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An Engineering Primer for Outreach to K-4 Education

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Introduction

A technological society needs an educational system that prepares all students in subjects of science, technology, engineering, and mathematics (STEM) and that directs many students toward related careers. However, the overall performance of K-12 students in the United States is generally lower in science and mathematics than in other subjects [1,2]. The drive to improve science and mathematics education has led to changes in how these subjects are taught in the classroom. Educators are seeking new, more hands-on methods for teaching these often abstract concepts. Professional societies and individual engineers are promoting engineering content as teaching and motivational vehicles. A variety of outreach projects seek to integrate engineering into the K-12 curriculum showing practical applications of technical concepts, linkages among technical topics, and relevance of STEM concepts to everyday life, cf. [3-10]. A recent Harris Poll survey found that the public views engineers very positively and that parents would be pleased to have their children choose an engineering career, but these same adults do not consider themselves well-informed about engineering [11].

Effective science and mathematics instruction must begin in the early grades. Currently, the first general assessment of students occurs in the third grade for science and the fourth grade for mathematics in states such as Missouri [1]. These students need basic concepts and terminology. Additionally, teachers work to layer the students' understanding with detail and connectivity. Later student performance and interest depends on this foundation. Resources and outreach at middle and high school levels may be too late for some students.

The K-4 environment has special challenges. The teachers may be responsible for the range of core subjects and they often lack a background in science and mathematics. Our work with in-service K-4 teachers revealed that more level-appropriate science resources are needed and that scientific inquiry and relevance are the most difficult to teach [2,12]. Engineering professionals can fill these needs. However, K-4 students and teachers are vastly different from the university students and colleagues with whom engineers and engineering educators are accustomed to dealing. K-4 teach-

ers are experts on how their students learn but often lack a technical background. Engineers are the technical experts but often lack the understanding of how children learn.

Lessons learned by engineering faculty and students from the University of Missouri-Rolla through interaction with local, in-service K-4 teachers are described. This primer is intended for engineers who desire to begin outreach efforts in K-4 classrooms. It provides a perspective for assisting elementary education teachers, insight into the K-4 learning environment, and content sources for developing outreach programs. Science and mathematics instruction for elementary education, example lessons for elementary education, and a listing of other available resources are discussed. Every outreach situation should be tailored to local needs and objectives. Consequently, these resources are not comprehensive and do not represent the only effective approach. Effective principles are modeled that can help outreach activities meet teacher expectations and needs.

Creating Resources for Elementary Education Teachers

Outreach programs must accommodate the elementary education environment. Teachers have an educational charge that includes balancing time among content area, meeting district and state mandates, developing lessons, and teaching to student diversity. Their lessons must engage students, relate to assessment, build on previous material, and prepare for future study. Lesson time constraints are about fifteen to twenty minutes which match the approximate attention span of K-4 students. Any assistance activities and resources should be tailored to this classroom and should be guided by the teachers' expertise in child learning.

Science Content and Testing in the Elementary Grades.

Curricula standards reflect the importance of technical literacy in society. While elementary education begins with facts, terminology, and other foundational knowledge, the inclusion of advanced connecting concepts and higher-level thinking skills are also mandated. Recommended curricula are defined at both national and state levels [1,13-16]. The pressure to satisfy these standards and to pre-

Abstract

Student motivation for and proficiency in science and mathematics begin in the early grades. Level-appropriate resources and professional outreach activities are as beneficial for teachers and students at elementary levels as for higher levels. Engineering applications can be effective vehicles for giving students hands-on exposure to technical concepts and for showing students how these concepts relate to everyday life. To improve the technical literacy of society and to promote STEM-related careers, engineers should be engaged in active outreach. However, engineers who seek these types of projects have some learning to do themselves. They must understand the unique elementary education environment and the expectations for lessons and demonstrations. This paper describes the lessons learned by engineering faculty and students from the University of Missouri-Rolla through interaction with local, in-service K-4 teachers. Science and mathematics instruction for elementary education, example lessons for elementary education, and a listing of other available resources are discussed.

pare students for the associated testing tends to drive teachers' interests. Teachers may be less inclined to use resources and outreach programs that are not explicitly aligned to standards even if the topics and presentation are "neat." While extra topics can be fun, the teachers need assistance related to their curricula and they rarely have surplus class time.

