Solving Rubric** in the Student Guide. Allow students to evaluate their own Problem Solving papers as *Exemplary*, *Expected*, *Nearly There,* or *Incomplete*. Remind students that all teams must achieve a level of *Expected*, and if their work scored *Nearly There* or *Incomplete*, they will have to correct or redo it.

It may seem like too much to ask students to redo work to meet a standard. However, when students realize that you will not accept work unless it meets the standard of Expected*, then they make an effort to complete the task carefully the first time. Also, it helps identify students who are genuinely confused right away, rather than days later when they are truly lost.*

All teams can work to earn an Expected or Exemplary.

This activity can be confusing. Unless your teams are reviewing area, conduct this lesson step-by-step through Tasks H, I, and J.

5. Allow 5–10 minutes for students to correct and recopy Day 2 **Problem-Solving Format** chart papers.

6. Distribute INVESTIGATION #3: Area of Triangles and conduct the lesson with the class. Depending on your students' maturity and math skills, they may need to work step-by-step with you, or assign one of the team members to facilitate the lesson for the group.

7. As students complete #1–4 in Task K, interrupt and ask your students to tell you what formula they created. Make sure that students have correctly determined a formula for determining the area of a triangle: *Area of a Triangle = 1/2 (Base x Height)*. **Stress** the importance of the labels in *square* units because the label tells how many squares cover the surface.

8. Distribute construction or chart paper to complete Task K #5. Remind students to follow the **Problem-Solving Format** in their Student Guide.

9. At the end of the class, direct students to hand in their chart paper from Task K #5 for your evaluation and to put all other completed work and left-over graph paper in the large team folder.

10. Evaluate all work using the **Problem-Solving Rubric**. Choose at least two to share the next day.

11. Answer Key for INVESTIGATION #3: Area of Triangles.

Task H

4. 150 squares
5. 75 squares
6. yes

Task J

a. yes
b. yes
c. yes
d. yes
e. 40 sq. in.
f. yes, 20 sq. in.
g. yes

Task K

4. Area = 1/2 (b x h)
5. Area = 18 sq. inches

Day 4
Investigating Perimeter

Objectives
- Investigate perimeter
- Use multiple strategies to solve problems
- Communicate problem-solving experiences
- Promote personal growth through collaboration, risk-taking, and self-evaluation
- Work cooperatively with other students: making decisions, solving problems, and completing a task successfully

Materials
- Student Guides — *class set*
- INVESTIGATION #4: Perimeter — *class set*
- Graph paper (1/4" grid) — *two per student*
- Overhead projector — *(optional)*
- Rulers — *class set*
- String (30" length) — *class set*
- Team folders — *one per team*

Procedure
1. Allow at least two teams to present their **Problem-Solving Format** charts to the class.

2. Distribute Team folders and INVESTIGATION #4: Perimeter and conduct the lesson with the class. Depending on your students' maturity and math skills, they may need to work step-by-step with you, or assign one of the team members to facilitate the lesson for the group.

3. After the teams have completed **Task M** interrupt and ask your students to tell you what formula they created. Make sure that students have correctly determined a short cut formula for determining the perimeter of a rectangle: *Perimeter = 2(L + W).*

   Walk around and check answers. Randomly ask students to explain perimeter. *Stress the difference in labels* between perimeter answers and area answers.

4. Before they start **Task O** #5: Review the steps of the **Problem-Solving Format** in the Student Guide. Students actually have to find three different answers. Remind them to underline or circle the answers and check the labels.

If you are using incentives, award four coins for an Exemplary *and two for an* Expected *score.*

This activity can be confusing. Unless your teams are reviewing perimeter, conduct this lesson step-by-step through Tasks L, M, and N.

5. As a team, students should solve the problems in **Task O**. Direct each team to prepare a chart using the **Problem-Solving Format** for *only* one of the two figures in **Task O**.

6. If time allows ask students to review the questions at the end of INVESTIGATION #4: Perimeter as well as the definition and formula for perimeter. If there is confusion, students should try to peer-teach team members or alert you to a student having difficulties. These questions will be the basis of the quiz on Day 5, an individual assessment.

7. At the end of the class, direct students to hand in the chart paper for your evaluation and to put all other completed work and left-over graph paper in the large team folder.

Be certain to choose the work of different teams each day. If time allows, share more than two per day.

8. Evaluate the charts using the **Problem-Solving Rubric**. Choose at least two to share for the following day.

9. Answer Key for INVESTIGATION #4: Perimeter.

Task L

1. three options: (1 x 12), (3 x 4) or (2 x 6)
2. Agree
3. 12
4. answers will vary, may be 26", 14", or 16"
7. a. shortest = 3 x 4 (14") b. longest = 1 x 12 (26")

Task M

2. Perimeter = 2(L + W)

Task N

Length of A = 4 in.; length of B = 15 in.; Perimeter = 38 inches

Task O

Figure I: W = 6 feet; V= 22 feet; Perimeter = 84 feet
Figure II: U = 18 feet; T= 8 feet; S = 40 feet; Perimeter =152 feet

Day 5
Investigating Scale

Objectives
- Investigate scale
- Use multiple strategies to solve problems
- Communicate problem-solving experiences
- Promote personal growth through collaboration, risk-taking, and self-evaluation
- Work cooperatively with other students: making decisions, solving problems, and completing a task successfully

Materials
- Student Guides — *class set*
- AREA & PERIMETER QUIZ — *class set*
- INVESTIGATION #5: Scale — *class set*
- Construction paper (12" x 18") — *three per team*
- Graph paper (1/4" grid) — *two per student*
- Heavy string (at least 21') — *one per team (or have students cut from a large ball of string)*
- Measuring tape — *at least one per team*
- Overhead projector — *(optional)*
- Rulers — *at least one per team*
- Scissors — *at least one per team*
- Team folders — *one per team*

Procedure
1. Distribute AREA & PERIMETER QUIZ. Allow 10 to 15 minutes for the quiz, based on your class. Collect papers and correct later.

2. Allow at least two teams to present their **Problem-Solving Format** charts from INVESTIGATION #4: Perimeter to the class.

If the quizzes help to identify students who still may need extra help, arrange to meet with them outside of class time to give individual instruction. Resource teachers may be able to help you with this.

If you are using incentives, award four coins for an Exemplary *and two for an* Expected *score*

Decide how much to teach your students about using shorthand notation when working with dimensions. Introduce inch, in. and " and feet, ft. and '. On student handouts all dimensions are spelled out, to ensure that no student becomes confused. Encourage students to adopt the shorthand notation if they are able to do so without confusion.

Many students get confused with fractions in scale work. Be certain to teach or re-teach this as needed. For the model building with a scale of 1 inch equal 10 feet, 1/2 inch will equal 5 feet (60 inches). The 1/4-inch graph paper boxes represent 2-1/2 feet (24 + 6 = 30 inches)

Although your evaluation will prevail, asking students to evaluate their own work encourages them to think about achieving Expected *or* Exemplary *work the first time they complete and hand in their work.*

3. Distribute Team folders and INVESTIGATION #5: Scale and conduct the lesson with the class. Depending on your students' maturity and math skills, they may need to work step-by-step with you, or assign one of the team members to facilitate the lesson for the group.

4. Walk around while observing the groups interact. Use the **Cooperative Group Work Rubric** as necessary. Stop to share the teams' work after **Task P** is complete.

5. Interrupt students to review what fractions mean in scale drawing. In this case, the scale is 1 inch represents 10 feet, so 5 feet in real life is drawn as 1/2 inch in scale.

6. Complete **Task R** #1–3 in class. For #4, invite students to create more scale drawings from items in their homes, including couches, beds, front steps, etc.

7. Ask students to evaluate their own papers using the **Problem-Solving Rubric** at the end of INVESTIGATION #5: Scale.

8. At the end of the class, direct students put their scale drawings on the bulletin board or hand in to you for your evaluation. All papers should be identified by the team name. Students should put all other completed work and leftover graph paper in the large team folder.

9. Evaluate scale drawings before the next class. Use the rubric to award *Exemplary* or *Expected* scores. Teams whose scores were *Nearly There* or *Incomplete* will need to correct or redo their work.

10. Answer key for AREA & PERIMETER QUIZ:

1. 6 sq. feet	6. 14 feet	11. 25 sq. feet
2. 14 feet	7. 16 sq. feet	12. 240 sq. feet
3. 6 sq. feet	8. 18 feet	13. 92 feet
4. 10 feet	9. 180 sq. feet	14. 124 feet
5. 12 sq. feet	10. 58 feet	15. 250 sq. feet

11. Answer Key for INVESTIGATION #5: Scale.
    2. 2-1/2 feet; there are 6 inches in a half-foot.
    4. 5 ft. long and 2 feet-6 in. wide.

Days 6 and 7
Problem Solving

Objectives

- Apply learning to an authentic problem: creating a classroom floor plan
- Use multiple strategies to solve problems
- Communicate problem-solving experiences
- Promote personal growth through collaboration, risk-taking, and self-evaluation
- Work cooperatively with other students: making decisions, solving problems, and completing a task successfully

Materials

- Student Guides — *class set*
- INVESTIGATION #6: Problem Solving — *class set*
- Chart paper, butcher paper, or large pieces of manila paper — *one or more per team*
- Graph paper (1/4" grid) — *two per student*
- Measuring tape or yardstick — *at least one per team*
- Rulers — *at least one per team*
- Team folders — *one per team*

Procedure

1. Return scale drawings and review the **Scale Drawing Rubric**. Discuss your evaluation and the students' self-evaluation.

2. As a class, review the **Problem-Solving Rubric** in the Student Guide and the class examples that show the difference between evaluations of *Expected* and *Exemplary*. Note also specifics that cause an explanation to be considered *Incomplete* and in need of a little or a lot of correction.

3. Next distribute INVESTIGATION #6: Problem Solving and read the problem out loud.

Answers to INVESTIGATION #6 will vary depending on the classroom.

If you are using incentives, award four coins for an Exemplary *and two for an* Expected *score.*

Encourage students to focus on the specifics that determine the scoring on rubrics. For example, no matter how sound their thinking, if a team did not number the steps, then they could not earn an Expected *score. Impress upon them that architects must pay attention to details and specific instructions.*

You may separate student teams so that they are drawing different spaces (For example, another classroom, the cafeteria, even an area outdoors.) If students are dispersed you may need additional adult supervision.

You can best determine the time necessary for students to complete this work correctly and carefully. Encourage students to work efficiently and to check their answers as they work. The world of work does insist on deadlines, and working under some time pressure causes students to stay on task.

Encourage students to come up with timesaving procedures such as making a template to trace for desks.

4. This is a two-day activity. On the first day students take the measurements and create the general layout of the area they are drawing to scale. Students need to pack up and store their work carefully at the end of each class.

5. On the second day, students work together in the classroom to create the floor plan. Students can label the drawing with words, make a key, or do a combination of both.

6. Students who are not working directly on the floor plan should work on solving the area and perimeter questions and completing at least two charts that use the **Problem-Solving Format**.

7. When the project is complete, teams prepare an oral presentation to share their floor plan, Problem-Solving Format charts, and answers with the rest of the class.

8. Have students refer to the **Investigations Presentation Rubric** in their Student Guides as they prepare their oral presentations.

Day 8
Presenting Solutions

Objectives
- Communicate problem-solving experiences
- Promote personal growth through collaboration, risk-taking, and self-evaluation
- Work cooperatively with other students: making decisions, solving problems, and completing a task successfully

Materials
- Student Guides — *class set*
- INVESTIGATION #6: Problem Solving — *from previous day*
- INVESTIGATIONS PRESENTATION RUBRIC — *as needed*
- Team folders — *one per team*
- Completed team work — *one per team*

Procedure
1. Allow students to present their solutions and floor plans from INVESTIGATION # 6: Problem Solving.

2. Even though some of the teams may have measured the same space, they may have slightly different answers to the area and perimeter questions. Allow for some discrepancy as long as the process is correct.

3. Use the INVESTIGATIONS PRESENTATION RUBRIC to evaluate the presentations.

4. This activity is a "dry-run" for the formal presentation that is the culmination of this unit. It is a great opportunity for students to experience what they will need to do to prepare their formal presentations at the end of the project.

5. Make a list on the board of "Lessons Learned" in this experience. The list should include what they think they will need to do to ensure an *Exemplary* score at the end of the unit.

If you are using incentives, award four coins for an Exemplary *and two for an* Expected *score.*

Days 9 and 10 (optional)
Designing a Theater

Objectives

- Communicate problem-solving experiences
- Promote personal growth through collaboration, risk-taking, and self-evaluation
- Work cooperatively with other students: making decisions, solving problems, and completing a task successfully

Materials

- Student Guides — *class set*
- INVESTIGATION #7: Designing a Theater — *class set*
- ADA GUIDELINES — *one per team*
- INVESTIGATIONS PRESENTATION RUBRIC — *as needed*
- Chart paper, butcher paper, or large pieces of manila paper — *one or more per team*
- Graph paper (1/4" grid) — *two per student*
- Measuring tape or yardstick — *at least one per team*
- Rulers — *at least one per team*
- Team folders — *one per team*

Answers to INVESTIGATION #7 will vary depending on team decisions.

Procedure

1. If you feel your students still need more directed practice, assign the optional INVESTIGATION #7: Designing a Theater. This investigation, although taking two days, directly ties into the larger unit project. It also provides the teams a chance to work on one room of their model using what they know.

2. Teams will have different designs and obviously different answers to the area and perimeter questions.

If you are using incentives, award four coins for an Exemplary *and two for an* Expected *score.*

3. Use the INVESTIGATIONS PRESENTATION RUBRIC to evaluate the presentations.

4. Students may find a spot in their pavilion for their theater floor plan. There is no need to create new theater space during Phase 3.

Day 1
Brainstorming and Decision-Making

3–4 Days

Teams

Objectives
- Introduce the basics of the architectural project—an educational theme park
- Introduce responsibilities of each role and determine roles
- Work cooperatively with other students: making decisions, solving problems, and completing a task successfully

Materials
- Student Guides — *class set*
- **Pavilion Project** and **Roles** — *transparencies of Student Guide pages (optional)*
- Computers with Internet access — *one per team (optional with content)*
- Library references (selected content area) — *enough for class (optional)*
- Team folders — *one per team*

Preparation
1. ***Optional***: Prepare a transparency of the **Pavilion Project** (page 8 of Student Guide) and **Roles** (page 4 of Student Guide) to use when you are discussing the project with the class.

2 If you are collaborating with another teacher, be certain to refer to the section called **Integrating ARCHITECTS OF LEARNING** (page 4).

Procedure
1. Choose or assign a theme for the class project.
   a. **Teacher Choice:** Disclose what will be the overall theme of the project. This may be a theme that is part of a social studies, science, or literature unit. Or it may be a theme based on a current event.
   b. **Student Choice:** Allow students to brainstorm possible themes of interest.

2. After you have decided on the major theme, read with the students the first few paragraphs of **Pavilion Project** (page 8 of Student Guide). If possible, use an overhead transparency to help students insert the correct information.

The section called Integrating ARCHITECTS OF LEARNING provides a unit overview for collaborating teachers. They can decide how best to integrate with the unit.

Decide which is best for your class and present the project by outlining the basic goals. See the sample Project descriptions and procedural steps in Integrating ARCHITECTS OF LEARNING for more information.

Do not read the whole project description at first. The details may be lost with information overload. Read the remaining paragraphs on Day 2.

Pavilion Project

Your team will create a pavilion that is part of a theme park similar to a world's fair exposition. Here the general public can come to learn important information about _____.

As members of an architectural team, your goal is to plan, design, and build a model of your pavilion that will be both educational and entertaining for children and adults.

In your pavilion you must provide space to exhibit information about your topic, as well as provide an environment for visitors' comfort. You have an unlimited budget for technology. You may install state-of-the-art equipment. Your designs must exhibit your topic, _____.

Also, all teams must design their pavilions to be in compliance with the Americans with Disabilities Act. All teams will have basic requirements such as restrooms, fire exits, and a presentation area. Your team will select a Special Area card and will then design an additional service area within your pavilion. This might be a snack bar, gift shop, first aid clinic, etc.

Throughout the simulation, your team will meet, make plans for the day's work, and solve problems. It will be essential that you record your problem-solving strategies and the solution to these problems because the records will be part of your final presentation.

The teams have not decided topics yet. Leave this blank.

3. Now that the theme is decided, students need to develop the topics. Write the theme in the center of the board or chart paper. Look at ***Integrating ARCHITECTS OF LEARNING,*** Phase 3, Step 2 (page 6) for examples of topics and themes.

4. After the initial brainstorming, organize the ideas into major topics, one major topic for each team. Assign topics to the teams by chance, by student interest, or by teacher choice. Write each major topic at the top of a separate piece of paper and distribute one paper to each team.

5. Give teams 5–10 minutes to brainstorm what could/should be part of an educational pavilion that will present their topic. Offer suggestions to spark discussion if students have difficulty.

6. Bring the teams back together and have teams share what they have included under their topic. Invite other students to add to the list, or add to the list any information you believe was overlooked. Encourage students to use library resources and/or the Internet if they need more information on their topic.

7. Now direct students to the **Roles** outlined in the Student Guide. Before the end of the period, students choose the role that they want to have for this project. The Phase 2: Investigations and Problem Solving activities should help individual students realize how they can best help their team. Decide if you will resolve any arguments regarding roles by vote or by chance.
   a. Help students realize they must share the work. Call a team meeting if you feel one or two members are "taking over," or if a member is shirking responsibility.
   b. Note that although the **Chief Architect** has the responsibility of overseeing the whole project, other team members routinely take the leadership at different times during the design, construction, and presentation stages of the project.
   c. Use the COOPERATIVE GROUP WORK RUBRIC as often as necessary to reinforce good group behavior.
   d. Note regarding the **Clerk of the Work**. This person usually works on behalf of the client and independent of the architect. He or she checks to see that the contractor is not doing shoddy work or installing cheaper materials than were called for in the original plans. For this simulation, however, the **Clerk of the Work** is working with the architectural firm to ensure accurate work on the model.

8. If students will complete a written research report related to their topic and architectural project, make that assignment within the next one or two days. Students will thus make the most efficient use of their research and note-taking time and will make wise decisions as to the topics to include in their pavilions.

Days 2–4
Project Planning

Objectives

- Plan the design of architectural models
- Further develop team decision-making skills
- Clarify ARCHITECTS OF LEARNING assessment criteria
- Introduce the size of the project and basic building specifications
- Work cooperatively with other students: making decisions, solving problems, and completing a task successfully

Materials

- Student Guides — *class set*
- **Pavilion Project** — *transparency of Student Guide page (optional)*
- SAMPLE DAILY AGENDA — *transparency (optional)*
- SPECIAL AREA CARDS — *one card per team*
- DAILY AGENDA FOR FIRST DAY — *one per team + transparency (optional)*
- DAILY AGENDA — *one per team per day of construction*
- CHIEF ARCHITECT'S SUPERVISORY NOTES — *one per team*
- CLERK OF THE WORK'S TASKS — *one per team*
- GENERAL CONTRACTOR'S TASKS — *one per team*
- INTERIOR DESIGNER'S TASKS — *one per team*
- LANDSCAPE DESIGNER'S TASKS — *one per team*
- ARCHITECTURAL PROJECT PROBLEM — *one of each per team*
- ARCHITECTURAL PROJECT RUBRIC — *one per team + one to post + transparency (optional)*
- ADA GUIDELINES — *one per team (as needed)*
- Large paper bag, cardboard box, or plastic storage bin — *one per team*
- Newsprint or butcher paper (30" square) — *one per team (minimum)*
- Paper (to cover the project board for the models) — *two pieces*
- Project board (4' x 4') — *one (plywood, paneling, foam core, beaverboard, etc.)*
- Graph paper (1/4" grid) — *at least three sheets per team*
- Team folders — *one per team*

Preparation

1. ***Optional***: Prepare a transparency of the **Pavilion Project** for use when you are discussing the project with the class.

