

Materials List

Printed materials. Textbooks, *Engineer's Notebooks* and Teacher Guides for this course are available from Key Curriculum Press. We recommend that you purchase one textbook and one set of all four *Engineer's Notebooks* for each student. Students are expected to write in their *Engineer's Notebooks*, so new ones need to be purchased yearly. Textbooks may be used again in subsequent years. However, in any given year each student should have a textbook so that he or she can take their textbooks home. In subsequent years only the *Engineer's Notebooks* will need to be replaced. You can find current prices and ordering information at www.keypress.com/etf.

Supplies and equipment. The cost of supplies and equipment—which need to be purchased in addition to the books—is a little more difficult to calculate; it depends on what is already available and the cost of local materials. Initially you will need to purchase one set of durable equipment, which can be used for any number of classes, provided they are not taught at the same time. Additional consumable materials will need to be purchased for additional classes. In subsequent years, only consumable materials need to be replaced, as well as any durable items that may have been lost or damaged.

Kits. Information on where kits can be purchased will also be available via the web at www.keypress.com/etf.

If you are assembling your own kits, you'll find that suggested items and vendors are listed, but many of the items may be in your storage room, or found at lower costs from other sources. The only case in which there is a single source is the electricity Snap Circuits™ kits from Elenco Electronics Inc.

Many items come in bulk or may be purchased at a lower price in bulk. Be sure to ask vendors if they give educational discounts. For some projects, the students may want to bring in their own materials as part of their design research. Optional items are indicated in the "Amount" column. If the item is not marked "optional," the student needs to do the activities in the *Engineer's Notebook*.

The lists are organized by project. When a piece of equipment is used in several tasks, it appears just once, for the first instance in which it is needed. A sufficient quantity will be listed so that there will be enough for later tasks.

This list is still in development, so items may be changed/improved/removed. All suggestions are welcome! Send suggestions to editorial@keypress.com.

Check the following web site for updates: www.keypress.com/etf.

Tools and General Supplies

In some schools students have access to a prototype lab or wood shop with a variety of hand tools and power tools, along with safety instruction and supervision provided by an experienced teacher. However, if facilities and expertise are not available, students can still have an excellent experience building scale models and prototypes using the materials listed below.

Most of the work in this course will be done in groups of four students. A convenient method is to assemble a tool box for each group, and place 1/4" plywood on the tables for cutting and gluing. The plywood sheets are especially important in science labs or other classrooms that are not normally used for construction projects. Following is a set of recommended tools and supplies.

Toolbox for Every Group of 3–5 Students—Durable Equipment

Amount	Durable Equipment	Source
1	plastic tool box	hardware store
1	hammer	hardware store
1	set of screwdrivers	hardware store
1	pair of pliers	hardware store
1	pair of leather gloves	hardware store
2	squeeze clamps	hardware store
4	retractable utility knives	office supply
1	stapler	office supply
1	glue gun	office supply
4	rulers	office supply
2	pairs of scissors	office supply
optional: 1	steel measuring tape	office supply
optional: 1	spring scale that measures in ounces and grams	office supply
optional: 1	T-square, right triangle	office supply
Amount	Consumable Supplies	Source
1	package assorted sandpaper	hardware store
1	package assorted nails	hardware store
1	package assorted screws	hardware store
1	package glue sticks (glue gun)	office supply
1	roll transparent tape	office supply
1	roll masking tape	office supply
4	pencils	office supply
1	package assorted elastic bands	office supply

General Supplies for the Classroom

Amount	Durable Equipment	Source
32	safety goggles or glasses	science supply
8	meter sticks or yard sticks	hardware store
16	sheets of 1/4" × 2' × 2' plywood or wallboard as cutting surface for each student station	hardware store
1	electric hand drill, variable speed, and set of drill bits	hardware store
1	saw for straight cuts	hardware store
1	coping saw or jig saw	hardware store
2	vise grips	hardware store
16	simple calculators	office supply
Amount	Consumable Supplies	Source
1	large newsprint pad or roll of butcher paper	office supply
8	sets of colored felt markers	office supply
32	sets of colored pencils	office supply
	paper towels or rags	grocery store
	extra materials to occasionally stock the tool boxes	office supply

Project 1.0: Design the Best Organizer in the World

In Task 1.2 all students will make a cell phone holder from manila folders and masking tape. In Task 1.3 they will learn to make drawings using both quad-ruled and isometric graph paper. In Task 1.8 your students will make scale models of their organizers. These can be made from corrugated cardboard using recycled boxes or purchased from an art supply store. Alternatively, the students can use foam core. While foam core is a little more expensive than cardboard, it can be cleanly cut, bent, and assembled into a very attractive scale model.