State standards are based on national standards, districts develop curricula from state guidelines, and teachers develop lesson plans for their classroom using the district curricula. For example, the State of Missouri developed the Show-Me Standards, a set of curriculum standards for all Missouri public school students. Curriculum frameworks outline what "students should know" and "should be able to do" by grade level from kindergarten to twelfth grade. The Missouri Assessment Program (MAP) is the testing system used to measure student progress toward meeting standards [1] and is one means for evaluating the districts themselves. Often, elementary educators feel that text-driven instruction is ineffective for meeting state standards. They extensively tailor the curriculum at district and classroom levels. Many districts have their teachers build custom collections of lesson plans that are passed on and shared among the teaching faculty.

Science categories in Missouri are [1]:

- Science I – Scientific Inquiry, Scientific Relevance, Matter and Energy, and Force, Motion, & Mechanical Energy
- Sciences II – Universe, Earth Systems, Living Systems, and Ecology.

Engineering topics are included within the Science categories, but are not typically labeled as such. Instruction may overlap science and other subjects. Mathematical content can be related to science (and engineering) concepts, e.g. through applications problems. Social studies can include historical figures and developments in STEM areas. Communication arts can include STEM-related reading and writing assignments. Also, career education should have a technical component.

A survey of in-service K-4 teachers in Missouri indicated that more level-appropriate science resources are needed [2,12]. These teachers were more comfortable with topics like ecology and living systems than physical sciences. They regarded abstract topics such as scientific inquiry and scientific relevance as the most difficult topics for them to teach. Matter, energy, force, motion, and mechanical energy were also rated as difficult. Appropriate resources for the early grades must have simplicity and continuity in the context of the standards. Concepts must be expressed in their most simple terms, which may not be obvious to a non-teacher. Also, concepts must be reinforced and

extended with consistent instruction to maintain continuity through the grades.

The difficult physical sciences are the very topics that lend themselves to engineering applications. In particular, engineering-related resources are well suited for scientific inquiry, scientific relevance, measurements (common aspects of the "should-be-able-to-do" lists), and STEM career education. However, elementary teachers are often unclear about what engineers do. When asked if they included engineering topics in their science and mathematics lessons, a common opinion was reflected by one first-grade teacher who stated [2,12], "Not at my grade level – too confusing!"

Lesson Plans for Elementary Education.

Lesson plans for elementary education should meet the expectations of teachers and the learning characteristics of the students. Pedagogy, presentation format, presentation organization, and time restrictions are all areas that must be addressed. Ready-to-use resources have more utility for teachers who do not have time to rework partially developed ideas.

Elementary students have short attention spans and lack the maturity to adapt to the classroom. Teachers must adapt instruction to the students and reinforce learning through multiple teaching approaches. Consequently, lesson plans are multifaceted with hearing, seeing, and doing components. Activities that include these auditory, visual, and kinesthetic components can accommodate the various learning styles of students.

The Madeline Hunter "seven step" format [17,18] is a common form that illustrates key components of a complete lesson plan, see Appendix. Content in a typical lesson consists of

- the specific objectives that the lesson will cover (objectives),
- a "hook" to grab the attention of the students (set),
- the concepts or information to be presented by the teacher (input),
- a demonstration activity by the teacher (modeling behavior),
- questions to check for student comprehension (check),
- a student activity under the direct supervision of the teacher and a similar activity for independent or group work (guided and independent practice), and
- a closing summary (closure).

Often, specific state standards are referenced, e.g. in the objectives components, to assist teachers in managing their curriculum. Also, materials lists and background resources can be included. The availability of the supplemental background material allows the teacher to alter the lesson more easily and to better answer student questions. This model is

recommended when the learning objectives are knowledge, comprehension, and application. Other lesson models are needed to guide open-ended experiences such as those emphasizing creative thinking.

A lesson plan must carefully choose level-appropriate terms. For example, one would not talk about light being “transmitted” to first graders. One would talk about light “going through” an object like a window pane. Additional vocabulary can be added as the students progress through the grades. Also, terminology as used on assessments, if known, can be stressed.

A lesson plan should address only one, focused concept. For example, an objective may be to convey the formation of shadows by the sun. Young students could become confused if this objective was taught in just one lesson. First, the students need to understand how shadows are formed. Then they can learn how the position of the sun affects the length and position of shadows. Such a sequence of lessons can be part of a thematic unit, perhaps over the course of a week. Through related lessons, students gain reinforcement for and connections among ideas. Also, short lessons better match the attention span of the target student audience.