2. Prepare two large pieces of paper that will cover the project board on which the models will be built. Cover the project board with one of the papers (the draft paper). Reserve the second piece for Phase 4.

3. Read all the task descriptions for each role for an overview of the project and individual tasks.

4. Determine how your students will store unfinished work. Set aside a large paper bag, cardboard box, or plastic storage bin for each team.

Procedure

1. Review with students what was discussed on Day 1. Confirm roles. Distribute the Student Guides and team folders.

2. Answer any questions students may have regarding the topics to be covered or the roles that were discussed the day before.

3. Direct students to the section where you left off in their Student Guides. Tell them that today they will learn the specifics of the project.

4. As you read, use the overhead to show students what they should insert on the blank lines, including the one that identifies the team's topic.

   Let us finish reading the Pavilion Project where we left off yesterday.

   There is a size limit for the pavilions. The project board represents the actual theme park property. If the scale is 1 inch equals 10 feet, then the project board represents a piece of property that is _____by ____. We need to put _____ pavilions on this space. We also need space for walking, parking, and maybe a common area that the buildings are set around.

Consider using large craft paper, old wallpaper, or inexpensive paper tablecloths. You may have to glue or tape pieces of drawing paper to cover the area.

Because the platform size is up to the individual classroom teacher, you will have to fill in the numbers for the teams. Show the teams the relative area that they will have for their pavilions on your class project board.

Add the information in parentheses only if it agrees with your own classroom presentation decisions.

After you finish the floor plan and construction, your team will site your pavilion model on a landscaped project board. Together you will present this project and your problem-solving experiences to an audience of prospective investors. (This audience will be made up of guest students, other teachers, your parents, and invited community members.)

You must follow the instructions carefully and work together cooperatively to finish the_____ Pavilion Project successfully.

5. Put the students into their teams. Before you distribute their individual job descriptions, review the **Roles** in the Student Guide. Impress on the **Chief Architect** that he/she must assume the leadership, but not be too bossy.

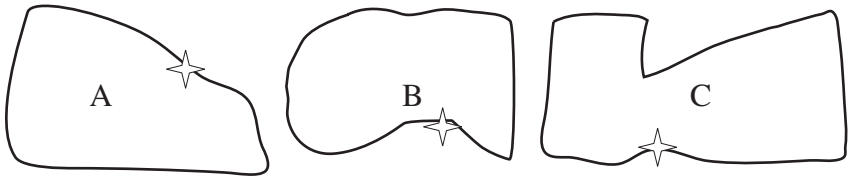
6. Distribute the individual job descriptions: the CHIEF ARCHITECT'S SUPERVISORY NOTES and the TASKS for the **Clerk of the Work**, **General Contractor**, **Interior Designer**, and **Landscape Designer**.

7. Discuss the **Sample Daily Agenda** in the Student Guide. Depending on your students' needs you may need to display the transparency. Walk the teams step-by-step through the first tasks. Discuss how students will fill in the **Agenda**.

8. Distribute and discuss DAILY AGENDA FOR FIRST DAY. The tasks relate to the individual role tasks. Take a moment to ask team members to read their task descriptions and determine their task on the DAILY AGENDA FOR FIRST DAY.

9. The name on the **Agenda** tells who has been given the task and who is responsible. If someone needs help, he/she should ask another team member to lend a hand. The **Chief Architect** should always be available to help as well.

10. The first task is to determine the actual space for each building. Show the teams the available space on the project board and tell them that each group will design and build one structure. Distribute the newsprint. Direct students to go back to their groups and sketch out a building shape on a piece of newsprint. Tell them to draw bubble shapes to represent the approximate size and shape.
    a. Students do *not* decide an exact design for each team pavilion now.
    b. Students can draw creative bubbles—circular/oval shapes—that represent the different pavilions. However, when they eventually draw the buildings, they must have *straight*, *not curved*, sides.



    c. Students label each bubble with their team name.
    d. Encourage students to be creative in the form of their space when they draw their bubbles. (Free-form areas are visually more interesting and create more stimulating challenges for students than a box).

11. Ask students to cut out the general shape of their building and bring it forward to the first large paper (the draft paper) that covers the project board. Arrange the different buildings around the paper.

12. The buildings may be arranged in a campus style, rather than side by side. Allow room for sidewalks. Consider creating a common space in the middle so that patrons do not have to walk "all the way across campus" to get to the snack bar, clinic, or gift shop.

TEACHING TIP

The idea is for teams to get a ballpark idea how much of the total project board space is needed for each of the teams' structures. Walk around and make sure team members have not appropriated too much or too little space.

TEACHING TIP

The objective is for students to draw curved shapes and later modify with straight lines. Without the curves the students might simply draw rectangular boxes.

TEACHING TIP

Place the project board paper where all the students can see. Arrange the free-form shapes on the board until they all fit. Then temporarily tape them down.

TEACHING TIP

If your class has more than six teams, provide extra SPECIAL AREA CARDS. The complex will be larger and can support more gift shops, snack bars, etc.

TEACHING TIP

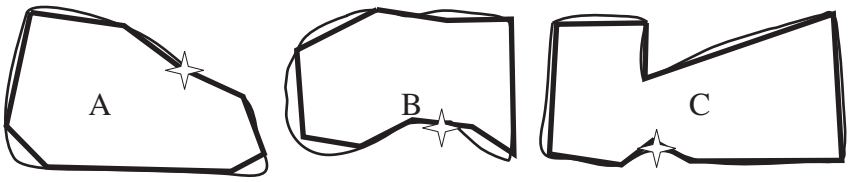
Define footprint *as the space on the ground that the building occupies.*

13. Ask the **Chief Architect** of each team to pick a SPECIAL AREA CARD. Their team must accommodate that special area in their pavilion. Decide if any team's SPECIAL AREA CARD changes any decisions about where the pavilions will be located. Move if necessary.

14. Teams decide where the main entrance to their pavilion will be and mark with a star. Each team puts its team name in the space on the project board.

15. When the preliminary decisions are finished, ask **Landscape Designers** to lightly sketch the footprint of each pavilion and give the newsprint paper back to the teams. Be sure the front door stars are still visible on the newsprint and the project board paper. All **Landscape Designers** remain at the project board to discuss parking, walkways, and access.

16. Send remaining students back to their teams so that they can translate the bubble shapes into straight-sided buildings. (See INTERIOR DESIGNER'S TASKS.)



17. These team members return to their team work area and translate the "bubbles" into a building formed with ***straight lines***. They should draw the outline of the building on 1/4-inch graph paper.
    a. The outside walls of the building should run along the lines of the graph paper where possible and turn at the point where the graph grid lines meet.
    b. All outside walls must be made of line segments that are ***at least one inch in length*** (which translates into 10' to scale).
    c. The pavilions must accommodate the teams' SPECIAL AREA CARD selections and all buildings must meet ADA building codes.

18. Distribute the ARCHITECTURAL PROJECT PROBLEMS, THE ARCHITECTURAL PROJECT RUBRICS, ADA GUIDELINES, and review unit expectations with the students.

19. Direct students to store their task sheets in the team folder and place with the team's other materials.

20. Announce that the Theme Park will need a name. Teams discuss name possibilities as they work. Put up a name suggestion sheet on the chalkboard or bulletin board and invite teams to submit names. Choose the name by vote as the students near the end of their construction.

21. Students are now ready to begin the *Construct the Project* phase of this simulation.

If your students completed Investigation #7: Problem Solving Designing a Theater, they already have the ADA GUIDELINES.

Approximately 3–4 Days

Teams

One or more samples of real architectural blueprints displayed around the room will help students understand their tasks during Phase 4.

Days 1–3 or 4
Constructing the Projects

Objectives

- Apply mathematical skills to design and construct a scale model
- Appreciate the importance of step-by-step preparation of a project
- Set up work schedules and share responsibilities
- Allow for independent and team decision making/problem solving

Materials

- Student Guides — *class set*
- DAILY AGENDA — *one per team + transparency (optional)*
- PAVILION DIMENSIONS — *one per team*
- SAMPLE FLOOR PLAN — *transparency or to post (optional)*
- **Troubleshooting Design and Construct Activities** — *teacher reference (pages 65–67)*
- Architectural blueprints — *several examples if possible*
- Construction paper (several colors) — *two sheets per team*
- Drawing paper (white) — *three sheets per team (optional extension)*
- Graph paper (1/4" grid) — *at least three sheets per team*
- Measuring tape or yardstick — *at least one per team*
- Rulers — *class set*
- Scissors — *several pairs per team*
- Poster board (white or buff)* (22" by 28") — *two per team Precut one piece per team into 2-inch strips using a paper cutter.)*
- Team folders — *one per team*
- Transparent tape — *one to two rolls per team*
- Utility knife — *one for teacher use*
- Watercolor markers (preferable), colored pencils (okay), or crayons (marginal) — *enough for students*

*See **Setup Directions #5: Materials** for more information about the poster board.

Finished Landscape Work Area

- Clean-up facilities (sink, sponges, paper towels, etc.)
- Modeling clay (hardening) — *several tubs*
- Paint brushes (1/2" or smaller) — *two per team*
- Paintbrushes (2") — *two per team*
- Tempera paint (red, yellow, blue, white, and black) — *enough for students*
- White glue — *one per team*

Procedure

1. Now the teams are ready to act like true architectural teams. Meet with them to go over the construction schedule. Just as in the real world, the classroom should be filled with team members working individually and cooperatively, completing necessary tasks that will help their team to complete their work to standard and on time.

2. Set dates and deadlines for completion of the structures and the final presentation.
   a. Working to deadlines lends purpose to a team's efforts and helps team members to better share tasks.
   b. The world of work requires deadlines, but does not allow for shoddy workmanship. Remind students that they will be required to redo work that does not meet standard.
   c. Students should report to you if they feel they will not meet a deadline and give a reason. Give extensions to the deadline, if you deem them necessary. Expect them to work "overtime," (e.g., before or after school) to catch up.
   d. You decide what penalties or rewards to assign for work that is completed late or early.

3. Introduce the teams to the DAILY AGENDA.
   a. This procedure and form will help students organize their work.
   b. You may need to show students how to write a specific task. At first students will tend to write too generally.
      - *"Make a floor plan"* is much too general. *"Draw the outside walls of the floor plan"* is much more specific.
      - *"Design the interior of the building"* is too general. *"Design the theater space"* is better.

4. The **Chief Architect** assumes leadership today. He/she will supervise the overall project. If necessary review the CHIEF ARCHITECT'S SUPERVISORY NOTES with those students.

5. Introduce the teams to the daily routine for Phase 4:
   a. All team members (including the **Landscape Designer**) attend a 5–10 minute meeting at the beginning of each day. During these meetings the team members tell what they did the day before and ask for feedback or help from other team members.
   b. The **Chief Architect** completes the DAILY AGENDA or delegates this job to another team member.

Prior to beginning Phase 4, cover the project board with the second piece of paper.

Remind students that they have a virtually unlimited budget in planning their pavilion. They may consider all ideas, regardless of cost, as long as they are appropriate to their target audience and pertain to the topic.

Give as many examples as necessary or allow students to write their own DAILY AGENDA. After 10 minutes, share tasks as a whole class activity. Correct those that are too general and commend those that are specific enough.

For the first day of the procedure, use the DAILY AGENDA FOR FIRST DAY. Encourage the Chief Architects to say something like, "Interior Designer Sally, tell me how the floor plan is coming along."

c. The team reviews the DAILY AGENDA of the day before. Each member reports the status of their previous day's tasks. The **Chief Architect** puts a check in the "done" column for every task completed.
d. The team members add any unfinished tasks to the new DAILY AGENDA
e. The team discusses what needs to be done in addition to the unfinished tasks. The **Chief Architect** assigns tasks to team members.

Routinely review the DAILY AGENDAS and comment on the team's organization and the Chief Architect's leadership.

6. Completing the DAILY AGENDA may be difficult for some teams. You may walk the students through the second day as a whole class. However, if you feel that the teams are ready, set them to work and walk around to facilitate as necessary. Use the COOPERATIVE GROUP WORK RUBRIC to reinforce good teamwork.

7. Note that every day the last two tasks of the DAILY AGENDA are to clean up and store materials safely and to turn in any work that the teacher has requested. Assign these tasks in one of the following ways:
   a. To different members on a rotating basis
   b. To the person in charge of the work (e.g., floor plans for the **Interior Designer**)
   c. Ultimately, to the **Chief Architect**, if the team cannot decide

8. To avoid problems in the detail-oriented process of floor plan design and model construction, clarify to students that there are certain limitations to this project:
   a. All sides of each structure will be straight-edged, measuring to the inch, three-quarter inch, half-inch, or quarter-inch (no eighth-inch or sixteenth-inch measurements).
   b. All structures will be one level with a real-world ceiling height of 20 feet (2 inches to scale).
   c. All roofs will be flat, as this is much easier to construct considering the materials being used.
   d. Although the roofs are removable, interior walls will not be constructed unless a team is ahead of schedule or the teacher decides to extend the deadlines to allow teams time to construct and decorate interior walls.

e. It is important that students think about the rooms and their functions when designing their structures. For example, when designing a doorway, students must not only provide a width that meets ADA guidelines, they may also need to design a wider door for oversized equipment to enter.
f. If a natural area such as a cave, mountain, etc., becomes part of a team's project, this can be built out of clay, included as part of the landscaping process, and does not need a floor plan. Teams should include this type of non-traditional structure in their tour during their final presentation.

9. If a team plans to design a structure larger than one piece of graph paper, they will have to attach a few sheets together by carefully lining up squares and taping the back sides together.

10. Encourage students to design an interesting shape that is made up of straight sides, to consider scale at all times, and to avoid drawing walls less than 1" long (10 feet actual).

11. As students measure the outside walls, have them proceed clockwise around their drawing, keeping track of the inch measurements on the DIMENSIONS SHEET. They will eventually have a column of measurements that add up to the perimeter of their structure. They will use these measurements for reference when they begin to construct their model.

12. Before students begin working on their own, explain a few standard symbols for the interior of the structures. If you have real floor plans to share, do so; show the SAMPLE FLOOR PLAN; or share a complete and accurate floor plan created by students in INVESTIGATION # 6. Review the symbols.
    a. **Walls** Indicate using straight lines.
    b. **Doors** Indicate by a break or separation in the wall lines.
    c. **Windows** Draw a — *W* — to indicate the location of windows.
    d. **Rooms** Identify all rooms with labels.
    e. **Furniture** Draw the shape as it appears from above. (For example, a round table looks like a circle; a chair might look like a square or circle; a desk looks like a rectangle; a sink might appear as an oval. The furniture should be in scale and proportional with the room itself.

If students have access to a computer with a printer they can make very neat and legible labels. Insist they make a list of ALL the labels first, then type them, then print them. Otherwise you will waste lots of paper with only one or two label words on a page.

f. **Labels** Write clearly and fairly small in order not to crowd the floor plan. Consider writing all your labels on computer and gluing them to the project.

g. Remind students that they will describe all details of the interiors of the pavilion on the floor plan or model, keeping in mind the educational objectives they are striving to meet.

13. Encourage students to be detail-oriented, but not to spend an inordinate amount of time on any one step towards completion of their models.

14. Remind students to refer to the ARCHITECTURAL PROJECT RUBRIC (either their team copy or one posted within the classroom) as they work.

15. Have students vote on the name for the Theme Park. The best way to handle this is to have two votes. Ask students to pick their two favorites. Then take the top three or four choices and have a second, run-off vote where students vote for their favorite name.

These troubleshooting hints are the result of many years of classroom experience with students working through ARCHITECTS OF LEARNING.

16. Read **Troubleshooting Design and Construct Activities** carefully and mark it for a convenient reference as you circulate throughout the classroom.

Troubleshooting Design and Construct Activities

Students may encounter problems as they proceed through their design and construct operations. The following hints may help solve some problems.

Measuring and Floor Plans

Remind students frequently to measure carefully, mark lines precisely, and work as neatly as possible. Refer them to the PAVILION DIMENSIONS and to the floor plans they created in Phase 2.

Marking and Folding the Walls

Make sure students are creating wall lines on their strips that are perpendicular. If they are following directions carefully, they will be making a mark on the top and bottom of the strip for each wall measurement. By connecting those two marks, they should be creating perpendicular wall lines.

The Footprints

Make sure that teams check with their **Interior Designer** to be certain that all their pavilion footprints match the floor plan. The footprints allow for different team members to be working on the project at the same time. While the **Interior Designer** completes the detailed floor plans, the **Landscape Designer** uses the first footprint to site the pavilion on the class project board. At the same time, the **Clerk of the Work** and **General Contractor** use the second footprint to begin work on the model's exterior walls.

Forming the Models

Make sure students don't keep bending the poster board back and forth when they make the wall folds, or the poster board will get too weak. The poster board thickness is fine for this project if it is only folded once and then sometimes reversed to fit the shape of the structure on student floor plans.

Cutting the Windows and Doors

This is the only step that requires you to do actual cutting. Many schools do not allow students to use utility knives themselves.

Accurate measurements of the model walls are crucial to student success in building the actual models.

Troubleshooting Design and Construct Activities (continued)

Adding Details to the Models

Make sure students turn in their floor plans to you as soon as they finish marking the locations of doors and windows. Discourage huge windows that take up the majority of a wall; very large windows will weaken that wall and cause difficulty in attaching the roof to the wall structure. After students mark the locations of all doors and windows have students bring their poster board strip to you for cutting. Place the strip over a piece of cardboard and carefully cut out the windows. Doors look best when you cut out only two of the three sides. Have the students fold the third side as a hinge to leave their doors open.

Markers and colored pencils result in the best finish for exterior walls; crayons are rather messy. If students use permanent markers, make sure they put paper underneath their work area so you don't end up with marked desks and floors.

TEACHING TIP

These can be difficult steps for students with poor fine-motor skills.

Constructing the Model and the Roof

You may assist students with these steps or make sure they have some help from a dependable peer. The students build the model using a footprint of the floor plans. This allows the **Interior Designer** to work on the floor plans while the exterior walls are being constructed.

Depending on the strength of the construction materials available, students may have difficulty with exterior walls buckling and bending when they position the roof. If such structural problems occur, allow students to tape the roof to the exterior walls. The roof will add the necessary stability to the model. However, in order for this to work the roof will have to be the exact dimensions of the footprint. Students will have to remove the 1/4" overhang they built in as specified on the Clerk of the Works Tasks handout (page 108).

Landscaping the Property and Assembling the Team Project

The teams site their model by gluing a footprint made of construction paper on the project board paper. This allows the **Landscape Designers** to work while the model is being made.

Set up an area where craft materials and clean-up facilities are available to accommodate several **Landscape Designers** at one time. Encourage students to take their time attaching their finished structures. Not using enough tape will cause the walls to detach from the footprint base, and using too much tape will look sloppy.

Troubleshooting Design and Construct Activities (continued)

Monitoring Students

It is important that the teacher, as facilitator, continue to circulate throughout **Phase 4: Construct the Project** While some students work very well on their own, others will try to rush—and be sloppy—or try to skip a step. If students do not follow the directions step-by-step, they may not be successful in constructing their pavilions. Students and their teams will work at very different paces on **Phase 4: Construct the Project**. Team members may assist other team members to stay on schedule. However, students must respect the team aspect of their project, and proceed with helping only after consultation with other team members in the DAILY AGENDA meeting.

Team members who finish their models early may help the **Landscape Designers** or add more detail to their models.

Interior Walls

Copy the Building Interior Walls information and distribute to the Chief Architect(s) if:

- a team is ahead of schedule, or
- all teams will construct interior walls.