You will need to plan ahead for Task 1.9, in which your students will build prototypes of their organizers. Most teachers have students make these from wood, using inexpensive pine boards and plywood. However, a few teachers have encouraged their students to use a wide variety of materials, such as fabric or plastic. Choose materials that can be cut and assembled in your workspace with the available tools. Be prepared to tell your students what materials they will have to work with by the time they start designing, in Task 1.4.

Durable Equipment for Several Classes

Amount	Equipment and Supplies	Source
50	simple blocks for drawing	toy store
optional: 1 set	density cubes	Science Kit**
optional: 1 set	equal mass cube set	Science Kit**

Consumable Supplies for a Class of 32 Students

Amount	Equipment and Supplies	Source
32	manila file folders	office supply store
100 sheets	isometric graph paper	art supply or online*
100 sheets	quad-ruled graph paper	art supply or online*
20 – 16" × 20" sheets	foam core or recycled cardboard	art supply store
optional	other building materials as needed: 8 – 1" × 6" × 8' pine or fir, clear, for building organizers 8 – 1/4" × 2' × 2' plywood for building organizers	lumber yard

* Graph paper can be purchased from some art supply stores or graphic supply stores. However, you may be able to download a template from a number of web sites and then copy the template for your students.

** Science Kit and Boreal Laboratories—www.sciencekit.com.

Project 2.0: Design a Building of the Future

Durable Equipment for Several Classes

Amount	Equipment and Supplies	Source
1	analog bathroom scale	department store
8	set of weights or 2-liter soda bottle	Science Kit or grocery
1 – 5" × 7" sheet	aluminum for crusher	hardware store
3 – 2" × 4" × 8'	pine or clear fir board for crusher	lumber yard
2 – 9" long	steel angle for crusher	hardware store
as needed	nuts, bolts, and washers for crusher	hardware store
8	light bulbs and sockets	hardware store
1 sheet	temperature-sensitive, liquid crystal, sheet (cut into 8 pieces)	Science Kit

Consumable Supplies for a Class of 32 Students

Amount	Equipment and Supplies	Source
4 boxes of 250	straight drinking straws	grocery store
20 – 16" × 20" sheets	foam core or corrugated cardboard	art supply store
5 boxes of 100	paper clips	office supply store
500 sheets (1 ream)	notebook paper or copy paper	office supply store
1 roll	kite string	sports store
16	cardboard rolls from paper towels	home
8	sheets of construction paper	art supply store
8	plastic produce bags	grocery store
1	8 lbs. of Portland cement	hardware store
1	8 lbs. of fine to medium sand	hardware store
1	8 lbs. of aggregate (gravel)	hardware store
2 – 6 ft. tubes	1/2" diam. pipe insulation (cut to 3")	hardware store
32	plastic cups for mixing cement	grocery store
32	plastic spoons for stirring concrete	grocery store
8	cardboard boxes	grocery store
16	overhead transparencies (windows)	office supply store
8	variety of insulating materials	hardware store
optional: 1–8	measuring cups or 500 ml graduated cylinders	chem. supply

For the final project, Task 2.9, in which students build a scale model of a building of the future, use materials left over from the previous projects: cardboard or foam core, overhead transparencies for windows, etc.

Project 3.0: Improve a Patented Boat Design

Durable Equipment for Several Classes

Amount	Equipment and Supplies	Source
1 – 4	commercial putt-putt boats	Buzzboats*
4	boat test channels (wallpaper tray or circular planter saucer)	hardware store
16	10cc syringes (small syringe with labeled measurements)	McMaster**
16	50cc syringes (large syringe with labeled measurements)	McMaster**
32	female quick-turn (luer) syringe caps	McMaster**
32	female quick-turn (luer) × 1/8" twist lock fittings	McMaster**
12 ft.	1/4" I.D. tubing	McMaster**
16	1/8" × 1/8" × 1/8" Barbed Tees, clear polycarbonate	Ark-Plas***
32	1/8" × 1/8" barbed checks (one-way) valve, silicone/ polycarbonate	Ark-Plas***
1	1" × 6" × 8' pine wood for hull press	hardware store
1 bottle	nail polish remover (acetone)	drug store
2	500 ml Pyrex™ beakers or other glass containers	chem. supply
1	clothes pin or squeeze clamp	grocery store
1	immersion heating coil or hot plate	chem. supply
4	drinking birds	Science Kit****
1	water rocket	toy store

* Buzzboats—www.buzzboats.com/poppop.htm.