Districts and teachers are particularly interested in resources that can be easily adapted to different grade levels. For example, a first-grader learns that, if the sun is behind him, his shadow is in front of him. A third-grader takes data on shadow length and position and uses it to predict the time of day. New modules, added detail, etc. build a continuity in scientific learning [2,12].

Demonstrations for Elementary Education.

Demonstrations form an integral part of a science lesson as activities presented by teachers or as hands-on activities for students. Engineering, as the application of science and mathematics, can give students a physical illustration of abstract concepts and can help student associate learning with their everyday lives. In particular, engineering-based demonstrations can give direct examples for the scientific relevance category of standards and can support other standards with regard to measurements and the use of tools.

The development of physical activities is a key outreach avenue. A clear match exists between the needs of teachers and the capabilities of engineers. Teachers are experts on student learning and are adept at developing content lessons. However, they are often limited to demonstrations that they themselves can build or that they have time to build. Engineers can provide valuable, complex activities and devices to supplement lessons.

Again, demonstrations for elementary educa-

tion classrooms should be consistent with teacher input, student characteristics, and standards. Paramount practical considerations are set-up time, take-down time, and storage. Teachers, especially those at the elementary level, must move quickly to keep their students’ attention. However, time restrictions may be less important in summer-camp settings than in the regular classroom.

Example Lessons: Engineering My Town Project

Two example lesson plans are given to illustrate the development concepts and the outline format. Design elements include the incorporation of multiple learning approaches (auditory, visual, and kinesthetic components) and the use of a progressive lesson format (in the second lesson). The topic of measurement was chosen because it is used in nearly all forms of technical endeavor. The topic of scientific careers was chosen because there are few age-appropriate resources available to elementary teachers on this topic. The outline format is not intended to be the recommended template for lesson construction, merely a guide for typical organization. Teachers are familiar with this format or similar formats.

The example lesson plans were developed for the NSF-sponsored Engineering My Town Project [12,19]. They were evaluated by in-service teachers and regarded as among the most useful in the project. The teachers were particularly interested in topics related to scientific inquiry and relevance and in sets of lessons that formed thematic units. Teacher preferences varied with regard to lesson plan organization. Some teachers wanted a simple outline of the lesson (as given here) while other teachers wanted a scripted format. Most teachers wanted a lesson plan with detail between the two extremes. Regardless, the teachers would customize any lesson plan to their classroom environment and teaching style. The inclusion of content such as material lists, worksheets, activity sheets, and background material was useful supplemental material.

Qualitative and Quantitative Descriptions Lesson Plan.

The lesson plan for Qualitative and Quantitative Descriptions was the first part of the three-unit thematic set on Relative Position and Measurement [12]. The other lessons dealt with types of maps, and the use of maps. While some lesson plans may have a more detailed script than this presentation, the length and the conceptual level are representative for elementary education.

A useful supplement is a list of materials. Providing such a list at the beginning helps the teachers to plan their day and to check their readiness before instruction starts.

“Materials: ruler, tape measure”

The “set” component of the lesson plan is the approach used to grab the attention of the students and to help them start thinking about the target concept.

“Set: Have the students describe their position relative to the teacher.”

The “objectives” component of the lesson plan defines the educational expectations. Objectives should reflect either district or state curriculum objectives. The objectives in this lesson correspond to Missouri state standards as described in the curriculum frameworks published by the Missouri Department of Elementary and Secondary Education. The first objective is a second-grade level objective in the Relative Force, Motion, and Mechanical Energy category. The second objective is a second-grade level objective from the Scientific Inquiry category [1].

“Objectives:

1. Understand how an object’s position can be described relative to another object.
2. Understand that position (or other properties) of an object can be described both qualitatively and quantitatively.”

The “input” component provides the explicit lesson concepts and may include information on presentation method. The wording must be at a level appropriate for the targeted students. This aspect of the lesson is the auditory or “hearing” instruction.

“Input:

1. Explain the difference between qualitative and quantitative descriptions of position.

Qualitative: Describes a characteristic that is not numerical. Words such as far from, close to, near, behind, in front of, and beside are examples of qualitative descriptions of position.

Quantitative: Describes a measured characteristic. It is a numerical quantity.