Building Interior Walls

1. Photocopy or by hand recopy the final floor plan.
2. Mount it on top of two pieces of poster board or a cardboard giftbox.
3. Color the floors of different rooms different colors. (Draw a dark line for each interior wall so they are easy to see.)
4. To make the walls for all the major rooms, measure interior walls on the floor plan and cut pieces from the same 2-inch poster board stock you used for the exterior walls.
5. Mark doorways and ask the teacher to cut them out.
6. Run a bead of white glue along the bottom of the walls, align with interior wall lines on the floor plan, and press and hold. (You may also need to attach a small piece of tape.)
7. If you have time, decorate the insides of the model much like a doll house, with furniture, paintings, area rugs, etc.

2–3 Days

Teams

Day 1–2
Preparing Presentations

Objectives

- Experience the process of developing a presentation for an audience
- Apply oral language and media skills
- Appreciate that knowledge in academic subjects has real-world applications
- Support personal growth through collaboration and risk-taking

Materials

- ARCHITECTURAL PROJECT RUBRIC — *class set*
- ORAL PRESENTATION RUBRICS: Content and Presentation — *class set*
- Chart paper, butcher paper, or large pieces of manila paper — *two class sets (at least)*
- Index cards — *four or five per student*
- Overhead projector — *one*
- Pointer stick — *one (optional)*
- Student Math Problem-Solving Format charts — *finished*
- Student Projects (model and floor plan) — *on display*
- Student Reports (if working with other content) — *on display*
- Team folders — *one per team*
- Transparencies (blank) and overhead pens — *as needed*

*See **Setup Directions #12: Preparing for Formal Presentations** (page 16) for specific recommendations for effectively showcasing student projects.*

Procedure

1. If working with another teacher or if students completed written research reports, discuss interesting information to share with the audience members.

2. Remind the students that their architectural teams will present their projects to an audience.
   a. The presentations will be in the form of *guided tours* of their individual pavilions and of their team project board area.
   b. All team members participate in presenting their project to the audience.
   c. When writing their tours students include the specific concepts that visitors would learn as they move from one area to another within each structure.

3. Advise students that their audience will be made up of peers, parents, teachers, and community members who will pretend they are representatives from corporations interested in investing in the building of a full-size, working version of their project. Students should consider this when putting together their team presentation.

4. Discuss with the entire class the qualities of an excellent oral presentation. Compile a list on the board or on a chart, to include:
   a. Well-organized
   b. Well-prepared
   c. Detailed descriptions
   d. Loud speaking voice
   e. Clear, expressive voice
   f. Relaxed manner

5. Break the expectations into broad categories of *content* (points a., b., and c.) and *presentation* (points d., e., and f.). For *content*, remind students of their organizational skills employed as they prepared their research written reports. Remind students of the ARCHITECTURAL PROJECT RUBRIC. Recommend that students rely on their outline and notes as they prepare their oral presentations. For *presentation*, remind students of their investigations presentation experiences.

6. If your students are novice speakers, instruct them in how to succeed with the presentation aspect of their speeches.
   a. **Volume**
      To help students develop the ability to speak loudly enough to be heard without shouting, employ the following exercise:
      - Take students to a larger space like an auditorium or cafeteria and have them sit at one end of the room.
      - One at a time, each student should go to the other end of the room and read a passage from a book as loudly as he/she can without shouting.
      - Demonstrate that shouting strains the voice while projecting does not.
      - When the students go back to their classroom they develop a voice level appropriate to the size of the room. That is the level of speaking students should use during **Phase 6: Present, Debrief, and Assess**.

TEACHING TIP

By providing instruction in volume and clarity, and by allowing time for students to practice their presentations within their teams and before their classmates, students will develop more comfort with the public speaking aspects of the simulation.

Clarify the difference between projecting one's voice and shouting.

b. **Clarity**
Emphasize speaking clearly, slowly, and with expression.
- Model an appropriate speed of speech that is clear to others.
- Demonstrate that opening one's mouth widely when speaking helps to create clarity of speech.
- Encourage vocal expression by demonstrating the difference between a monotone speech and a very expressive speech.

c. **Relaxed Manner**
Encourage students to be relaxed in their presentation manner by emphasizing preparedness of a clearly written and edited tour.
- Allow adequate time for students to practice and critique their team members. This will increase their comfort level during the actual presentations.
- During the full rehearsal, take time to give feedback to each presenter, either verbally or in writing. This will also aid in students feeling more comfortable during the final presentation.

7. Spend some time going over requirements for team tours of their structures:
   a. Students will use their floor plans or model with the roof removed to imagine taking a touring group through their pavilions.
   b. Each team will compose a written tour, starting at the entrance and moving through all areas of the pavilion structure. Team members must share presentation time. Suggest that students outline the tour and work from note cards.
   c. In each area where their content area topic is taught, students will give a general description of what is learned in that area and how the information is imparted to the visitors.
   d. Students can use their written reports to provide the content area knowledge necessary for the tour, but should not read directly from reports.
   e. Encourage students to keep the tour interesting and fluid by adding narrative that a tour guide might use in walking people through a pavilion.
   f. At the end of the pavilion tour narrative, team members present their **Architectural Project Problems** and use the prepared chart papers to explain how they solved their problems.

TEACHING TIP

Students do not prepare a detailed content lesson for each room within each structure. This is too involved for the time available. Students will best express the extent of their content knowledge of their topic in a research report.

g. The **Chief Architect** should be the last to speak and signal the end to the presentation with something like, "And that concludes the presentation of our part of the project." This presentation should include a transition to the next presenting team.
h. Each team's tour of their project board area will last from 8–10 minutes.

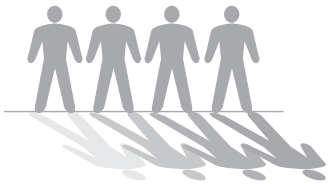
8. Suggest possible presentation techniques that students may use:
   a. Students take turns presenting their specific information while another team member uses a pointer to simulate the tour by moving the pointer along the roof of the model pavilion in the direction the tour is moving.
   b. The presenter may use an overhead projector to display a large version of the floor plan during the tour of the structure while moving a pointer across a transparency of the floor plan.
   c. Technology-savvy students can design a computer-oriented presentation if the proper equipment is available.

9. Have each team decide which presentation technique they will use; they will need to let you know their decision well in advance of the presentation day.

10. Have students write the text of their tours on index cards to prevent them from holding large pieces of paper in front of their faces during the presentation, crinkling paper, etc.

11. Encourage the teams to practice their presentations with their team members (including use of the selected audiovisual materials and techniques). Such rehearsal will accomplish the following:
    a. Alleviate student trepidation by practicing exactly what is to be presented, including the order that speakers will present
    b. Identify areas that students can improve on before the dress rehearsal and actual presentations
    c. Clarify how long the presentation will take (usually 8–10 minutes per team tour)
    d. Reinforce team identity and cooperation, and provide opportunities for peer encouragement

12. During these preparation days write and send out invitations to your selected audience. See **Setup Directions #12: Preparing for Formal Presentations** for more information.



Teams

Days 2–3
Rehearsal

Objectives

- Apply oral language and media skills
- Appreciate that knowledge in academic subjects has real-world applications
- Support personal growth through collaboration and risk-taking

Materials

- Chart paper, butcher paper, or large pieces of manila paper — *two class sets (at least)*
- Overhead projector — *one*
- Pointer stick — *one*
- Student Math Problem-Solving Format charts — *finished*
- Student Projects (model and floor plan) — *on display*
- Student Reports (if working with other content) — *on display*
- Team folders — *one per team*
- Transparencies (blank) and overhead pens — *as needed*

Procedure

1. After students write their tours, allow time for them to practice their presentation in front of at least one other team or the rest of the class (including use of any audiovisual materials). Such a rehearsal is necessary for several reasons:
   a. To allow all students to listen to other teams present their projects (Students will be preoccupied the day of the formal presentations and won't really be listening carefully to other teams.)
   b. To enhance students' confidence and comfort with the procedures of the formal presentations, including the order that teams will present
   c. To identify areas in which students can improve before the actual presentation
   d. To clarify how long the class presentation will take
   e. To help students realize and adapt to the time constraints

2. Share with your students that the way a presenter looks has an influence on the presentation itself. Encourage students to dress neatly for their presentations.

3. Allow one or two days for the class dress rehearsal. Actual presentations before the audience will probably take less time than this dress rehearsal.

Take the time after each team's rehearsal presentation to give some constructive feedback; ask for comments from the other students.

Prior to Day 1

15–30 minutes

Teacher

Preparations

1. Because presentations normally take 60 to 90 minutes, try to rearrange your schedule so that the presentations can occur on one day. If students must present on two days, take advantage of the fact you can invite two groups of parents who would come only on the day their child's team was presenting.

2. Before the day of your class presentation, make several oversized copies of the ARCHITECTURAL PROJECT RUBRIC and post prominently for audience members to reference. Duplicate the ORAL PRESENTATION RUBRIC: **Content** and ORAL PRESENTATION RUBRIC: **Presentation** for distribution to audience members. Half the audience will evaluate the formal presentations for content, half for presentation. In addition, duplicate sufficient ARCHITECTURAL TEAM EVALUATIONS for audience members to complete and turn in to you after the team presentations.

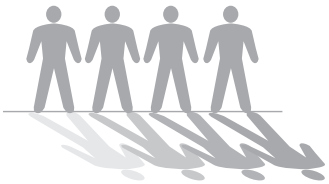
3. Re-arrange the room well in advance of audience arrival:
   a. Set up chairs to face the project board and the floor plans.
   b. Set up any audiovisual equipment so that the audience can clearly see all displays.
   c. Make sure there is room near the project board for all team members to stand while each member is presenting.
   d. Provide enough room around the project board for visitors to be able to walk around all sides in order to study the models, compare finished models with the floor plans, and evaluate the quality of student work.
   e. Leave room for each team to enter and depart the presentation area.
   f. Provide an area where the rest of the class can sit or stand while each team is presenting.

4. Provide a bulletin board very close to the project board and equivalent in size to the project board. This is an excellent supplement to the finished models. Attach individual floor plans, clustered within their teams, for display and comparison between plans and finished projects.
   a. If possible, include a brief summary of the project on the bulletin board, to help visitors understand what the class has accomplished.

b. The most effective way of displaying the plans is to mark off the bulletin board into the same size sections as the project board itself.
c. If possible, display pavilion plans in the same configuration as the models appear on the board.
   - This will enable visitors to your classroom to more easily understand the project.
   - Plans will display more effectively if students mount their floor plans onto colored paper before stapling or pinning the plans onto the display board.
d. Have students produce a label with the name of each structure to attach above or below the floor plans.

Photo display of project board with floor plans
This class cooperated to build a school, not a pavilion project.

Day 1
Presentation Day



Teams

Objectives

- Apply oral language and media skills
- Appreciate that knowledge in academic subjects has real-world applications
- Support personal growth through collaboration and risk-taking

Materials

- ARCHITECTURAL PROJECT RUBRIC — *one or two to post for audience + a few copies for requests (optional)*
- ORAL PRESENTATION RUBRIC: **Content** — *enough for half the audience members*
- ORAL PRESENTATION RUBRIC: **Presentation** — *enough for half the audience members*
- ARCHITECTURAL TEAM EVALUATION — *class set + enough audience members*
- Overhead projector — *one*
- Pencils — *enough for audience members*
- Pointer stick — *one*
- Student Projects (model and floor plan) — *on display*
- Student Reports (if working with other content) — *on display*
- Visual aids including Math Problem-Solving Format charts — *ready for presentations*
- Team folders — *one per team*
- Transparencies (blank) and overhead pens — *as needed*

Procedure

1. It is helpful if you open the presentation with a short summary of the many phases of ARCHITECTS OF LEARNING that the students have completed. This helps set the stage for the student presentations by providing a solid background to the audience.

2. Clearly explain the role of *investor* that each audience member will simulate. Distribute the ORAL PRESENTATION RUBRICS and ARCHITECTURAL PROJECT RUBRICS, the ARCHITECTURAL TEAM EVALUATIONS and pencils to the audience. Explain that, as each team finishes their presentation, audience members should choose a *Yes* or *No* answer to the questions about that team's project and presentation.

Keep this very short. Both the audience and the architectural teams are eager to begin the formal presentations.

If possible, allow time for audience members to circulate around the project board in order to get a closer look at the written reports, the models, and the floor plans.

3. After the formal presentations are over, the audience will refer to their responses and, using the rubrics, give each team a score for the project and the presentation.

4. Potential investors will also mark whether they would be interested in investing in each team's project, based on the information they heard and the project they saw.

5. Introduce the first architectural team to present. All members will stand near the project board during their team's presentation.
   a. As each team presents, you—or they—may complete your evaluation form.
   b. When the first team is finished, they will leave the presentation area, after introducing the next team. (You may instead announce the next team.)
   c. Continue until all teams have presented.

If possible, give the audience a chance to look more closely at the project and plans before they complete their Evaluations.

6. Encourage applause for the architectural teams. If time allows, facilitate a question/answer session between the audience and the young architects.

7. Collect all Evaluations, thank the audience for attending, and facilitate the exit of the audience.

8. Immediately congratulate students on the success of their completed projects.

9. Use the audience evaluations and the ones you completed to grade student projects and presentations. Record the grades and notify the students at the start of the debriefing session.

Day 2
Debriefing and Assessment

Objectives
- Promote personal growth through self and team evaluation
- Enhance appreciation of completing a multi-layered project through patience, determination, and cooperation

Materials
- ARCHITECTURAL PROJECT RUBRIC — *student copies*
- ARCHITECTURAL TEAM EVALUATIONS — *from previous day*
- ORAL PRESENTATION RUBRIC — *student copies*
- AWARDS — *as needed*
- Student Math Problem-Solving Format charts — *graded*
- Student Projects (model and floor plan) — *graded*
- Student Reports (if working with other content) — *graded*

Preparation
1. Complete the evaluation of all student work. Include observations of student cooperative group work, results of Investigations, the AREA & PERIMETER QUIZ, IMHOTEP COIN awards, and the formal presentations.

2. Prepare awards for teams and/or individuals.

Procedure
1. Distribute ARCHITECTURAL PROJECT RUBRICS, ORAL PRESENTATION RUBRICS, and ARCHITECTURAL TEAM EVALUATIONS with individual and team scores to students. Remind them that these grades were determined by not only you, the teacher/facilitator, but by an audience comprised of their peers, parents, and other adults.

2. Have students look at the ARCHITECTURAL PROJECT RUBRIC and then at their score. Facilitate a whole-class discussion of their project experience. Include the following points in the discussion:
   a. Give each team a chance to express their feelings about successes and failures throughout the creation of the project.
   b. Ask them about their team dynamics—level of cooperation, collaboration, encouragement, and support.
   c. Discuss whether they feel their grade is fair. Try to include comments from the other teams as each project is discussed.

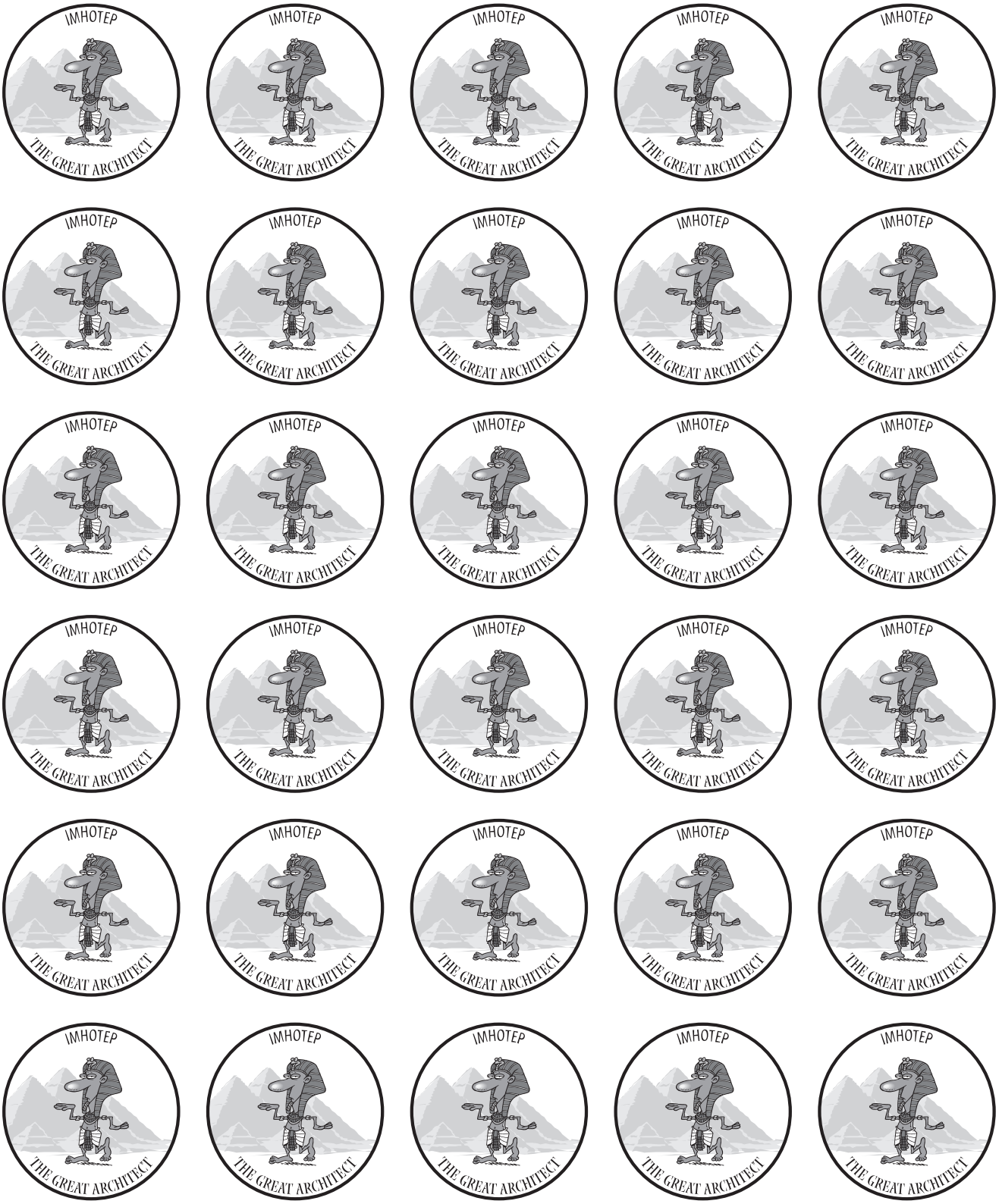
3. Distribute team grades for the oral presentations to students. Have students look at the ORAL PRESENTATION RUBRIC and then at their score. Repeat the process you followed in discussing team projects.

4. Begin a class discussion of the students' entire ARCHITECTS OF LEARNING experiences. Include the following:
   a. Successes and failures in completing tasks individually and in teams
   b. Team dynamics—level of cooperation, collaboration, encouragement, and support
   c. What students learned from the entire experience
   d. How the class can use the content area information gathered by individuals for future learning in the classroom
   e. What they enjoyed most and what they enjoyed least about the unit
   f. Suggestions regarding changes in future implementation of ARCHITECTS OF LEARNING with other students

5. If your class is very engaged and verbal, this discussion may extend for more than one day.

6. Present AWARDS as determined.

IMHOTEP COINS



COOPERATIVE GROUP WORK RUBRIC

COOPERATIVE GROUP WORK RUBRIC

Name_____

4 — *Exemplary* —You *consistently* and *actively* helped your group achieve its goals by communicating well with other group members, by encouraging the group to work together, and by *willingly* accepting and completing the necessary work of your daily role.

3 — *Expected* —You *usually* helped your group achieve its goals by communicating with other group members, by encouraging your group to work together, and accepting and completing the necessary work of your daily role.

If your evaluation is less than *Expected*, try to use your cooperating skills more consistently.

2 — *Nearly There* — You *sometimes* helped your group achieve its goals.

1 — *Incomplete* — You *did very little* to help your group achieve its goals.