** McMaster-Carr—<http://www.mcmaster.com>.

*** Ark-Plas—<http://www.ark-plas.com>.

**** Science Kit and Boreal Laboratories—<http://www.sciencekit.com>.

Consumable Supplies for a Class of 32 Students

Amount	Equipment and Supplies	Source
4 packages	matches/lighters	grocery store
4 packages	birthday candles	grocery store
12 – 48	tea lights	grocery store
32	empty soda cans cut into 2" × 8" strips (or 1 coil 0.005" thick aluminum shim stock 6" × 100" [cut into 50 strips 2" × 6"])	recycling or McMaster**
32	empty 1/2 gallon juice cartons (or 1 box of 24 poly file folders [makes 48 boat hulls])	recycling or office supply
8 packages	5-minute epoxy—Loctite	hardware store
8 tubes	GE 100% Silicone II Adhesive/Sealant	hardware store
2 pkg. of 100	clear flexible straws (~1/4" dia.)	grocery store
1 box	disposable polyvinyl (or nitrile) gloves (not latex)	hardware store
1 box	toothpicks	grocery store
1 package	thumbtacks	office supply
1 pkg. 24	9" balloons (1 bag)	grocery store
	aluminum sheets (pie pans) for hull (or qty 1 0.010" formable aluminum sheet 6" × 24" [makes 4 hulls per sheet])	grocery store or McMaster**
1 16 oz. bottle	liquid soap with visible particles in suspension	drug store
1 pkg. of 100	stirrer straws (~1/8" dia.)	grocery store
	Leftover materials from previous activities	

Project 4.0: Electricity and Communication Systems

In Project 4.0 students use a customized kit of Snap Circuits™ available from Science Kit and Boreal Laboratories, <http://www.sciencekit.com> organized as follows:

- 1) **Student Kits** include all of the materials needed for every four students.
- 2) **A Teacher Kit** includes the materials in a Student Kit, plus extra parts to replace lost or damaged components, as well as additional durable materials.

Student Kits (for every four students)

Each student kit will be broken down into three smaller boxes. Two of the boxes will be for teams of two students each. For Task 4.1 and many of the other activities the students will be using just these materials. The third box includes a number of other parts for tasks that involve groups of four students. Following is a list of parts included in each of the three boxes.

Boxes 1 and 2 will each contain the following parts for pairs of students:

Durable Kit Parts for Groups of Two Students

Durable Components	Elenco #	Number in Student Kit
battery holder	6SCB1	2
slide switch S1	6SCS1	2
single snap conductor	6SC01	7
conductor with 2 snaps	6SC02	6
conductor with 3 snaps	6SC03	6
conductor with 4 snaps	6SC04	1
conductor with 5 snaps	6SC05	1
conductor with 7 snaps	6SC07	1
light bulb 2.5V/0.3A	6SCL1B	3
2.5V lamp socket	6SCL1	3
jumper red	6SCJ2	1
jumper black	6SCJ1	1
resistor 10 ohms		1
resistor 100ohms	6SCR1	2
photosensitive resistor	6SCRP	1
7-segment LED display	6SCD7	1
adjustable resistor	6SCRV	2
capacitor 470uF	6SCC5	1
red LED	6SCD1	1
green LED	6SCD2	1
analog meter	6SCM2	1

motor	6SCM1	1
fan blade	6SCM1F	1
power amplifier IC	6SCU4	1
base grid	6SCBG	1
alligator clip, red		1
alligator clip, red		1

Box 3 in the Student Kit will contain the following parts for groups of four students:

Durable Components	Elenco #	Number in Student Kit
FM module	6SCFM	1
speaker	6SCSP	1
microphone	6SCX1	1
solar cell B2	6SCB2	1
two-spring socket	6SC?1	1
electromagnet	6SCM3	1
magnet		1
hand-crank generator		1
multimeter	9M105	1

Teacher Kit

The Teacher Kit will include one four-student kit, plus the following durable equipment and supplies.

Amount	Durable Equipment and Supplies	Source
1	Hula Hoop	toy store
16	copper nails	hardware store
16	galvanized (zinc coated) nails	hardware store
8	magnifier (10x or greater)	school supply
1	TV remote-control device	home
2 – 5	various designs of flashlights	home or hardware store
optional: 1– 16	ping pong balls	toy store
optional: 1– 16 of each	blue LEDs, red LEDs and green LEDs	hardware store

Consumable Supplies for a Class of 32 Students

Amount	Consumable Equipment and Supplies	Source
40	batteries AA (4 for each student kit + extra)	hardware store
8	lemons	grocery store
1	ball of steel wool	hardware store
8 oz.	salt	grocery store