Examples:

<u>Qualitative</u>	<u>Quantitative</u>
Mary is standing near me.	Mary is standing two feet from me.
My home is far away.	My home is five miles away.
The pencil is close to the book.	The pencil is two inches from the book.

2. Explain that qualitative phrases and words such as to the left of, to the right of, under, and over are matters of perspective. Have two students face each other and place a book beside them. The

book will be to the left of one student and to the right of the other student.”

The “modeling behavior” component contains a activity in which the teacher demonstrates the concept. This aspect of the lesson is the visual or “seeing” instruction.

“Modeling Behavior:

Write a sentence on the board that expresses a qualitative description of relative position (e.g. My desk is far from the door.)

Measure the distance from the desk to the door with a tape measure and write a sentence on the board that expresses a quantitative description of the relative position of the desk to the door (e.g. My desk is 8 feet and 4 inches from the door.)”

Before proceeding with the lesson, the teacher must determine if the students have comprehended the material. The “check comprehension” component may include pertinent questions for the students.

“Check Comprehension:

1. How can we describe the position of an object relative to another object qualitatively?
2. How can we describe the position of an object relative to another object quantitatively?”

The “guided practice” component is an exercise or activity in which the students work under the close supervision of the teacher. This aspect of the lesson is a kinesthetic or “doing” instruction.

“Guided Practice:

The teacher arranges several objects on a table or the floor. The students then write sentences that express the position of the objects first qualitatively then quantitatively.”

Examples:

<u>Qualitative</u>	<u>Quantitative</u>
The pencil is close to the book.	The pencil is four inches from the book.
The block is beside the book.	The block is two inches from the book.
The cup is far from the pencil.	The cup is 20 inches from the pencil.

Now the students are ready for an exercise or activity in which the concepts are reinforced. This “independent practice” component should be similar to the one developed for guided practice and may be done by the students as individuals or as groups. This aspect of the lesson is additional kinesthetic or “doing” instruction.

“Independent Practice:

1. The students then write sentences that express the relative positions of the objects around the room, first qualitatively then quantitatively.
2. The students then share their discoveries by presenting them to the class.”

The “closure” component is the conclusion to the lesson. The concepts in the lesson should be summarized and reinforced.

“Closure:

Today we looked at how the position of an object can be described qualitatively by words like far from, close to, near, behind, in front of, and beside. Some qualitative words such as to the left of, to the right of, under, and over mean different things depending on one’s position. We also measured distances to find quantitative descriptions of the positions of

objects.”

A comprehensive, easy-to-read background section can be included with each lesson plan or thematic set to facilitate customization by the teachers. Also, a lesson plan may be chosen for use across grade levels so that students will see similar content and instruction repeatedly and can build vocabulary and understanding progressively. Level-related notes and alternatives can be included in selected lesson components, e.g. the guided and independent practice components, can provide flexibility and continuity in instruction.

Careers in Science and Engineering Lesson Plan.

The lesson plan for a Guest Speaker was the first part of the three-unit thematic set on Careers in Science and Engineering [12]. Figure 1 shows








	<p><u>Materials</u> guest speaker from the community drawing paper and crayons (younger students)</p>
	<p><u>Set</u> Ask the students to list jobs in the immediate community such as scientists, engineers, doctors, nurses, dentists, veterinarians, lab technicians, nutritionists, conservation agents, computer technicians, etc. which use science and technology.</p>
	<p><u>Objectives</u> 1. Understand that everyone can do scientific activities. 2. Understand how science and technology will impact most career fields.</p>
	<p><u>Input</u> 1. Discuss the types of technology a person might use in his job (e.g., computers, cellular phones, and electronic testing equipment such as automotive diagnostic systems) 2. Have guest speaker from the community come and talk to the students about their job.</p>
	<p><u>Check Comprehension</u> 1. What types of technology did the guest use in his job? 2. How did the guest use science in his job? 3. How does what they do affect our lives? 4. How would you become a <u>(guest’s occupation)</u> ?</p>
	<p><u>Guided Practice</u> Write on the board the answers by students to the check comprehension questions. This list will help the older students as they write their paragraph.</p>
	<p><u>Independent Practice</u> Older Students: The students write a short paragraph summary of what they learned about the guest speaker’s job. Younger Students: The students draw a picture showing what they learned about the guest speaker’s job.</p>

Figure 1. Sample Lesson Plan Format

Careers in Science: Playground Swing Set	
Instructions: Match each scientific or engineering career with a role in the construction of a playground swing set. Draw a line between the career and the correct role.	
Career	Role
Chemist	Design the assembly line in the factory where the swing set was built.
Mechanical Engineer	Design the metal alloys from which the frame and chains are constructed.
Civil Engineer	Design the paint on the swing.
Electrical Engineer	Design the layout of the playground including the position of the swing set.
Manufacturing Engineer	Design the electrical motors which cut the metal and plastic parts of the swing.
Metallurgist	Design the shape and structure of the swing set.