COOPERATIVE GROUP WORK RUBRIC

Name_____

4 — *Exemplary* —You *consistently* and *actively* helped your group achieve its goals by communicating well with other group members, by encouraging the group to work together, and by *willingly* accepting and completing the necessary work of your daily role.

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If your evaluation is less than *Expected*, try to use your cooperating skills more consistently.

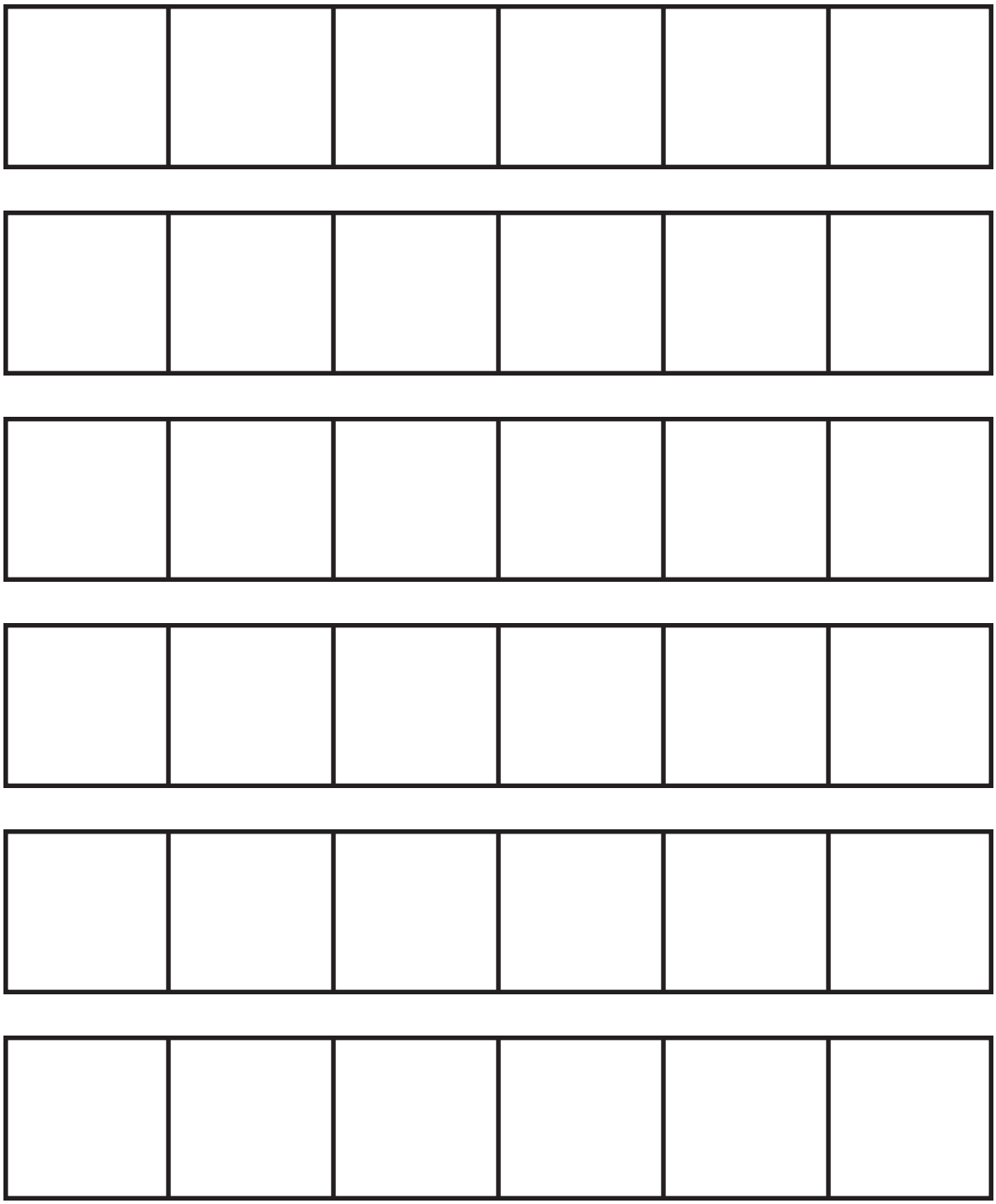
2 — *Nearly There* — You *sometimes* helped your group achieve its goals.

1 — *Incomplete* — You *did very little* to help your group achieve its goals.

AREA SQUARES

Directions: Work Carefully

1. Cut out the strips first, and then cut the squares.
2. Put your initials on the back of each square.
3. Each day collect your Area Squares and store in the team envelope



INVESTIGATION #1:
AREA

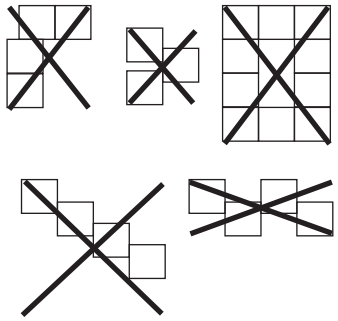
Materials

- AREA SQUARES
- Graph paper

Directions

- Use graph paper to record the arrangements your design.
- Label each drawing *Task A*, *Task B*, or *Task C*.
- Follow these rules
  1. Sides must touch the next square side to side.
  2. The shape cannot have a hole in the middle.
  3. You cannot make a shape using the corners.

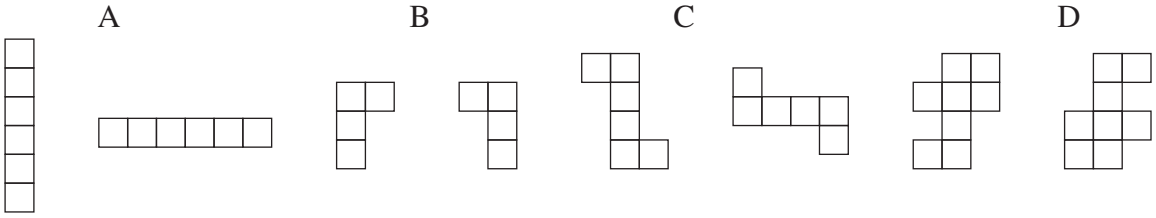
  These arrangements DO NOT follow the rules:



Task A: Work in pairs. One arranges the actual squares and draws the shape. The other colors the squares in the graph paper, square for square.
Following the rules above, arrange six squares into a rectangle. Color the rectangle using the squares on graph paper. Label **Task A.** You can make more than one arrangement and still follow the rules. Draw another rectangle that uses the six squares. Write ***area = 6 squares*** under both.

Task B: Work in pairs. One arranges the actual squares and draws the shape. The other colors the squares in the graph paper, square for square.
Following the rules above, arrange the six squares into a shape other than a rectangle. How many *truly different* shapes can you make? Draw your shapes on the graph paper and label **Task B**. Write ***area = 6 squares*** under these.

Truly Different? When counting different arrangements, *do not count* rotations or mirror images. Study the examples. An arrangement of squares that are 1 by 6 is the same as one that is 6 by 1. Or four squares arranged with a row of three with a fourth square placed to the right side of the top square is a mirror of one with a row of three and a fourth square placed to the left of the top square.
These pairs of figures are the same:



Task C: Work as a team. Decide how to organize your team for the best team results.
Use nine of your squares. How many truly different arrangements can you and your team make following the rules above? Make a plan to complete this task as a team. Label **Task C**. At the end your team will share its results with the other teams. Scoring: *Expected* = 10 arrangements. *Exemplary* = more than 15 *truly different* arrangements. (Make a few extra in case one or two are disqualified.)

PROBLEM-SOLVING RUBRIC

PROBLEM-SOLVING RUBRIC

Name_____

4 — *Exemplary*
- You *correctly* found the solution to this problem and *clearly* and *neatly* described your process using numbered steps and drawings.
- You also described one or more insights that helped your group to find a solution and showed your understanding of mathematics.

3 — *Expected*
- You *correctly* found the solution to this problem and *clearly* and *neatly* described your process using numbered steps and drawings.

2 — *Nearly There*
- You found the solution to this problem and *clearly* and *neatly* described your process using numbered steps and drawings. However, you need to correct it because of one or more of the following
  —You forgot the label or used the wrong label.
  —You made a simple computational error.
  —One of your steps is not clear and needs to be reworded.

1 — *Incomplete*
- Your work needs to be corrected or redone because of one or more of the following:
  —You made a major error in reasoning.
  —You made a major error in computation.
  —Your work is too messy.
  —Your steps are confusing or not numbered.

PROBLEM-SOLVING RUBRIC

Name_____

4 — *Exemplary*
- You *correctly* found the solution to this problem and *clearly* and *neatly* described your process using numbered steps and drawings.
- You also described one or more insights that helped your group to find a solution and showed your understanding of mathematics.

3 — *Expected*
- You *correctly* found the solution to this problem and *clearly* and *neatly* described your process using numbered steps and drawings.

2 — *Nearly There*
- You found the solution to this problem and *clearly* and *neatly* described your process using numbered steps and drawings. However, you need to correct it because of one or more of the following
  —You forgot the label or used the wrong label.
  —You made a simple computational error.
  —One of your steps is not clear and needs to be reworded.

1 — *Incomplete*
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  —You made a major error in reasoning.
  —You made a major error in computation.
  —Your work is too messy.
  —Your steps are confusing or not numbered.

PROBLEM-SOLVING RUBRIC

Name_____

4 — *Exemplary*
- You *correctly* found the solution to this problem and *clearly* and *neatly* described your process using numbered steps and drawings.
- You also described one or more insights that helped your group to find a solution and showed your understanding of mathematics.

3 — *Expected*
- You *correctly* found the solution to this problem and *clearly* and *neatly* described your process using numbered steps and drawings.

2 — *Nearly There*
- You found the solution to this problem and *clearly* and *neatly* described your process using numbered steps and drawings. However, you need to correct it because of one or more of the following
  —You forgot the label or used the wrong label.
  —You made a simple computational error.
  —One of your steps is not clear and needs to be reworded.

1 — *Incomplete*
- Your work needs to be corrected or redone because of one or more of the following:
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  —You made a major error in computation.
  —Your work is too messy.
  —Your steps are confusing or not numbered.

PROBLEM-SOLVING RUBRIC

Name_____

4 — *Exemplary*
- You *correctly* found the solution to this problem and *clearly* and *neatly* described your process using numbered steps and drawings.
- You also described one or more insights that helped your group to find a solution and showed your understanding of mathematics.

3 — *Expected*
- You *correctly* found the solution to this problem and *clearly* and *neatly* described your process using numbered steps and drawings.

2 — *Nearly There*
- You found the solution to this problem and *clearly* and *neatly* described your process using numbered steps and drawings. However, you need to correct it because of one or more of the following
  —You forgot the label or used the wrong label.
  —You made a simple computational error.
  —One of your steps is not clear and needs to be reworded.

1 — *Incomplete*
- Your work needs to be corrected or redone because of one or more of the following:
  —You made a major error in reasoning.
  —You made a major error in computation.
  —Your work is too messy.
  —Your steps are confusing or not numbered.

INVESTIGATION #2:
AREA OF RECTANGLES (1)

Materials

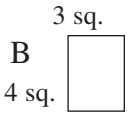
- AREA SQUARES
- Chart paper or construction paper
- Graph paper
- Markers or crayons

Directions

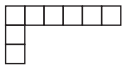
Work alone to complete Tasks D, E, and F.

1. On your desk, set up your squares to look like Box A. Instead of counting all the little squares inside Box A, can you think of an easy way to find how many squares are inside? Box B gives you a hint.

A 

B 

2. On your desk, set up the top and side of a rectangle that is 6 squares across and 3 squares down. How many squares do you need to make the whole rectangle?



Compute your answer, then lay out the squares to complete the rectangle and count them to check your answer.

3. Create a formula explaining what you did. Use the letters *L* for the long side (*Length*) and *W* for the shorter side (*Width*). If *Area* is the *number of square units* needed to cover a surface, what is the formula for finding the *Area* of a rectangle?

4. Using your new formula and graph paper, determine the area of these figures. Work alone, but check your answers with another team member. Label your work by **Task** letter.

Task D: Color a rectangle that is 4 squares by 5 squares. Write the *Area* next to the figure.

Task E: Color a rectangle that is 2 squares by 10 squares. Write the *Area* next to the figure.

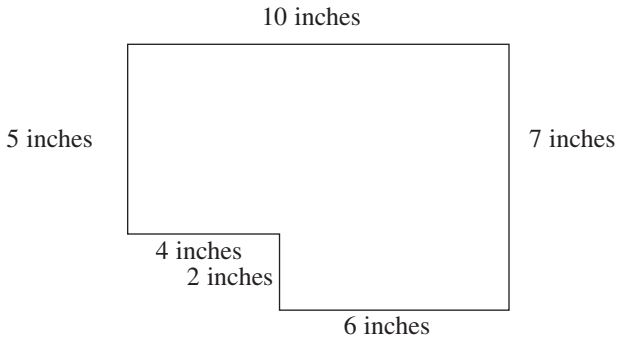
Task F: Color a rectangle that is 4 squares by 7 squares. Write the *Area* next to the figure.

INVESTIGATION #2:
AREA OF RECTANGLES (2)

Task G: Work as a team.

Part 1: Think about a shape that looks like the one below. Working with your team, come up with a strategy to figure out the area of this shape.

- Check your work
- Be **certain** that all members of your group understand how your team found the answer.



Part 2: Follow the **Problem-Solving Format** in the Student Guide to explain how your team solved this problem.

- Write on a large piece of construction paper or chart paper.
- Describe your strategy and show how you determined the area of this shape.
- Number the steps.
- Use a marker or crayon and large neat handwriting so that the rest of the class can read your work from a distance.

Keep all your work in your team folder. You will need it later.

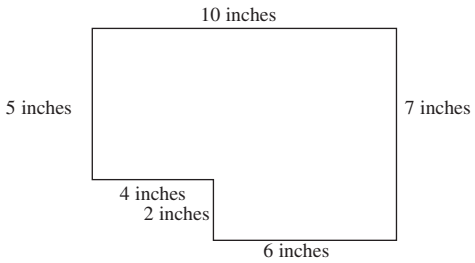
PROBLEM-SOLVING FORMAT:
SAMPLE #1

ARCHITECTS OF LEARNING

Directions
When explaining your problem-solving experience follow this format:

Part I: Read the problem carefully and determine what is being asked. (You may make a simple drawing.) Determine now what your label will be.

We are trying to find the area of a shape that looks like this:



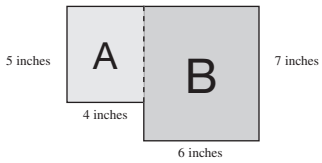
Our answer will be labeled ***square inches****.*

Part II: List what you know—all the numbers you have. (This may include some you have to measure before beginning the problem solving.)

*We know the length of all six sides. (****10, 7, 6, 2, 4, and 5 inches****).*

Part III: Write (in order) the steps that you followed to solve your problem. Be certain to NUMBER each step. You may use drawings to help with your explanations. Underline your answer and be certain to include your correct label.

1. *First we drew a line to make the figure into two rectangles.*



2. *We labeled one rectangle "A" and the other rectangle "B".*
3. *The dimensions of rectangle A are 5 inches by 4 inches. Its area is 20 square inches.*
4. *The dimensions of rectangle B is 6 inches by 7 inches. Its area is 42 square inches.*
5. *Next we added area of A to area of B (20 + 42) and the answer is* ***62 square inches****.*

Part IV: Write down any "insights" you had while solving the problem or while determining the final answer. (This may include something you tried and discarded, or an estimation of the answer.)

1. *We realized that we could make this into two rectangles.*
2. *We realized that we only needed to know two of the sides to figure the area, as long as the sides were not opposite each other.*

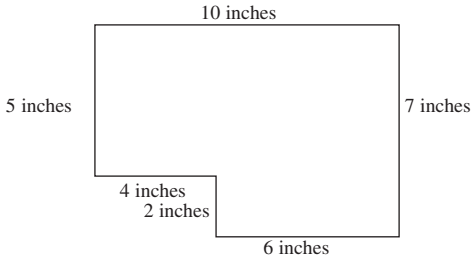
PROBLEM-SOLVING FORMAT:
SAMPLE #2

ARCHITECTS OF LEARNING

Directions: When explaining your problem-solving experience follow this format:

Part I: Read the problem carefully and determine what is being asked. (You may make a simple drawing.) Determine now what your label will be.

*We are trying to find the area of a shape that looks like this***:**



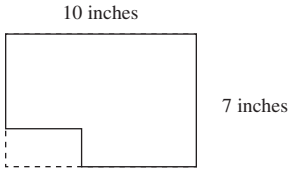
Our answer will be labeled ***square inches****.*

Part II: List what you know—all the numbers you have. (This may include some you have to measure before beginning the problem solving.)

*We know the length of all six sides. (****10, 7, 6, 2, 4, and 5 inches****).*

Part III: Write (in order) the steps that you followed to solve your problem. Be certain to *number* each step. You may use drawings to help with your explanations. Underline your answer and be certain to include your correct label.

1. *First we drew two lines to make the figure into one big rectangle.*



2. *The big rectangle's dimensions are* ***10 inches by 7 inches****.*
3. *The area of the big rectangle is* ***70 square inches****.*
4. *There is a small rectangle formed in the corner that is* ***4 inches by 2 inches*** *and has an area of* ***8 square inches****.*
5. *Next we subtracted the area of the small rectangle from the big one (70 - 8). The answer is* ***62 square inches****.*

Part IV: Write down any "insights" you had while solving the problem or while determining the final answer. (This may include something you tried and discarded, or an estimation of the answer.)

1. *We realized that the shape looked like a big rectangle with a piece taken out of it.*
2. *We realized that the answer had to be a less than 70 square inches.*
3. *We also realized that the longest sides gave us the dimensions of the big rectangle.*

INVESTIGATION #3:
AREA OF TRIANGLES (1)

Materials

- Graph paper
- Scissors

Task H: Complete with a partner.

1. In the top left corner of your graph paper make a rectangle that is 10 squares wide and 15 squares long. Cut it out and put it on your desk. Both partners should make a rectangle.

2. One partner should draw a diagonal from corner to opposite corner on his/her rectangle and cut along that line to make two triangles.

3. Label the rectangle X and the two triangles Y and Z.

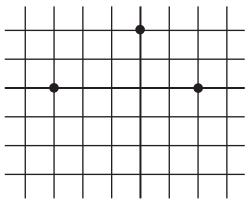
4. What is the *Area* of rectangle X?

5. What is the *Area* of triangle Y?

6. Explain to your partner how you know the area of triangle Y. Is the *Area* of triangle Z the same as the *Area* of triangle Y? Explain to your partner why you know this answer.

Task I: Complete with a partner.

1. On your remaining graph paper, one partner draws three dots approximately one to three inches away from each other.
   Make sure that the dots are at a point where the lines cross.
   Make sure that the dots do not share the same lines.
   Connect the dots to make a triangle.



2. Put the second partner's graph paper under the triangle so that when you cut out the triangle, you actually cut out two triangles.

3. Arrange the triangle with the widest angle at the top and draw a dotted line from the top point perpendicular to the bottom line. This is the *Height* of the triangle. (See above.) Cut the second triangle along the dotted line so that now you have three triangles.

4. Can you arrange the three triangles into one rectangle? See if all the other partners can do the same with their triangles.

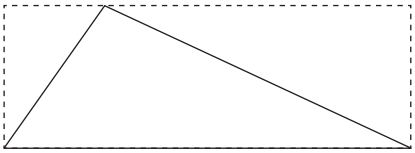
Task J: Complete as a team. Talk about these questions with your team.

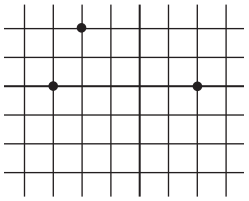
a. Did the first two triangles have the same area?
b. After the cut, did the two smaller triangles together equal the larger uncut triangle?
c. Could you make a rectangle out of the three triangles?
d. Do you think it works with all triangles?
e. If the rectangle you made was 10 inches by 4 inches how many square inches would its *Area* be?
f. Is the area of the big triangle 1/2 of the area of the rectangle? What is the Area based on the rectangle in question e.?
g. Is this statement true? *You can find the area of a triangle if you can find the area of the rectangle around it and divide by two.*

INVESTIGATION #3:
AREA OF TRIANGLES (2)

Task K: Complete as a team. Discuss your thinking out loud and make sure that all members of the team understand the steps and can retell the steps correctly. You are going to explain how to determine the *Area* of a triangle.

1. This time, you will use only graph paper. (You will not cut anything out.) Draw a new triangle making sure that the vertexes (corners) are at a point where the lines cross.
   Draw a rectangle around the triangle.

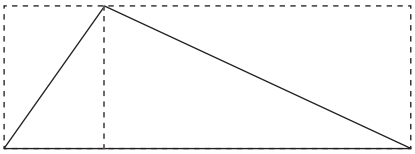




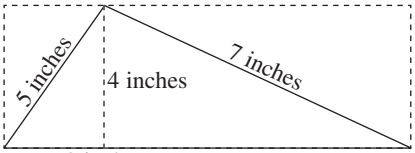
2. Count the number of squares across the top of your rectangle. Count the number of squares on the side of your rectangle. What is the *Area* of the rectangle?

3. From what you have discovered, what is the *Area* of the triangle you made?

4. Write a formula using the words *Base* and *Height*.



5. Using the **Problem-Solving Format**, prepare a chart that explains how you find the *Area* of a triangle that measures 9 inches x 5 inches x 7 inches, with a height of 4 inches.



   Remember: you do not need all of the numbers to solve this problem.

6. **Review:** Practice with triangles of difference sizes. Also go back over your work for the past three days and make sure every member of your team can do the following:
   a. Write the definition of area.
      (Area is the number of square units needed to cover a surface.)
   b. Determine the *Area* of a rectangle.
   c. Determine the *Area* of a shape made up of rectangles.
   d. Determine the *Area* of triangles.
   e. Correctly write their *Area* answers in *Square* units.

7. Keep all your work in your team folder. You will need it later.

INVESTIGATION #4:
PERIMETER (1)

Materials

- AREA SQUARES
- Ruler
- String

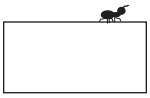
Task L: Work alone for steps #1–#6. Work with your team for #7.

1. Take out 12 one-inch squares and arrange them into a rectangle on your desk. (Your rectangle may not look like the your neighbor's rectangle.)

2. Do you agree or disagree with this statement: *If 12 squares cover the surface of your rectangle, then the Area is 12 square inches.*

3. Take out your ruler and measure one long and one short side of your rectangle. If you use the formula for finding *Area* of rectangles, the answer will be _____ square inches.

4. Measure all the way around your rectangle (all four sides). Answer this question: *If an ant walked all around your rectangle along the outside edge, how far would it walk?*
   _____ inches. The distance the ant walked is the *Perimeter* of your rectangle. You determine the *Perimeter* by adding up the lengths of the sides.



5. Memorize this definition: *Perimeter is the distance around a polygon.* (*Polygon* is a big name used to describe any closed figure made up of three or more straight sides.) You can find the perimeter by adding up the length of all the sides.

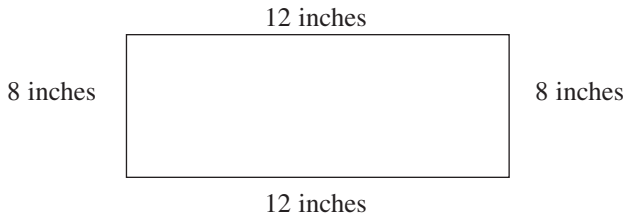
6. Cut a piece of string that is the same length as your perimeter answer in #4 above.

> **Notice:** the string has only one measurable dimension—*Length*. Perimeter is always written in a unit of length: inches, feet, miles, etc. **not** *square* inches, *square* feet, or *square* miles.

7. Meet with your team members and compare the length of your string to theirs. If all your teammates did not design the same rectangles, then they may not have the same length of string. Polygons with the same area do not necessarily have the same perimeter. Look at all the rectangles on your team.
   a. Which rectangle has the shortest perimeter? The one that measures _____ by ____
   b. Which rectangle has the longest perimeter? The one that measures _____ by ____

Task M: Work as a team.

1. To find the *Perimeter* of a rectangle, you can add all four sides, but there is a short cut. Look at the rectangle below, and think of a strategy to save you time.

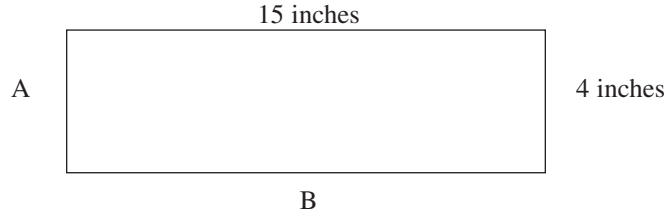


2. Create a formula that helps you find *Perimeter* of a rectangle, and write it on a piece of paper to share with your teacher when you are asked. Make sure all of your team members can explain the strategy to the class.

INVESTIGATION #4:
PERIMETER (2)

Task N: Continue to work as a team.

1. Think about this: Sometimes you can determine the length of a side, even if the length is not given. Look at this figure.



What is the length of A? _____ What is the length of B? _____
What is the perimeter of the rectangle? _____ (Watch your label!)

Task O: Work as a team and find the answer to these three questions.

1. How about Figures I and II? Prepare the **Problem-Solving Format** to explain how you solved this:

Figure I What is the length of side W? What is the length of side V? What is the perimeter of Figure I? (Label correctly!)

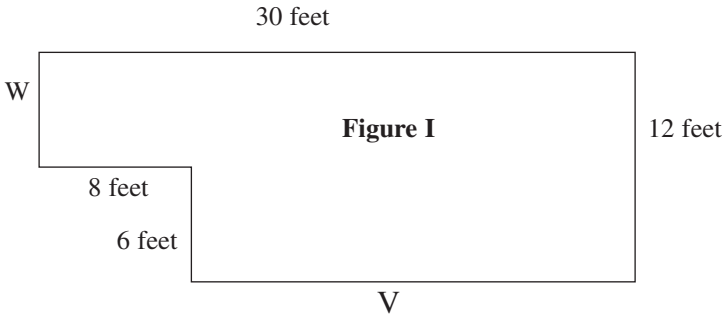
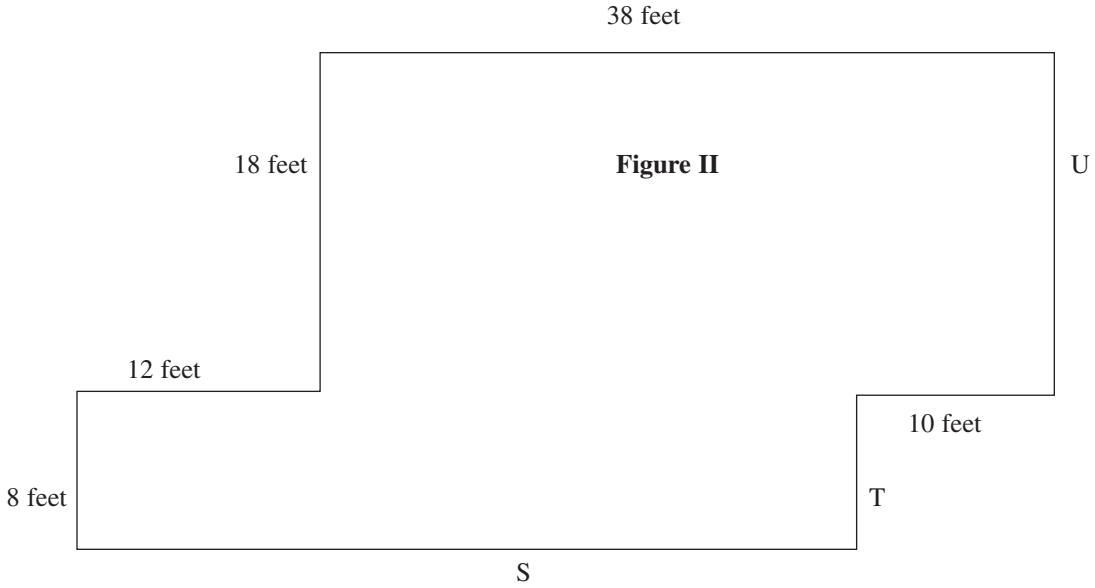


Figure II What is the length of side U? What is the length of side T? What is the length of side S? What is the perimeter of Figure II? (Label correctly!)



AREA & PERIMETER QUIZ

ARCHITECTS OF LEARNING

Directions: Answer the questions. You must write the correct *labels* beside each number answer. In questions #1–8, each box represents one square foot.

1. What is the area of figure A? _____

Figure A

2. What is the perimeter of figure A? _____

3. What is the area of figure B? _____

Figure B

4. What is the perimeter of figure B? _____

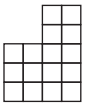
5. What is the area of figure C? _____

Figure C

6. What is the perimeter of figure C? _____

7. What is the area of figure D? _____

Figure D



8. What is the perimeter of figure D? _____

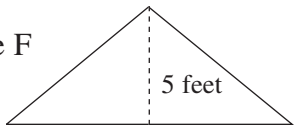
9. What is the area of figure E? _____

Figure E

10. What is the perimeter of figure E? _____

11. What is the area of figure F? _____

Figure F



12. What is the area of a rectangle that is 6 feet by 40 feet? _____

13. What is the perimeter of a rectangle that is 6 feet by 40 feet? _____

14. How many feet of fencing would you have to buy to enclose a garden that is 12 feet by 50 feet?

15. How many square feet of tile to cover a kitchen floor that is 25 feet by 10 feet? _____

INVESTIGATION #5:
SCALE (1)

Materials

- Construction paper
- Ruler
- Measuring tape
- Heavy string
- Graph paper
- Scissors

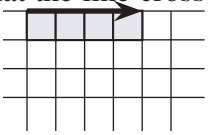
Background

You have probably worked with scale using maps in social studies. With the magic of scale, a mapmaker can accurately draw the whole world on one sheet of paper. The key is establishing a ratio of the actual size to the scale size and using it consistently throughout the drawing. For example, the scale on a one-page world map is generally about 1 inch equals 2,000 miles, often written 1 inch **:** 2000 miles. This means the distance from New York to San Francisco (3600 miles) can be represented in a scale map by a paper distance of a little less than 2 inches.

Directions

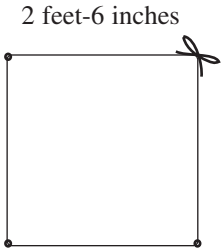
Work as a team. Use the scale of 1 inch : 10 feet for all **Tasks** in **Investigation #5**.

1. Measure one inch on your graph paper starting at a point where two lines cross. You should discover that the line crosses the top of four boxes.



2. If the scale is 1 inch : 10 feet, what does length of the side of each block actually represent? _____ feet.
   How many inches in a half foot?_____

3. As a team, cut two lengths of string each 10 feet-1 inch long. Take one of the 10 foot-1 inch strings and tie the ends to make a loop using about 1/2 inch on each end to make the knot. Using a ruler or measuring tape put a mark every 2 feet-6 inches around the loop. Working on the floor or counter, each team member holds the string at one of the marks. Together pull the loop to form a square. This square represents a 1/4-inch square on your graph paper using the scale of 1 inch equals 10 feet (1" : 10').



4. Repeat the steps in #3 to make a second loop. Mark this one every 2 feet-6 inches as well. Arrange it into a square next to the first square. The two squares together form a rectangle that is ____feet long and ___feet ___inches wide. Outline two small blocks on your graph paper to represent these two squares.

Task P: Work as a team. Create scale drawings and present them to the class. This will require you to make the drawings, cut them out, paste them on construction paper, and label them. On the paper, be sure to write the scale 1 inch : 10 feet

1. Begin by drawing all your team members to scale. Ask one of your teammates to lie over the two squares on the floor, and draw an outline picture of him/her to scale on the graph paper.
2. Repeat for each member of the team. Some may fit inside the two squares, but some may extend beyond the square. Carefully cut them out, paste them on construction paper, and label with names.

INVESTIGATION #5:
SCALE (2)

Task R: Work as a team. On the paper, be sure to write the scale 1 inch : 10 feet.

1. Place some items (books, stapler, ruler, hat, ball) inside the square string loop on the floor. Draw them (as best you can) inside a quarter-inch square on your graph paper. Sometimes it is difficult to show detail when drawing to scale. Cut it out carefully and label.

2. Put a desk or chair into the two loops. When you draw items in a room to scale, you have to imagine you are floating above the furniture looking down. In that position you would see only the top of the chair or desk. When you draw furniture, then, you only need to draw the tops in the small squares of your graph paper.

3. Below is a list of common items. Draw them to scale, cut them out, paste them to your paper, and label them each by name. **Remember:** in this activity you do not have to draw details. (These measurements are approximate.) The activity is to draw reasonable shapes that are accurate in size.
   - Cargo bay of the space shuttle: 60 feet x 15 feet
   - Olympic-size swimming pool: 76 feet x 65 feet
   - Competition surfboard: 6 feet
   - Sloop sailboat: 28 feet long, 6 feet wide at the middle
   - High school basketball court: 94 feet x 50 feet
   - Baseball diamond: a square with 90 feet per side
   - Minivan: 12 feet long, 6 feet wide
   - School bus: 40 feet x 8 feet
   - 747 jet plane: 232 feet long, 20 feet wide, wingspan of 196 feet (draw rough outline)

4. **Extensions:** Individually measure items at home or throughout the community and draw them to scale on 1/4 inch graph paper with a scale of 1 inch equals 10 feet. Follow the directions above and add the scale drawing to your team's presentation.

Scale Drawing Rubric

Exemplary: Your scale drawings were neatly drawn, labeled, and very accurate.
Expected: Your scale drawings were neatly drawn, labeled, and accurate with only one or two minor errors.
Nearly There: Your scale drawings were neatly drawn, labeled, and nearly accurate with one or two errors.
Incomplete: Your work was incomplete for one or more of the following reasons:

- Messy
- Too many errors
- Not labeled
- Not finished

INVESTIGATION #6:
PROBLEM SOLVING

Materials

- Chart paper or manila paper
- Graph paper
- Measuring tape or yardstick
- Ruler

Real Task

Your team is going to make a scale drawing (floor plan) of your classroom or some other area your teacher assigns.

Requirements

1. Draw the room to scale using the 1/4-inch graph paper with the scale of 1 inch : 10 feet.
2. Draw straight lines for walls and indicate where there are windows and doorways.
3. Draw the furnishings and counters or cabinets to scale and in proportion to the room.
4. Label areas of the room (library corner, computer center, etc.) Make it easy for someone looking at the plan to understand. For items in your drawing use these standard symbols:
   a. **Walls** Indicate using straight lines.
   b. **Doors** Indicate by a break or separation in the wall lines.
   c. **Windows** Draw a — W — to indicate the location of windows.
   d. **Furniture** Draw the shape as it appears from above. (For example, a round table looks like a circle; a chair might look like a square or circle; a desk looks like a rectangle; a sink might appear as an oval.
   e. **Labels** Write clearly and fairly small in order not to crowd the floor plan. Consider writing all your labels on computer and gluing them to the project.
5. Determine the *Total Area* and *Perimeter* of your space.
6. Prepare an oral presentation that you will give to your classmates that includes
   a. A neat scale drawing of your space
   b. At least one **Problem-Solving Format** chart for any problem you had to solve to complete this real task. (You choose which one you want to explain.)

Suggestions

1. Remember: this task is a **Team Task**. Everyone can and must participate.
2. Make a "TO DO" list of subtasks, decide who should do each, and write a person's name next to each subtask.
3. Ask, "What do we need to know? How can we find out?" (*Hint*: What do you need to measure or count?)
4. When measuring actual objects, measure to the closest inch.
5. When you measure, measure twice to ensure accuracy.
6. One team member must keep careful records of the measurements on a separate paper.
7. One team member must keep track of the steps you take and write down any insights the team makes regarding the task. (Remember your team must tell how you solved problems that arose as you worked on these tasks.)
8. Check all your computations twice to ensure accuracy. **Check your labels**.
9. Before the presentation, recopy the floor plan and the **Problem-Solving Format** charts neatly. Share this responsibility with more than one person.
10. Practice the presentation at least once. Allow all team members to speak in the presentation.

INVESTIGATIONS PRESENTATION RUBRIC

INVESTIGATIONS PRESENTATION RUBRIC

Name________________________________

When you present the result of your Investigations to the rest of the class, you will be judged on the quality of your presentation using the following standards:

4 — ***Exemplary***
- Your voice was *loud and very clear*.
- You *maintained eye contact* with your audience.
- You *effectively used* visual aids.

3 — ***Expected***
- Your voice was *loud and very clear*.
- You *made eye contact* with your audience.
- You *used visual aids*.

2 — ***Nearly There***
- Your voice *could have been louder and/or clearer*.
- You *seldom made eye contact* with your audience.
- You *did not effectively use* visual aids.

1 — ***Incomplete***
- The audience could not understand your presentation.

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1 — ***Incomplete***
- The audience could not understand your presentation.

INVESTIGATION #7:
DESIGNING A THEATER

Materials

- ADA GUIDELINES
- Chart paper or manila paper
- Graph paper
- Measuring tape
- Ruler

Project Task

Design a theater for presentations. A presentation could be a demonstration, lecture, movie, short play, or even a musical performance.

Specifications

Design the room so that it meets these specifications:

- Accommodate at least 25 seats with room for four wheelchairs.
- Determine how much space you need for the seating and wheel chairs and provide comfortable legroom between rows.
- Build in an emergency fire exit.
- Design a stage with an area of at least 40 square feet.

Requirements

1. Draw this room to scale using the 1/4-inch graph paper with the scale of 1 inch : 10 feet.
2. Determine the *Total Area* and *Perimeter* of your theater space.
3. Prepare an oral presentation that you will give to your classmates that includes:
   a. A neat, accurate scale-drawing of your theater, the stage, and the layout of the chairs.
   b. At least one **Problem-Solving Format** chart for any problem you had to solve. (You choose which one you want to explain.)
   c. A list of items that you include in your theater (Sound system? Projectors? Lighting? Fire exits?)

Suggestions

1. Remember that this task is a **Team Task**. Everyone can and must participate in its completion.
2. Decide what you can best do to help the team complete this task.
3. Make a "TO DO" list of subtasks and write a name next to each. You can all design a room and choose the best, or you can work together sketching out what you want the room to look like and then assign someone to make the final copy.
4. Ask yourselves, "What do we need to know? How can we find out?" (*Hint*: How much room do you need for each chair?)
5. Ask at least one member of your group to keep track of the steps you take and any insights the team makes regarding the task. (Remember your team must tell how you solved the problems that arose as you worked on these tasks.)
6. When the specifications say "at least," this means you can make them larger, but not smaller.
7. Before the presentation, neatly recopy the floor plan and the **Problem-Solving Format** charts.

ADA GUIDELINES (1)

PUBLIC LAW 101-336, also known as the Americans with Disabilities Act, was written and enacted by the 101st Congress in 1990. The ADA prohibits discrimination and ensures equal opportunity for persons with disabilities in employment, state and local government services, public accommodations, commercial facilities, and transportation. It also mandates the establishment of Telecommunications Devices for the Deaf or TDD/telephone relay services.

Public Law 101-336 Construction Guidelines

This ADA information was quoted directly or paraphrased from the published ADA GUIDELINES.

1. The ADA requires that newly constructed facilities, first occupied on or after January 26, 1993, meet or exceed the minimum guidelines of the ADA Standards for Accessible Design (Standards).