Figure 2. Sample Careers Worksheet

this lesson plan. Note that no examples or demonstrations, i.e. a modeling behavior component, were used in this lesson plan. The other lessons dealt with researching a career and with types of STEM careers. Figure 2 shows a sample worksheet associated with types of careers lesson plan. This activity relates various STEM careers to a playground swing.

content are given in Table 1 and Table 2. A particularly useful reference in Table 1 is that for the ASEE Annual Conference which includes papers on pre-college outreach experiences by engineers. The maintenance of these resources depends on feedback and evaluation from users and on support from the members of the sponsoring organizations. Professional organizations that do not have outreach activities should be encouraged to do so.

Selections of Available Resources in Engineering and Science

Outreach may take many forms. Depending on teacher needs, engineers can provide new lesson plans, demonstrations, background resources, or simply time. The environment may be the classroom, a field trip, science fair activities, summer camps, etc. An important step in developing programs for elementary education is to find out what is already available. The teachers may not be aware of what is available or may not have the time to search for it. Also, they are often limited to what they themselves can build in order to demonstrate concepts. Engineers may find that the existing resources apply for their outreach directly or serve as inspiration for dedicated development.

Many engineering-related organizations maintain websites containing science resources for teachers. (The teaching community has additional science resources, cf. National Science Teachers Association [20].) This material is typically for all ages with much of the material directed at the secondary rather than the elementary level. Summaries of some websites with elementary-education

Summary

Engineering outreach to the K-4 grades can promote learning toward technical literacy and STEM-related careers. Engineers and engineering-related resources can address the needs for level-appropriate science instruction, for hands-on learning options, and for difficult scientific relevance and measurement proficiencies. To contribute science resources and other outreach for the elementary school classroom effectively, engineers should prepare for this new environment. This primer discusses mandated standards for curricula, learning by elementary students, expectations for the classroom, and a selection of available resources.

Outreach efforts should strive to build a supporting partnership with K-4 teachers and to tailor activities for long-term benefits. While the engineers may be the experts on technical subjects, the K-4 teachers are experts on teaching to young children and on the needs in their local classrooms. The desired benefits are improvements in student motivation for and proficiency with science and mathematics. Engineering resources as physical

Table 1. Selected K-4 Resources from Private Sources, 2004

Institute for Electrical and Electronics Engineers (IEEE)	http://www.ieee.org/
<i>IEEE Pre-College Education</i> http://www.ieee.org/organizations/eab/precollege/ - listing of extracurricular programs and projects, links to sites with lesson plans	
American Society of Civil Engineers (ASCE)	http://www.asce.org/
<i>Kids and Careers</i> http://www.asce.org/kids - Career information and activities using simple structures	
American Society for Engineering Education (ASEE)	http://www.asee.org/
<i>ASEE EngineeringK12 Center</i> http://www.engineeringk12.org/ - Data on outreach programs, career guidance materials, readings and links to sites which have lesson plans and other information on engineering education <i>Engineering Your Future</i> http://www.asce.org/precollege/ - Information on famous engineers and common questions about engineering, articles, questionnaire to assess whether engineering is a viable career choice <i>Database of ASEE Proceedings Papers 1996-Present</i> http://www.asee.org/conferences/#proceedings/ - Searchable database of papers published on engineering education including pre-college from the ASEE Annual Conferences	
American Association for the Advancement of Science (AAAS)	http://www.aaas.org/
<i>Project 2061</i> http://www.project2061.org/ - Resources available to order, evaluation of common textbooks, and articles on research in teaching and learning, testing, and learning goals	
Optical Society of America (OSA)	http://www.osa.org/
<i>Optics For Kids</i> http://opticsforkids.org/ or www.optics4kids.org/ - Lesson plans, background resources, and educational articles	
Eisenhower National Clearinghouse for Mathematics and Science Education	http://www.enc.org/
<i>ENC</i> - Web links to sites containing lesson plans and activities arranged by math or science topic, professional development information, articles	