2. **Architectural Barriers:** Architectural barriers are physical features that limit or prevent people with disabilities from obtaining the goods or services that are offered. They can include parking spaces that are too narrow to accommodate people who use wheelchairs; a step or steps at the entrance or to part of the selling space of a store; round doorknobs or door hardware that is difficult to grasp; aisles that are too narrow for a person using a wheelchair, electric scooter, or a walker; a high counter or narrow checkout aisles at a cash register, and fixed tables in eating areas that are too low to accommodate a person using a wheelchair or that have fixed seats that prevent a person using a wheelchair from pulling under the table.
   a. **Accessible Entrance:** When a business has two public entrances, only one must be accessible. Most entrances use 36-inch wide doors (these are wide enough). There must be maneuvering clear space in front of and inside the doorways.**:** If steps are needed, then ramps must be provided that rise at no more than 1 foot in a distance of 20 feet.
   b. **Maneuvering Space:** A 180 degree turn requires a 60-inch diameter turning space or a 36-inch wide "T" (at least a 36-inch space on each segment of the "T").
   c. **Counter Space:** Provide a 30 inch x 48-inch space in front of sales or service counters to accommodate a wheelchair or electric scooter. The space must be connected to an accessible route that connects the entrance and other areas of the building.
   d. **Self-service Food Lines:** Provide maneuvering space with a minimum of 36 inches, but a 42-inch width is preferred. If the line requires a change in direction, then more space must be provided. (See b. above.)
   e. **Fixed Seating and Tables:** If tables are provided and attached to the floor, then 5% (or at least one if fewer than 20) accessible tables must be provided.
   f. **Accessible Routes:** An accessible route provides access to each accessible table and a clear floor area (30 inches x 40 inches) at each accessible seating location.
   g. **Segregation:** Furthermore, it is illegal to segregate people with disabilities in one area by designating it as an accessible area to be used only by people with disabilities. Seating should be designed so that disabled persons can sit with family and friends in public places.

3. **Restrooms, etc.:** Restrooms, telephones, and drinking fountains must be readily accessible to and usable by individuals with disabilities. (There are several code-complying designs. This simulation will use only the following. Also, there are guidelines for grab bars not outlined here.)
   a. **Number:** At least one accessible restroom for each sex or a single unisex accessible restroom.
   b. **Stall size:** Minimum width of a handicap-accessible stall is 60 inches wide and 56 inches deep.
   c. **Door:** The door must open out and there must be clear space for turning.

4. **Parking:** When parking is provided for the public, designated accessible parking spaces must be provided. An accessible parking space must have space for the vehicle and an additional space located either to the right or to the left of the space that serves as an access aisle. The aisle allows persons using a wheelchair, electric scooter, or other mobility device to get out of their car or van.
   a. **Dimensions of Parking Spaces:** The access aisle shall be a minimum of 60 inches wide for cars or a minimum of 96 inches wide for vans. The accessible route connected to the access aisle shall be a minimum of 36 inches wide. This means ADA parking spaces for cars must be 60 inches wider than regular parking spaces, and 96 inches wider for vans. The access aisle refers to the unobstructed path to the building.
   b. **Minimum Number of Accessible Parking Spaces Per Lot**

Total spaces	Total Accessible (Column A)	Van 96 inches wide access aisle	Car 60 inches wide access aisle
1 to 25	1	1	0
26 to 50	2	1	1
51 to 75	3	1	2
76 to 100	4	1	3
101 to 150	5	1	4
151 to 200	6	1	5
201 to 300	7	1	6
301 to 400	8	1	7
401 to 500	9	2	7
501 to 1,000	2% of total in each lot	1/8 Column A	7/8 Column A
1,000 and over	20 + 1 for each 100 over 1,000	1/8 Column A	7/8 Column A

***Only one out of every eight accessible parking space must be Van accessible.

   c. **Location:** Accessible parking spaces should be the spaces closest to the accessible entrance and be located on level ground. An accessible route must be provided between the access aisle and the accessible building entrance. This route must have no steps or steeply sloped surfaces and it must have a firm, stable slip-resistant surface.

The philosophy behind the ADA is to allow persons with disabilities the same access and opportunities as those persons without disabilities. If you have any specific questions you may call the ADA Information Line (800) 514-0301 (voice) or (800) 514-0383 (TTY) or look at the web site at www.usdoj.gov/crt/ada/adahom1.htm

Remember that the ADA guidelines spell out the **minimum** sizes and numbers. Your team may design bigger or more spaces than those described in the guidelines. The ADA Act has pages and pages of guidelines and definitions, but your team will only be responsible for specifications described here.

Daily Agenda **Team** *Power of Pyramids* **Date** *5/26/01*

CA *Juan* **CW** *Sandy* **GC** *Kelly* **ID** *Jade* **LD** *Terry*

Task	Member(s)	due	done
"Bubble" buildings—Prepare shape of the building on newsprint.	*Jade & Juan*		
Site the team's "bubble" drawing on the project board to see where it will be situated in the park.	*Terry*		
Pick a **Special Area Card**.	*Juan*		
Discuss what will be in the pavilion.	*ALL (led by Juan)*		
Draw straight lines to make general shape of the building.	*Jade*		
Make two footprints (copies of the general shape).	*Kelly*		
Read over and become familiar with the building code requirements of the Americans with Disabilities Act.	*Sandy*		
Clean up the work space and store the materials safely.	*Juan*		
Turn in any work that the teacher has requested.	*Kelly*		

SPECIAL AREA CARDS

ARCHITECTS OF LEARNING

Your team must include the following special area in your pavilion. The size given is the *minimum* size. You may make your special area larger.

GIFT SHOP
— at least 400 sq. feet.

Your team must include the following special area in your pavilion. The size given is the *minimum* size. You may make your special area larger.

FIRST AID CLINIC
— at least 200 sq. feet.

Your team must include the following special area in your pavilion. The size given is the *minimum* size. You may make your special area larger.

SNACK BAR
— at least 3,000 sq. feet
(Kitchen area and dining area)

Your team must include the following special area in your pavilion. The size given is the *minimum* size. You may make your special area larger.

GARDEN STORAGE AREA
— at least 400 sq. feet

Your team must include the following special area in your pavilion. The size given is the *minimum* size. You may make your special area larger.

WORKSHOP
— at least 600 sq. feet

Your team must include the following special area in your pavilion. The size given is the *minimum* size. You may make your special area larger.

OFFICE SPACE
— at least 750 sq. feet

DAILY AGENDA
THE FIRST DAY

Daily Agenda	Team	Date		
CA	CW	GC	ID	LD

Task	Member(s)	due	done
"Bubble" buildings—Prepare shape of the building on newsprint.			
Site the team's "bubble" drawing on the project board to see where it will be situated in the park.			
Pick a **Special Area Card**.			
Discuss what will be in pavilion.			
Draw straight lines to make general shape of building.			
Make two footprints (copies of the general shape).			
Read over and become familiar with the building code requirements of the Americans with Disabilities Act.			
Clean up the work space and store the materials safely.			
Turn in any work that the teacher has requested.			

DAILY AGENDA

ARCHITECTS OF LEARNING

Daily Agenda **Team** **Date**

CA **CW** **GC** **ID** **LD**

Task	Member(s)	due	done

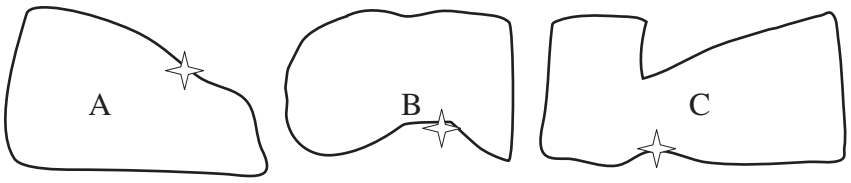
CHIEF ARCHITECT'S SUPERVISORY NOTES (1)

As the Chief Architect, you have a lot of responsibility. Your role requires leadership and organization. Read through what has to be done at the beginning, during the middle, and at the end of this project. Work with all of your team members to help them complete their tasks. You can assign more than one person—including yourself— to a task.

Do not be overwhelmed—you have your team to help you. Working together you can successfully complete the work on time.

Beginning of the project

1. **Draw a "Bubble"**
   Prepare a general shape for your building in the available space on the project board. Remember, each team in your class will design a pavilion. Sketch out a building shape on a piece of newsprint. Draw a "bubble" shape to represent the approximate size and shape.
   a. Your "bubble" building can look like one of these. Put a star to mark the front entrance.



   b. Be creative when you draw your bubble. (Free-form areas are visually more interesting than a box).
   c. Label your bubble with your team name.

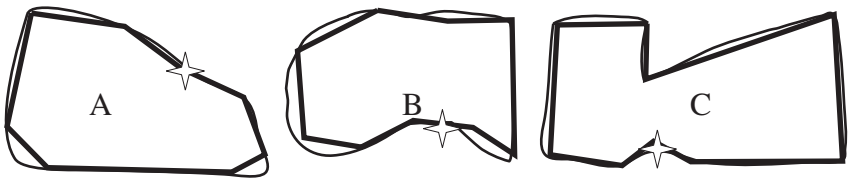
2. **Place your Bubble on the Project Board**
   Cut out the bubble shape of your pavilion and bring it forward to the project board. Arrange your pavilion "bubble" on the paper. Move it as needed to accommodate all the other teams' pavilions. Change the front entrance position if necessary.

3. **With other Teams Consider the Entire Campus**
   Allow room for sidewalks. Consider creating a common space in the middle so that visitors do not have to walk "all the way across campus" to get to the snack bar, clinic, or gift shop.

4. **Pick a Special Area Card**
   This special area must be in your pavilion. Decide if the **Special Area Card** changes your team decisions about where your pavilion will be located. Move it if necessary.

5. **Trace your Pavilion Bubble**
   Lightly trace the outline of the "bubble" pavilion on to the project board paper. Place the bubble in your team folder. Be sure the front door star is visible on both the newsprint and the project board. The **Landscape Designers** from each team remain at the project board to discuss parking, walkways, and access.

6. **Design the Exterior from the Bubble**
   The **Interior Designer** will translate the "bubble" shape into walls made with straight lines. At this point the general shape is still a draft and can be changed, although not so drastically that it no longer fits in the allotted space on the project board.



7. **Determine Pavilion Contents**
   Your team has made a preliminary outline of your pavilion to fit the space on the project board. Now lead a team discussion of what to include in your pavilion. Make any minor adjustments to the size and shape of the building based on your decisions.
   a. Your pavilion focuses on one topic of the overall theme.
      - Make a list of the content information that your pavilion must communicate.
      - You may research more information and add to your topic.
      - Try not to duplicate information other teams are presenting under their topics.
   b. Think about how best to present the information.
      - Consider a showcase exhibition, wall hangings, a movie, computer simulation, play, etc. You have an unlimited budget.
      - Consider all ideas, regardless of the cost, as long as they are appropriate to your target audience and relate to your team's theme.
      - After making your decision, design rooms where the presentations will take place (a movie theater, an exhibition hall, etc.)

8. **Determine the General Floor Plan**
   As a team design the general floor plan. Keep it as simple as possible.
   a. Remember to include your **Special Area Card** facility in your plans.
   b. Your pavilion must accommodate the handicap-accessibility codes outlined in the American with Disabilities Act.
   c. Create spaces in the pavilion to accommodate the visitors' needs such as entrances, restrooms, coatrooms, sitting areas.
   d. Decide how many entrances and exits to include and where to locate them.
      - Erase a portion of the wall line to indicate the width and location of a door. Make a mark such as —W— to show a window.
      - Make doors wide enough to allow moving in any necessary equipment or furniture and for wheel chair accessibility.
   e. When everyone on your team agrees to the *general* layout, review it one more time.
      - Make sure your layout meets all requirements.
      - Decide if you need a little more room in some area. You cannot change your building too much. It must still fit in your team's space on the project board.
   f. Your team should stay together as a team until the general layout of the pavilion is decided. Then team members separate to assume specific jobs for their roles.

Middle of the Project

9. **Specific Jobs for your Team Members**

Clerk of the Work

1. The Clerk of the Work measures and labels each side of the *scale drawing* of the model with the measurement of the *actual* structure. (For example, if a side of the model measures 2 inches long, the Clerk labels that side 20 feet; if a side measures 3-1/4 inches long, the Clerk labels that side 32 feet-6 inches.)
2. The Clerk helps complete the **Pavilion Dimensions** so the General Contractor can "order" the 2-inch poster board for the walls. This person rechecks appropriate measurements so that the building meets or exceeds ADA codes.
3. He/she will work with the General Contractor to mark windows, doors, etc. exactly matching the floor plans.
4. The Clerk of the Work solves a *security lighting* problem and writes up a description using the **Problem-Solving Format**.

General Contractor

1. The General Contractor uses the Interior Designer's graph paper scale drawing as a pattern. He/she cuts out two pavilion shapes using construction paper. This is called a *footprint*. (A *footprint* is the space on the ground that the building occupies.)
2. The General Contractor uses one *footprint* to order building materials and build the outside walls of the model.
3. He/she cuts pieces of 2-inch poster board to make the walls.
4. The General Contractor refers to the scale drawing of the floor plan for the location of windows and doors and works with the Clerk of the Work to mark windows, doors, etc. exactly matching the floor plan. (The teacher will cut the windows and doors.)
5. The General Contractor solves an *exterior wall* problem and writes up a description using the **Problem-Solving Format**.

Interior Designer

1. After the team decides on all the minor size adjustments, the Interior Designer draws the outside walls. The drawing must be to scale, on graph paper. Line segments of outside walls must be **at least one inch** in length.
2. The Interior Designer makes sure that the pavilion includes all the rooms and special areas (exhibition halls, restrooms, exits, etc.) that the team decided to include. The team creates this list of rooms and the Interior Designer draws the rooms on the floor plan.
3. The Interior Designer solves a *carpeting* problem and writes up a description using the **Problem-Solving Format**.

Landscape Designer

1. The Landscape Designer places one *footprint* on the project board to mark exactly the size and location of the team's pavilion.
2. He/she works on the landscaping, walkways, and parking while the rest of the team is working on the model.
3. He/she must touch base with the team each day for the DAILY AGENDA
4. The Landscape Designer solves a *parking lot* problem and writes up a description using the **Problem-Solving Format**.

End of the Project

10. **Design Review**
    a. Ask your teacher to look at the team floor plan when you think it is finished—it is possible you have overlooked something important.
    b. Ask team members to recopy their problem-solving charts so that they are neat and easy to understand.
    c. Are all the labels neatly written and spelled correctly?

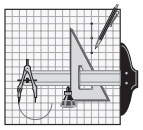
11. **Assemble your Team Project**
    When the paint and glue on the project board and the model are completely dry, attach your model in the appropriate place over the footprint on the project board.
    a. Put a light layer of white glue across the footprint base of the model.
    b. Carefully align the model to the footprint on the project board and press firmly to glue.
    c. Arrange your roof on top. (Glue the roof to model *only* if you do not intend to show the interior of your pavilion in the final presentation.)
    d. After your team has attached the pavilion, have one more team meeting to evaluate whether your section of the project board needs any final additions or adjustments.
    e. **Congratulations!** Inform your teacher that your team completed your pavilion.

12. **Organize the Presentation**
    Work with your team to decide the following:
    a. Who will speak first?
    b. What content will each team member present?
    c. Who will give the tour of the pavilion?
    d. In what order will your team present your work and how you solved your problems?

13. **Prepare and Present**
    You are in charge of the final presentation of your pavilion project. You will introduce team members to present what they did and the problems they solved.
    a. Direct the rehearsals for your team.
    b. Prepare introductions for your team members.
    c. Lead your team's presentation.

14. Solve your **Architectural Project Problem**.

CLERK OF THE WORK'S TASKS



1. **Complete the Pavilion Dimensions Chart**
   Your first job is to measure the footprint of your pavilion. Enter all your information on the **Pavilion Dimensions** chart. The **General Contractor** will assist you. Measure carefully and write your numbers clearly.
   a. Begin at one corner of your pavilion footprint and measure the length (in inches) of the first wall (side A) of your pavilion.
   b. Work clockwise around the footprint. Write each model wall measurement in the first column ("Side in Scale")
   c. In the center column, show the math (For example, if a side of the model measures 2 inches long, the math is 2 x 10 = 20 feet; if a side measures 3-1/4 inches long, the math is (3 x 10) + (1/4 x 10). Put 32-1/2 feet (or 32 feet-6 inches) in the third column.
   d. Continue measuring around the footprint to back where you started and fill in **Pavilion Dimensions** chart.

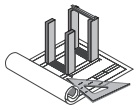
2. **Build the Outside Walls**
   Work with the **General Contractor** to make the outside walls. Use your measurements to make a continuous strip of poster board. Next help him/her mark the different walls of the building.

3. **Locate Windows and Doors**
   When the **Interior Designer** has marked the windows and outside doorways on the floor plan, draw the doors and footprints on the poster board strip. The **General Contractor** will help you.
   a. Draw the window or doorway lightly with pencil matching the placement on the floor plan and then outline with fine marker.
   b. Draw windows and doorways as rectangles and remember the scale of the project in determining their height.
      - Draw your lines clearly and neatly using pencil and a ruler **matching** the placement on the floor plan and then outline with fine marker.
      - Decide whether the windows are for people to look out of or only to supply light.
      - Do not place windows right against the fold where a wall ends, as it will weaken your model. If the **Interior Designer** has windows too close to a fold, talk with him/her and arrange for a "change order." Be sure that the Interior Designer changes the window placement on the floor plan as well.
   c. Give your poster board strip to the teacher who will cut the doors and windows.

4. **Make the Roof**
   Before your team tapes the walls to the footprint, make the roof.
   a. Use the footprint as a pattern and trace it on to a piece of poster board.
   b. Measure with a ruler and put a little pencil dot 1/4 inch out from the edge of the footprint all the way around the outside.
   c. Using a ruler connect the dots to make a roof that will overhang 1/4 inch all the way around the building. (1/4 inch scale = 2 feet-6 inches actual)
   d. Use markers to color the roof or cover the roof with black or tan-colored paper.

5. **Check for ADA Codes**
   a. Check the **Interior Designer** floor plan when he/she asks to make sure that the floor plan meets the building codes described in the Americans with Disabilities Act.
   b. Check with the **Landscape Designer** when he/she asks to make sure he/she has included ramps and handicapped parking spaces.

6. Solve your **Architectural Project Problem**.



GENERAL CONTRACTOR'S TASKS (1)

1. **Make the Footprints**
   Using the general floor plan as a pattern, cut out two floor plan "footprints" from two different colors of construction paper. Put a small X on the top side of both footprint papers.

2. **Prepare to "Order" Materials**
   Measure and write your numbers clearly. Use one of the footprints of the pavilion for your measurements. Work with the **Clerk of the Work**.
   a. Begin at one corner of your pavilion and measure the length in inches of the first wall (side A) on your floor plan.
   b. Work clockwise around your floor plan. Write each model wall measurement in the first column ("Side in Scale")
   c. Show the math (For example, if a side of the model measures 2 inches long, the math is 2 x 10 = 20 feet; if a side measures 3-1/4 inches long, the math is (3 x 10) + (1/4 x 10). Put 32-1/2 feet (or 32 feet-6 inches) in the third column.
   d. Continue measuring around the footprint and fill in **Pavilion Dimensions**.
   e. Request the correct amount of poster board strips to build the walls.

3. **Measure and Cut the Walls**
   a. When you determine the perimeter of your scale building, you will know the total length of 2-inch wide poster board strips you will need for your model. (All the walls will be 20 feet tall, so the strips are 2-inches wide.)
   b. If the perimeter is longer than the 2-inch strips, you will have to piece them together with tape.
   c. Once you have successfully prepared your poster board strips you will have one long strip of poster board equal to the perimeter of your pavilion.

4. **Mark the Walls**
   a. Use the first column of measurements from the **Pavilion Dimensions** to mark your walls.
   b. Starting on the left side of your strip, carefully find the distance from the very edge of the strip to the length of side A.
   c. Make a pencil mark on the poster board where side A ends.
   d. Mark both the top and bottom of the strip of poster board to get an even line. Check the length against the footprint. It should match **exactly**!
   e. When you are sure it is correct, draw a line with a ruler connecting the mark on the top of the strip with the mark on the bottom.
   f. You will have a straight line that is perpendicular (at a right angle) to the top and bottom of the strip.

5. **Form your Model**
   a. After you have marked the walls of your model, carefully fold along the perpendicular lines you drew to mark the length of each wall.
   b. Take the edge of your ruler, place it carefully against the first mark on your strip, and fold the poster board against the ruler edge.
   c. Do the same for all the marks on your poster board strip.

6. **Check the Walls**
   a. As you work check your walls with your footprint. Make sure everything matches up. The **Clerk of the Work** will help you.
      - Align the bottom left edge of your poster board strip with the line where you started measuring for the **Pavilion Dimensions**.
      - Moving clockwise around your building, you should be able to match up all the folds you made with the walls on the footprint.
      - You may have to reverse some of the folds, depending on the shape of your structure.
      - Try not to bend the poster board more than once, as this will weaken the walls.
   b. If you are successful, you may move on! If not, ask for help. You may add more poster board, subtract extra poster board, or begin again with a new strip of poster board.
   c. Do not tape the walls to the footprint yet. You need them to still be in strip form.

7. **Build the Outside Walls**
   a. When the **Interior Designer** has marked the windows and outside doorways on the floor plan, work with the **Clerk of the Work** to transfer the information accurately to the footprint. Mark the door openings and put —W— for all the windows.
   b. Help the **Clerk of the Work** to draw in the doors on your poster board strip. These should match up exactly with where you drew them on your footprint.
      - Draw your lines clearly and neatly using pencil and a ruler.
      - Draw each door as a rectangle. Make sure doors are high enough for a person to walk through and wide enough for any equipment that needs to come through the door.
   c. Give your perimeter strip to your teacher who will cut out the windows and the doors and return it to you.
   d. Now your team decides on the color, pattern, or theme of your exterior walls.
      - Be creative with the outside of your model; consider a mural or multi-colored walls.
      - Draw in any signs to designate the name or purpose of your structure. Print neatly or use a computer to print labels.
      - Use markers, colored pencils, or crayon to color the walls.

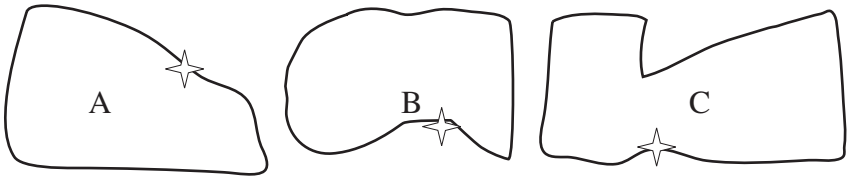
8. **Construct the Model**
   After you have finished decorating the outside, put your model together. You need more than one set of hands to do this. Ask for help from the **Clerk of the Work** and **Chief Architect**.
   a. Tape the two ends of your perimeter strip together on the inside.
   b. Carefully arrange the walls (perimeter strip) around the outside edge of your footprint.
   c. Test the strength of the walls. Place the roof on top of the walls. Check that the walls stay firm and do not bend. If the walls bend, check with your teacher.
   d. Remove the roof and begin to tape the walls to the footprint. Put small pieces of tape on the bottom edge of the walls, about one-half to one inch apart all the way round the building footprint.
   e. Place the roof on the top of the building.

9. Solve your **Architectural Project Problem**.

INTERIOR DESIGNER'S TASKS (1)

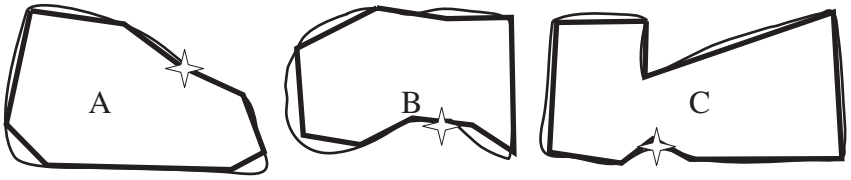
Your primary job is to draw the detailed floor plans for this project. Listen to the **Chief Architect's** instructions.

1. **Draw a "Bubble"**
   a. You will help make the first drawings of the building.
   b. Your "bubble" building can look like one of these. Mark the front entrance with a star.



   c. Label your bubble with your team name.

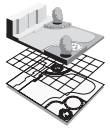
2. **Outline the Pavilion**
   Translate the "bubble" into a building formed with **straight lines**.
   a. The drawing must be to scale, on 1/4 inch-graph paper. Use a ruler and pencil.
   b. Line up the outside walls of the building along the lines of the graph paper where possible. Place corners at the point where the graph grid lines meet.
   c. Line segments of outside walls must be **at least one inch** in length.



3. **Develop a Detailed Draft Floor Plan**
   Once the preliminary sizing is done, work on the detailed draft floor plan. Work with the whole team. Listen to ideas from others. Help the team agree on what to include.
   a. Quickly recopy the outside walls of the general floor plan onto a new piece of graph paper. Let the **General Contractor** use the original floor plan to make the two footprints.
   b. Under the leadership of the **Chief Architect** your team decides where to place the doors and windows. Using pencil, carefully designate marks for doors (a break in the outside wall) and windows (—W—). As soon as you finish, give the information to the **General Contractor** and the **Clerk of the Work**.
   c. As your team decides the interior of your pavilion, sketch in the inside walls to mark the rooms. Include coat closets, storage areas, rest rooms, and your team's special area. At this point the drawing should give the general layout of the rooms.
   d. Still working on the draft, sketch the major pieces of furniture and equipment (tables, chairs, computer stations, video screens, etc.) in each room.
   e. Neatly label each room.
   f. Check with the **Clerk of the Work** that the plans comply with the ADA building code.
   g. Share your drawings with your team members daily to make sure that you have correctly put in any "change orders." The model and floor plans **must match exactly**.

4. **Prepare a Final Floor Plan for Presentation**
   a. When the **Chief Architect** has signed off the work, copy the draft to make your final floor plans.
   b. Color the floors with colored pencil, light crayon, or light markers. Make all the support rooms (restrooms, closets, etc.) one color. Color your special area a special color.
   c. Make a color key and neat labels for the larger rooms.
   d. Mount your final floor plan on construction paper with your team name.

5. Solve your **Architectural Project Problem**.



LANDSCAPE DESIGNER'S TASKS (1)

1. **Work with Other Landscape Designers**
   Work cooperatively with the other **Landscape Designers** and report back to your team each day.
   a. If your team is unhappy with a landscaping decision, bring it up at the next Landscape Designers' meeting to try to accommodate your team's wishes.
   b. However, the **Landscape Designers** committee makes all final landscaping decisions.
   c. Every day, clean up any art supplies or mess you may have made.

2. **Plan the Pavilion Grounds**
   For all the planning activities, use the first project board paper as a draft paper. Use this draft paper to "sketch" where things will go.
   a. After the general building sites are set, lightly trace around the "bubble" shape and write your team name inside. Be sure to mark the main entrance to the pavilion.
   b. With the other **Landscape Designers**, decide the location of the front gate of the theme park. Mark it on the draft paper.

3. **Decide on Landscaping**
   You and the other **Landscape Designers** will decide what kind of landscaping to have in this theme park. Use these questions to guide your discussion.
   a. What will the ground cover be—grass, dirt, concrete, etc.?
   b. What types of plants will surround the structures and be placed in open spaces? (trees, shrubs, cactus, flower gardens, etc.)
   c. What other objects or areas will you include in open spaces—statues, fountains, picnic areas, playgrounds, hills, ponds, caves, etc.?
   d. Where will you include sidewalks?
      - Design sidewalks from your team's project to the team projects on either side.
      - Check ADA guidelines for walkways requirements.
   e. Where will the parking lots be located?
      - Check ADA guidelines for parking lots. How many handicap-accessible parking spaces will you need near your building?
      - Do you have a traffic pattern inside the park?

4. **Mark your Team's Pavilion Site**
   a. Transfer your draft sketches lightly and carefully to the final project board paper.
   b. When your team's **General Contractor** completes the footprints, glue your team's footprint onto the second, final project board cover sheet. This marks the location of your team's finished model.

5. **Prepare your Team's Pavilion Site**
   When you and the other **Landscape Designers** agree on the final penciled plans, begin to paint and decorate the project board.
   a. Decide if you will use only paint, only paper, or a combination of both.
   b. Begin landscaping by painting the groundcover on the project board with tempera paint, carefully painting around the markings for the structures. **Do not paint any surface that you will glue**.
   c. Paint sidewalks on the project board over the ground cover paint.

6. **Construct Landscaping Features**
   While you wait for the paint to dry, construct other aspects of the landscaping.
   a. Make plants using modeling material and paint them.
   b. Make statues, fountains, hills, etc. with modeling material and paint.
   c. You can use sandpaper or other interesting materials such as pebbles, twigs, etc. on your project board.

7. **Attach the Landscaping Features**
   a. Attach plants, statues, fountains, hills, etc., to the ground cover using white glue.
   b. If an area is painted, you may have to lightly scrape off the paint so that the glue will adhere.

8. Solve your **Architectural Project Problem**.

ARCHITECTURAL PROJECT PROBLEMS (1)

Architectural Project Problem — Chief Architect

You must tell the investors the area of your pavilion. Answer these three questions:

a. How big is the exhibition area? (This includes galleries, theaters, and exhibition halls.)
b. How big is the support area? (This includes closets, storage areas, workshops, etc.)
c. How big are the visitor areas? (This includes coatrooms, snack bars, clinics, ticket areas, entrance areas, etc.)

Procedure

a. You may solve this problem at any time.
b. Use the measurements from *your team's* floor plan.
c. You may ask your team members to check your thinking and your computations, but you must solve the problem yourself.
d. Prepare a piece of chart paper using the **Problem-Solving Format**.
e. Neatly recopy the chart and be prepared to explain how you solved your problem in the final presentation.

Hint: Use the floor plans and consider using what you learned in Investigations #2: Area of Rectangles and #3: Area of Triangles to help you solve this problem.

Architectural Project Problem — Clerk of the Work

Your team has decided to hang security lighting around the outside of the building. The lighting requires two lengths of weatherproof wires all the way around the building and the security lights must hang every six feet. The wiring costs 15 cents per foot and the security lights cost $12 each.

a. How much wiring will you need to buy?
b. How much will it cost?
c. How many security lamps will you have to buy?
d. How much will they cost?

Procedure

a. You may solve this problem at any time.
b. Use the measurements from *your team's* floor plan.
c. You may ask your team members to check your thinking and your computations, but you must solve the problem yourself.
d. Prepare a piece of chart paper using the **Problem-Solving Format**.
e. Neatly recopy the chart and be prepared to explain how you solved your problem in the final presentation.

Hint: Use the floor plans and consider using what you learned in Investigations #4: Perimeter to help you solve this problem.

ARCHITECTURAL PROJECT PROBLEMS (2)

Architectural Project Problem — General Contractor

Your team has decided to paint the outside of the building. The sides need two coats of paint. Each gallon of paint covers 450 sq. feet. You will not paint the windows or doors. The paint is only sold in a one-gallon size that costs $10 per gallon.

a. How much paint will you need to buy?
b. How much will it cost?

Procedure

a. You may solve this problem at any time.
b. Use the measurements from *your team's* floor plan.
c. You may ask your team members to check your thinking and your computations, but you must solve the problem yourself.
d. Prepare a piece of chart paper using the **Problem-Solving Format**.
e. Neatly recopy the chart and be prepared to explain how you solved your problem in the final presentation.

Hint: Use the floor plans and consider using what you learned in Investigations #2: Area of Rectangles to help you solve this problem.

Architectural Project Problem — Interior Designer

Your team has decided to carpet the exhibition halls of your pavilion with carpeting. The carpeting costs $10 per square yard. Fortunately the carpet has a random pattern. You can easily piece the carpet if you need to.

a. How much carpeting will you need to buy?
b. How much will it cost?

Procedure

a. You may solve this problem at any time.
b. Use the measurements from *your team's* floor plan.
c. You may ask your team members to check your thinking and your computations, but you must solve the problem yourself.
d. Prepare a piece of chart paper using the **Problem-Solving Format**.
e. Neatly recopy the chart and be prepared to explain how you solved your problem in the final presentation.

Hint: Use the floor plans and consider using what you learned in Investigations #2: Area of Rectangles and #3: Area of Triangles to help you solve this problem.

ARCHITECTURAL PROJECT PROBLEMS (3)

Architectural Project Problem — Landscape Designer

Your team has decided to seal the parking lots directly around your building with a special black, waterproofing sealant. The sealant is sold in 55-gallon containers. Each container will seal 3,000 square feet of asphalt and costs $100.

a. How much sealant will you need to buy?
b. How much will it cost?

You also need to make handicapped-accessible space parking spaces. These spaces will require handicap-parking signs that cost $12 each.

a. Check with your plans to determine how many signs you need to buy?
b. How much will they cost?

Procedure

a. You may solve this problem at any time.
b. Use the measurements from your team's floor plan.
c. You may ask your team members to check your thinking and your computations, but you must solve the problem yourself.
d. Prepare a piece of chart paper using the **Problem-Solving Format.**
e. Neatly recopy the chart and be prepared to explain how you solved your problem in the final presentation.

Hint: Use the floor plans and consider using what you learned in Investigations #2: Area of Rectangles and #3: Area of Triangles to help you solve this problem.

ARCHITECTURAL PROJECT RUBRIC

Team Name _____

Preparation, accuracy, and quality

***Exemplary* — Master Architects**

- Your project demonstrated a thorough understanding of mathematical and architectural concepts needed to complete the floor plan and model.
- You carefully followed directions and created very neat and accurate products.

***Expected* — Architects**

- Your project demonstrated a general understanding of mathematical and architectural concepts needed to complete the floor plan and model.
- You followed directions and created neat and mostly accurate products.

***Nearly There* — Apprentice Architects**

- Your project demonstrated a limited understanding of mathematical and architectural concepts needed to complete the floor plan and model.
- You only partially followed directions and/or created products that were not neat and accurate.

***Incomplete* — Not Rated**

- For one or more reasons your team was unable to work together to complete the project.

ARCHITECTURAL PROJECT RUBRIC

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Preparation, accuracy, and quality

***Exemplary* — Master Architects**

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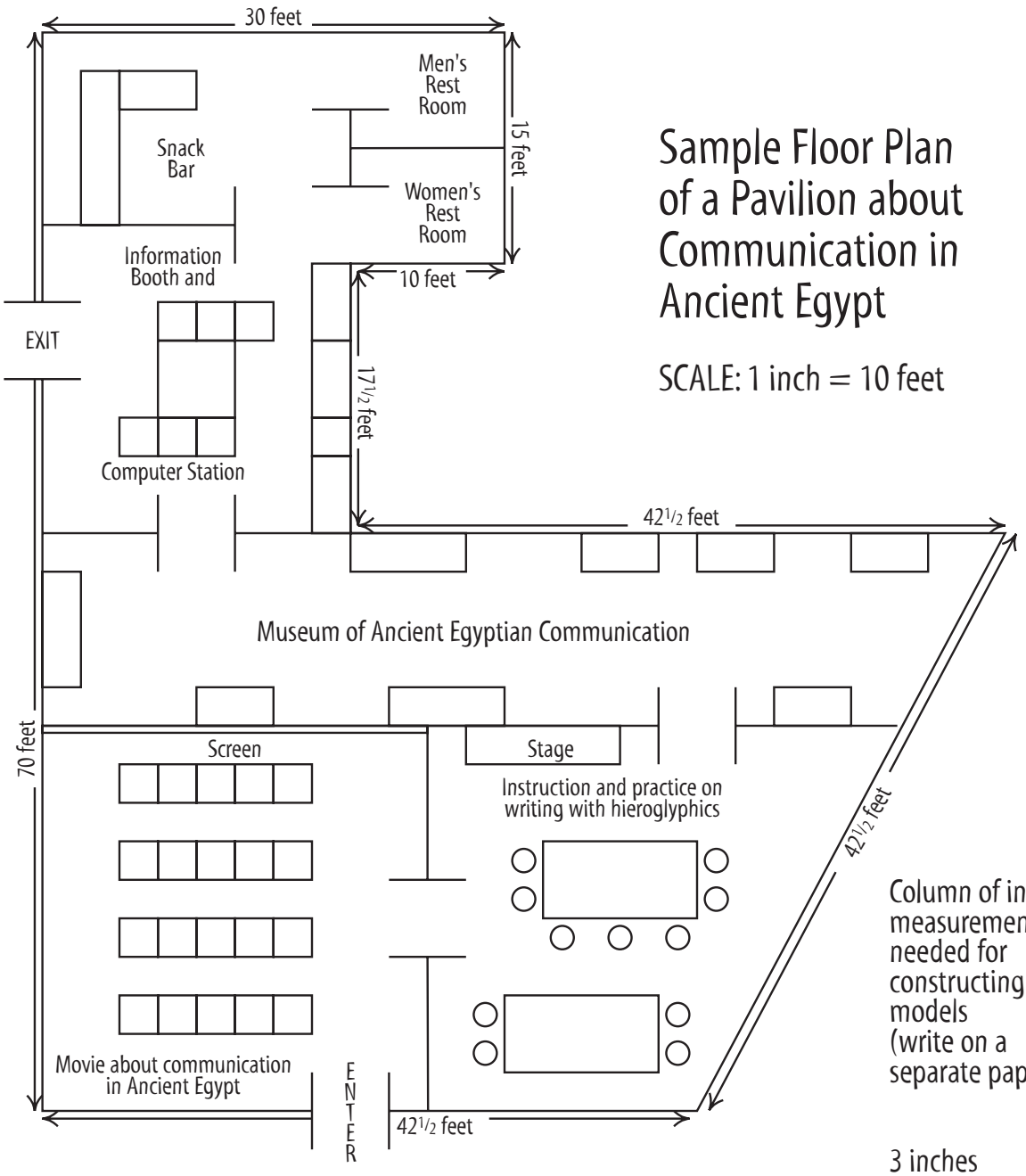
***Incomplete* — Not Rated**

- For one or more reasons your team was unable to work together to complete the project.

PAVILION DIMENSIONS

Side in scale Label inches	***Perimeter*** Scale: 1 inch = 10 feet (show the math here)	**Side** actual Label feet
A =		
B =		
C =		
D =		
E =		
F =		
G =		
H =		
I =		
DIMENSIONS in scale	Special Area: _____ Square Footage Required: _____ Square Footage As Drawn:	**DIMENSIONS** actual

SAMPLE FLOOR PLAN



Sample Floor Plan of a Pavilion about Communication in Ancient Egypt

SCALE: 1 inch = 10 feet

Column of inch measurements needed for constructing models (write on a separate paper)

A 27-inch strip of card stock would be needed to construct this model

3 inches
1½ inches
1 inch
1¾ inches
4¼ inches
4¼ inches
4¼ inches
+ 7 inches
27 inches

FINAL PRESENTATION RUBRICS

ORAL PRESENTATION RUBRIC: Content
Preparation, organization, and detail

Team Name _____

***Exemplary* — Master Guide**
- Your tour provided an **excellent explanation** of your project and your math problem solving.
- The information was **very well organized**, and you provided **more information** than expected.
- You **consistently provided** detailed descriptions.

***Expected* — Guide**
- Your tour provided an **accurate and appropriate explanation** of your project and math problem solving in an **organized** manner.
- You **provided some** detailed descriptions.

***Nearly There* — Guide in Training**
- Your tour offered only **some information** about your project and/or was **somewhat disorganized**.
- You **seldom provided** detailed descriptions.