Table 2. Selected K-4 Resources from Government Sources, 2004

The City of New York	http://citytechnology.cuny.cuny.edu/
<i>"The Stuff that Works" Curriculum Guides</i> - Guides and classroom-tested activities available to order for a fee <i>City Technology</i> - Outlines for hands-on workshops and web-based forums for teachers	
National Aeronautics and Space Administration (NASA)	http://www.nasa.gov/
<i>NASA Explorers</i> http://www.nasaeexplorers.com/ - Lesson plans for K-4, 5-8, and 9-12 on current aerospace and space topics <i>NASA Kids Science News Network</i> http://ksnn.larc.nasa.gov/home.html - Web- and video-based program using an inquiry format for K-5 <i>NASA SpaceLink</i> http://spacelink.nasa.gov/Instructional_Materials/ - On-line guides, photographs, images, activities, etc. <i>Central Operation of Resources for Educators (CORE)</i> http://core.nasa.gov/ - Distribution center for NASA's educational multimedia (minimal fees apply)	
Department of Energy (DOE)	http://www.doe.gov/
<i>Atmospheric Radiation Measurement (ARM) Education and Outreach</i> http://education.arm.gov/ - Lesson plans for K-12 on weather and climate <i>Project YOTO Drifters</i> http://drifters.doe.gov/ - Activities, materials, images, and data related to ocean drifting buoys <i>Energy Efficiency and Renewable Energy</i> http://www.eere.energy.gov/education/ - Links related to energy resources and Dr. E's Energy Lab	
National Oceanic and Atmospheric Administration (NOAA)	http://www.noaa.gov/
<i>National Weather Service's Weather Education</i> http://www.education.noaa.gov/ - Weather related resources including lesson plans, coloring books, etc. <i>Jet Stream</i> http://www.srh.noaa.gov/jetstream/ - On-line weather school with experiments and lessons <i>NOAA Photo Gallery</i> http://www.photolib.noaa.gov/ - Photographs of weather phenomenon, shores, and marine animals	
Environmental Protection Agency (EPA)	http://www.epa.gov/
<i>SunWise School Program</i> http://www.epa.gov/sunwise/ - SunWise School Activities and toolkit for sun-related activities	
National Science Foundation (NSF)	http://www.nsf.gov/
<i>Just For Kids</i> http://www.nsf.gov/od/lpa/events/justforkids.htm - Find Out Why and Hands On sections include science activities and resources	

and often everyday applications are potential tools in the demystifying of these concepts for young students. Clear standards and assessment measures in pre-college education are available to guide the engineer in the classroom.

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Appendix: Modified Madeline Hunter Lesson Plan Format

Lesson plans for elementary school students can be organized using an outline method based on the Madeline Hunter Model [17,18]. Note that all steps may not be relevant to a given lesson plan. This approach contains the main components as shown in Figure 3. A materials list is included in the seven components of the format. Also, the following additional components can be added.

Supplemental Aids

Worksheets to check comprehension and/or activity sheets to provided practice.

Background Material

Detailed discussion of concepts and lists of references.








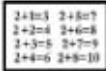

	<p><u>Materials</u> List of items needed to conduct the lesson and related activities.</p>
	<p><u>Set</u> The teacher presents a “hook,” that is actions or statements that get the students’ attention, defines the scope of the lesson, and/or illustrates the concepts.</p>
	<p><u>Objectives</u> The teacher must have clear, specific objectives as to what the students should be able to know and to do as a result of the lesson. References to state standards are useful.</p>
	<p><u>Input</u> The teacher must present the concepts by some method such as lecture, graphics, etc.</p>
	<p><u>Modeling Behavior</u> The teacher uses the concepts in examples and demonstrations.</p>
	<p><u>Check Comprehension</u> The teacher tests the students informally or formally for understanding and repeats instruction in the concepts as necessary.</p>
	<p><u>Guided Practice</u> The teacher guides the students in exercises or activities that reinforce their learning</p>
	<p><u>Independent Practice</u> The teacher assigns further exercises or activities to be done as individual or group work.</p>
	<p><u>Closure</u> The teacher should summarize and reinforce the concepts.</p>

Figure 1. Guest Speaker Lesson Plan

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