***Incomplete* — Not Rated**
- Your presentation offered **too little information** or was **disorganized**.

ORAL PRESENTATION RUBRIC: Presentation
Volume, clarity, eye contact, and visual aids

Team Name _____

***Exemplary* — Master Guide**
- Your voice was **loud** and **very clear**.
- You **maintained eye contact** with your audience.
- You **effectively used** visual aids and your model.

***Expected* — Guide**
- Your voice was **loud and clear**.
- You **made eye contact** with your audience.
- You **used visual aids** and your model.

***Nearly There* — Guide in Training**
- Your voice was **not loud** enough or you **did not speak clearly**.
- You **seldom made eye contact** with your audience.
- You did not effectively use visual aids and/or your model.

***Incomplete* — Not Rated**
- The audience **could not understand** your presentation.

ARCHITECTURAL TEAM EVALUATION

Design Team _____ Evaluator _____

Project Did you understand the team project? _____ Y _____ N

Does the project appear to be neat? _____ Y _____ N

Rating: _____ Master Architects _____ Architects _____ Apprentice Architects _____ Not Rated

Presentation Was the team well prepared? _____ Y _____ N

Was the team well organized? _____ Y _____ N

Did the team speak loudly? _____ Y _____ N

Did the team speak clearly? _____ Y _____ N

Was the team interesting? _____ Y _____ N

Rating: _____ Master Guides _____ Guides _____ Guides in Training _____ Not Rated

Are you interested in investing in this project? _____ Y _____ N

ARCHITECTURAL TEAM EVALUATION

Design Team _____ Evaluator _____

Project Did you understand the team project? _____ Y _____ N

Does the project appear to be neat? _____ Y _____ N

Rating: _____ Master Architects _____ Architects _____ Apprentice Architects _____ Not Rated

Presentation Was the team well prepared? _____ Y _____ N

Was the team well organized? _____ Y _____ N

Did the team speak loudly? _____ Y _____ N

Did the team speak clearly? _____ Y _____ N

Was the team interesting? _____ Y _____ N

Rating: _____ Master Guides _____ Guides _____ Guides in Training _____ Not Rated

Are you interested in investing in this project? _____ Y _____

ARCHITECTURAL TEAM EVALUATION

Design Team _____ Evaluator _____

Project Did you understand the team project? _____ Y _____ N

Does the project appear to be neat? _____ Y _____ N

Rating: _____ Master Architects _____ Architects _____ Apprentice Architects _____ Not Rated

Presentation Was the team well prepared? _____ Y _____ N

Was the team well organized? _____ Y _____ N

Did the team speak loudly? _____ Y _____ N

Did the team speak clearly? _____ Y _____ N

Was the team interesting? _____ Y _____ N

Rating: _____ Master Guides _____ Guides _____ Guides in Training _____ Not Rated

Are you interested in investing in this project? _____ _____ Y

ARCHITECTS OF LEARNING

AWARD FOR

_____

_____

_____

_____

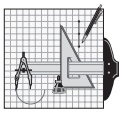
Awarded on this date

_____

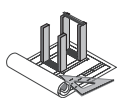
Student's Name

_____

Teacher's Name







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Age of Student: _____ (print)

Parent or Guardian: _____ (print)

Signature: _____ Date: _____

Address:

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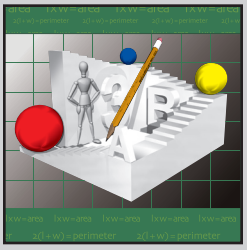

STUDENT GUIDE

Name: _____ Team Name:_____

ARCHITECTS OF LEARNING

WHAT IS ARCHITECTURE?. However, a structure is more than a sum of its materials. A structure tells a story about its inhabitants. It reveals the cultural, social, and political ideologies of the time period in which it was built.

The famous American architect Frank Lloyd Wright said, "Architecture is the greatest living creative spirit which from generation to generation, from age to age, proceeds, persists, creates, according to the nature of man, and his circumstances as they change. That is really architecture."

What Wright meant was that during any particular time, human society and its surrounding environment affect the design of a structure. As an environment and the people within it change, so too will the architecture. To state it simply, a building is a historical remnant of its time.

ARCHITECTURE AND THE PAST

The architect is the person who conceives of a design and facilitates its construction. Certainly, the role of an architect has changed through time. Early architects had no formal training, and their names have been lost over the years. Amazingly enough, we do know the name of one ancient Egyptian architect, Imhotep. Imhotep created a step pyramid for King Zoser in Egypt 2700 B.C.E. The Pyramids of Egypt were our first architectural monuments.

Many times architects reinterpret past styles. Almost five thousand years after Imhotep, in 1989, I.M. Pei, a Chinese-born American architect, built the Louvre Pyramid in Paris, France. Pei chose to model his pyramid after the Great Pyramid at Giza. However, Pei's interpretation was quite different. He constructed his pyramid of glass and placed it at the entrance to the Louvre Museum in Paris, France. Pei's high-tech pyramid not only differs from the stone pyramid at Giza, but also contrasts with the Louvre Museum itself, which was built in a classical Renaissance style.

Louvre Museum, Paris

Pyramids at Giza, Egypt

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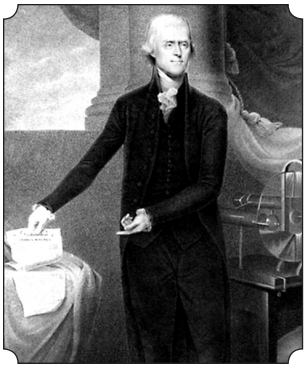
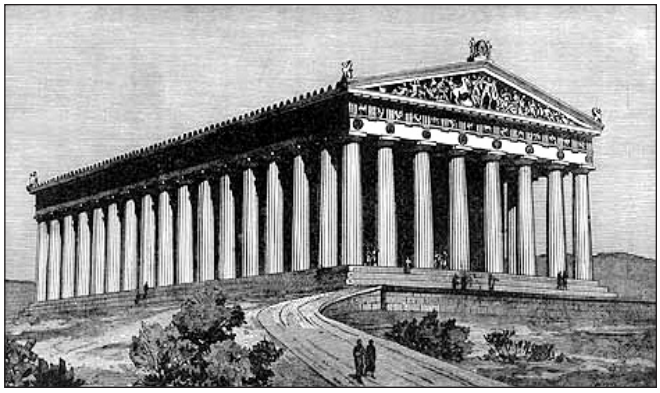


Thomas Jefferson

Thomas Jefferson, our third President, was another architect who reinterpreted past designs. He was a politician and gentleman farmer with no formal architectural training. However, he was considered the greatest American architect of his time. He designed his beautiful home called Monticello, and the capitol building in Richmond, Virginia.

Monticello, Jefferson's Home

Jefferson wanted American architecture to be different from that in Great Britain. He studied buildings while living in France and Italy. He studied pictures in books. He then developed his classical designs. He designed buildings in a style similar to Ancient Greece and Rome. He wanted to suggest the ideals of those classical societies (the democracy of Greece and the republic of Rome) in American buildings.

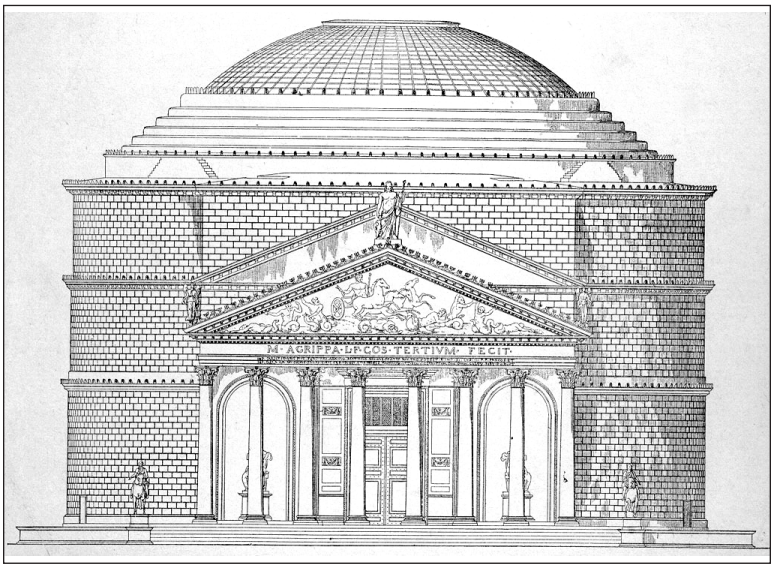


Parthenon, Greece

ARCHITECTS TODAY

Education and skills

A person must complete specific training to become a licensed architect. First a student earns a professional degree from a school of architecture. He or she then completes an internship or some formal training with an architectural firm. Finally, the architect must pass the Architect Registration Examination (like the Bar Exam for lawyers). Drawing skills (by hand or by computer) are essential to being an architect. He or she must understand scale and floor plans and be able to apply a creative imagination. Most architects use computers and computer-aided design software. Artistic talent is not enough to make an architect, however. Architects also need good communication skills. An architect must be able to clearly explain ideas to the client, to the architectural team, and to the workers who will construct the building. Usually before starting his or her own company, a new architect joins an established architecture firm to gain experience. At the firm, the new architect helps prepare documents and drawings and does research for various projects.



Pantheon, Italy

After several years of practical experience, an architect earns the right to manage a job as chief architect. Customers, usually called clients, hire architects to do a specific job. These clients may be individuals seeking to build a house. A client might also be a corporation seeking to build an office, or a government agency seeking to build a museum.

MANAGING A PROJECT

Gathering Information

The first task of the architect is to gather information about the project so that he or she can create a structure that satisfies the needs of the client. An architect must consider many elements. What is the site of this structure? What is the function of this structure? Is it an office building, a school, a factory? What is the budget for the project?

Planning and Designing

Suppose the project is an art museum. First of all, where is the museum? Is it in a busy urban environment where space is limited? In that case, the architect would employ multiple floors to maximize the space of the site. Or is it in a more open location where the architect has more options? What is the geographic location of this site? The weather and climate of the location impact the types of materials an architect might choose.

The architect next considers the function of the building, in this case a museum to exhibit art. How much gallery space is needed to display the artwork? In most museums, the exhibition space is a small part of the entire building. A museum includes many support facilities. Museums have an entrance area to greet visitors and offices for the staff. Artwork not on display needs secure storage. The museum staff needs freight elevators and a space for restoration of artwork. Many museums also have loading docks, a restaurant or snack bar, a theater, and a gift shop. Finally all buildings need public elevators and stairways, a handicap access ramp, and restrooms.

Drawing Plans and Making Models

Once the architect has gathered valuable information, he or she begins drawing plans and building models of the project. Here, mathematical precision is critical. The architect creates a floor plan for the entire structure mapping out the exact dimensions of every room, hallway, window, door, etc. In addition, the architect draws section and elevation drawings. A section drawing shows the interior of building if you cut it in half. (Imagine cutting a building in half like a cake to see all the layers.) An elevation is an exterior view of one side of the building.

Presenting to Clients

The next step for the architect is to present the design to the client. If the client approves the design, the architect prepares the final plans for construction. These plans are detailed working drawings for the construction crew that will actually build the building. Usually a general contractor is in charge of the construction of the project. The contractor supervises all of the subcontractors who do specific types of work—electrical, plumbing, etc. The architect writes a detailed list of specifications for the structure that the contractors follow. During construction the architect inspects and oversees the project to ensure the contractors are complying with all specifications. Upon completion of the structure, the architect makes one final inspection.

The Value of Teamwork

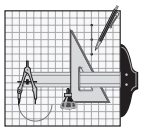
The idea for a project can be the vision of one architect, but bringing a building to life is clearly a team effort. In addition to the chief architect there are those who assist with plans and drawings, research, and measurements. There are also the contractors who build the structure, the interior designers who decorate it, and landscape designers who prepare the grounds. This collaboration results in a lasting structure that reflects the people who built it and the times in which they lived.

Your architectural team will have four or five members.* Sometimes the duties of your role require you to be the leader. Accept your responsibilities willingly. Other team members will help you with your tasks. Help your team members complete their tasks, also.

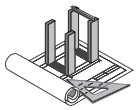
Read the description of the responsibilities for each role. Although there are specific duties described, **all** members can and should work on **any** part of the project. Try not to be too bossy, and be certain to allow **all** members of the team to contribute.

Roles

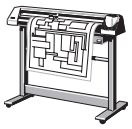
Chief Architect—Directs the project, creates structural plans for building (style and design), and keeps the team's folder. Helps the Interior Designer to complete the floor plan. Provides leadership in discussions, proofreads the tour scripts and presentation charts, and directs the final team presentation. Solves a problem and prepares an explanation.



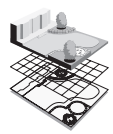
Clerk of the Work—Checks the measurements and dimensions of the model and the math presentations. Makes sure that the doors and walking areas meet the Americans with Disabilities Act (ADA) building codes. Works with General Contractor to complete the outside of the building. Solves a problem and prepares an explanation.



General Contractor—Has overall responsibility for building the model. This includes supervising the materials, the workers, and the work area when other team members are working on the model. Keeps track of the building materials including storing them safely at the end of each workday. Solves a problem and prepares an explanation.



Interior Designer—Overall responsibility for the floor plan. Works with the Chief Architect to ensure that all elements of the model are included. This includes space planning, redrawing the plans neatly, and labeling the rooms for the presentation. Solves a problem and prepares an explanation.



Landscape Designer—Responsible for the land directly around the building, including the parking areas. Works with Landscape Designers from other teams to complete the layout of the project including the main entrance and walkways. Solves a problem and prepares an explanation.

*If your team has only four members, then the Chief Architect also is the Clerk of the Work.

Your teacher will evaluate you and your team using the **Cooperative Group Work Rubric**.

COOPERATIVE GROUP WORK RUBRIC

4 — ***Exemplary***
- You *consistently* and *actively* helped your group achieve its goals by communicating well with other group members, by encouraging the group to work together, and by *willingly* accepting and completing the necessary work of your daily role.

3 — ***Expected***
- You *usually* helped your group achieve its goals by communicating with other group members, by encouraging your group to work together, and accepting and completing the necessary work of your daily role.

If your evaluation is less than *Expected*, try to use your cooperating skills more consistently.

2 — ***Nearly There***
- You *sometimes* helped your group achieve its goals.

1 — ***Incomplete***
- You *did very little* to help your group achieve its goals.

Use the **Problem-Solving Rubric** during your investigations.

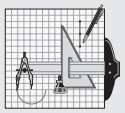
PROBLEM-SOLVING RUBRIC

4 — ***Exemplary***
- You *correctly* found the solution to this problem and *clearly* and *neatly* described your process using numbered steps and drawings.
- You also described one or more insights that helped your group to find a solution and showed your understanding of mathematics.

3 — ***Expected***
- You *correctly* found the solution to this problem and *clearly* and *neatly* described your process using numbered steps and drawings.

2 — ***Nearly There***
- You found the solution to this problem and *clearly* and *neatly* described your process using numbered steps and drawings. However, you need to correct it because of one or more of the following
  —You forgot the label or used the wrong label.
  —You made a simple computational error.
  —One of your steps is not clear and needs to be reworded.

1 — ***Incomplete***
- Your work needs to be corrected or redone because of one or more of the following:
  —You made a major error in reasoning.
  —You made a major error in computation.
  —Your work is too messy.
  —Your steps are confusing or not numbered.



Your teacher will evaluate you and your team using the **Investigations Presentation Rubric**.

INVESTIGATIONS PRESENTATION RUBRIC

4 — ***Exemplary***
- Your voice was *loud and very clear*.
- You *maintained eye contact* with your audience.
- You *effectively used* visual aids.

3 — ***Expected***
- Your voice was *loud and very clear*.
- You *made eye contact* with your audience.
- You *used visual aids*.

2 — ***Nearly There***
- Your voice *could have been louder and/or clearer*.
- You *seldom made eye contact* with your audience.
- You *did not effectively* use visual aids.

1 — ***Incomplete***
- The audience could not understand your presentation.

PROBLEM-SOLVING FORMAT

Directions

When explaining your problem-solving experience follow this format:

Part I: Read the problem carefully and determine what is being asked. (You may make a simple drawing.) Determine now what your label will be.

We are trying to find:

Our answer will be labeled:

Part II: List what you know—all the numbers you have. (This may include some you have to measure before beginning the problem solving.)

We know:

Part III: Write (in order) the steps that you followed to solve your problem. Be certain to NUMBER each step. You may use drawings to help with your explanations. Underline your answer and be certain to include your correct label.

1.

2.

3.

4.

5.

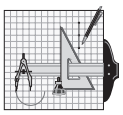
Part IV: Write down any "insights" you had while solving the problem or while determining the final answer. (This may include something you tried and discarded, or an estimation of the answer.)

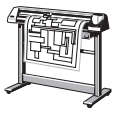
1. *We realized:*

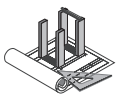
2. *We realized:*

Sample Daily Agenda

Daily Agenda	**Team** *Power of Pyramids*	**Date** *5/26/01*	
CA *Juan* **CW** *Sandy* **GC** *Kelly* **ID** *Jade* **LD** *Terry*			
Task	**Member(s)**	**due**	**done**
"Bubble" buildings—Prepare shape of the building on newsprint.	*Jade & Juan*		
Site the team's "bubble" drawing on the project board to see where it will be situated in the park.	*Terry*		
Pick a Special Area Card.	*Juan*		
Discuss what will be in the pavilion.	*ALL (led by Juan)*		
Draw straight lines to make general shape of the building.	*Jade*		
Make two footprints (copies of the general shape).	*Kelly*		
Read over and become familiar with the building code requirements of the Americans with Disabilities Act.	*Sandy*		
Clean up the work space and store the materials safely.	*Juan*		
Turn in any work that the teacher has requested.	*Kelly*		







Daily Routine for Phase 4: Construct the Project

To accomplish your best work in the most efficient manner, follow this routine every day.

1. All team members (including the **Landscape Designer**) attend a 5–10 minute meeting at the beginning of each day. During these meetings the team members tell what they did the day before and ask for feedback or help from other team members.
2. The **Chief Architect** completes the **Daily Agenda** or delegates this job to another team member.
3. The team reviews the **Daily Agenda** of the day before. Each member reports the status of their previous day's tasks. The **Chief Architect** puts a check in the "done" column for every task completed.
4. The team members add any unfinished tasks to the new **Daily Agenda**.
5. The team discusses what needs to be done in addition to the unfinished tasks. The **Chief Architect** assigns tasks to team members.

PAVILION PROJECT

Your architectural team will create a pavilion that is part of a theme park similar to a world's fair exposition. Here the general public can come to learn important information about _____.

As members of an architectural team, your goal is to plan, design, and build a model of your pavilion that will be both educational and entertaining for children and adults.

In your pavilion you must provide space to exhibit information about your topic, as well as provide an environment for visitors' comfort. You have an unlimited budget for technology. You may install state-of-the-art equipment. Your designs must exhibit your topic, _____.

Also all teams must design their pavilions to be in compliance with the Americans with Disabilities Act. All teams will have basic requirements such as restrooms, fire exits, and a presentation area. Your team will select a Special Area card and will then design an additional service area within your pavilion. This might be a snack bar, gift shop, first aid clinic, etc.

Throughout the simulation, your team will meet, make plans for the day's work, and solve problems. It will be essential that you record your problem-solving strategies and the solution to these problems because the records will be part of your final presentation.

There is a size limit for the pavilions. The project board represents the actual theme park property. If the scale is 1 inch equals 10 feet, then the project board represents a piece of property that is _____ by _____. We need to put _____ pavilions on this space. We also need space for walking, parking, and maybe a common area that the buildings are set around.

After you finish the floor plan and construction, your team will site your pavilion model on a landscaped project board. Together you will present this project and your problem-solving experiences to an audience of prospective investors.

You must follow the instructions carefully and work together cooperatively to finish the _____ Theme Park project successfully.