Observatory: The Environment, **Second Year of Secondary Cycle Two**
Teacher's Guide B

TECH LABS

Overview chart

This overview of the tech labs provides a variety of information. The first column in the chart contains the lab number and, in parentheses, the number of the relevant student book chapter. The second column contains the title of the lab and, in parentheses, the lab type (technique, observation, experiment, technological analysis or modelling). Concepts related to the lab appear in the third column. The fourth column indicates the source program or programs for the lab content: ST for Science and Technology, EST for Environmental Science and Technology and AST for Applied Science and Technology. Finally, the last column contains a list of the materials for each lab.

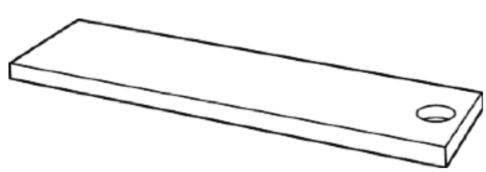
Lab number (Student book chapter)	Lab title (Type of lab)	Concept	Programs	Materials
TECH 1 (Chapter 12)	Constraints and deformations (Observation)	Constraints (deflection, shearing)	ST EST AST	• strip of iron (about 126 mm × 20 mm × 2 mm) with a hole drilled through the centre, 1 cm from one end • strip of polypropylene (about 126 mm × 20 mm × 2 mm) with a hole drilled through the centre, 1 cm from one end • 3 strips of wood (tongue depressors) each with a hole drilled through the centre, 1 cm from one end • bar clamp (12.5 cm × 2 cm) • universal clamp • ruler • retort stand • 1000-g weight with hook

NOTE TO TEACHERS OR LAB TECHNICIANS

– For the strips of iron, you can use electrodes.

– **Part A: Compression**
- This lab was tested with a 12.5 cm × 2 cm bar clamp. (The same procedure can be performed with a vise or a C-clamp.)
- Make sure you tell students to compress the strip downward. Samples compressed upward have been known to fly into the air.
- To reduce lab expenses, you can compress a single strip of iron in a demonstration. Once compressed, it is difficult to return an iron strip to its original shape.

– **Part C: Deflection**
Before the lab, drill a hole in one end of each sample so that the weight can be hung from it. The hole should be 1 cm from the end of the strip and centred across its width. For the weight used in this lab, we used a 4.36-mm (5/32-inch) drill bit to bore the holes.



– It is best to use specialized machines for tension tests. Lab tests were conducted with equipment typically available in high schools, but the results were inconclusive. For this reason, this lab does not include a test for tension.

– To demonstrate shearing, you can prepare demonstration samples. This will prevent students from wasting materials and damaging scissors. You can expect the following results (with an ordinary pair of scissors):
- iron: small marks on the sample (plastic deformation)
- polypropylene: grooves in the sample (plastic deformation). However, if great force is applied, fracture may result.
- wood: deep grooves in the sample (plastic deformation) and, occasionally, fracture if great force is applied (and depending on the wood samples)

– The various parts of this lab may be set up at different workstations. Students form teams and take approximately 15 minutes to complete a workstation procedure. Then, they move on to the next workstation to do another part of the lab.

Lab number (Student book chapter)	Lab title (Type of lab)	Concept	Programs	Materials
TECH 2 (Chapter 12)	The modification of properties (Experiment)	Modification of properties (degradation, protection)	ST EST AST	• piece of wood (at least 25 mm × 125 mm) • 2 universal clamps • 2 retort stands • ruler • 1000-g weight • 500-g weight • piece of low-density fibreboard (at least 25 mm × 125 mm) • plastic container (with lid), filled with water

NOTE TO TEACHERS OR LAB TECHNICIANS

– Suggestions for test materials:
  • wood: stirring sticks or tongue depressors
  • low-density fibreboard: particleboard.

– The samples should be identical in size.

– To soak the samples, have students bring in large containers (yogurt, spaghetti sauce, ice cream) with the lids. Students must make sure to fill their containers to the brim with water to prevent the samples from floating.

– To speed up this experiment, you can also presoak the samples of wood and fibreboard for a week. In this case, inform students that all samples were soaked for the same length of time.

Lab number (Student book chapter)	Lab title (Type of lab)	Concept	Programs	Materials
TECH 3 (Chapter 12)	Types and properties of plastics (Observation)	Types and properties of plastics (thermoplastics and thermosetting plastics)	ST EST AST	• linear heat table for bending plastic • sample of each of the following plastics: – acrylic – polystyrene (PS) – polyvinyl chloride (PVC) – phenolic C – polypropylene (PP) – high-density polyethylene (HDPE) – phenolic G10 – polyethylene terephthalate (PETE) • yogurt container lid • CD jewel case • frozen food container • melamine plate

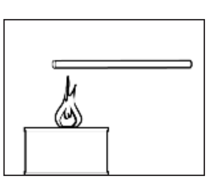
NOTE TO TEACHERS OR LAB TECHNICIANS

– The objects suggested for this lab are examples. Students may bring in other objects, except articles made of plastic foam, such as meat trays or polystyrene foam insulation panels.

– To prepare the samples of known plastics, it is best to use pieces of identical dimensions. A number of suppliers sell plastic in 600 mm × 600 mm pieces. Simply cut these sheets into smaller pieces with a retractable utility knife. This lab was tested with strips measuring 30 mm × 150 mm × 2 mm.

– To cut thermosetting plastics, use a carbide-tipped blade. We strongly recommend that you wear safety glasses and a mask.

– If you do not have a linear heat table for bending plastic, you may use the following procedure:
  1. Heat one end of a glass stirring rod over an alcohol burner for 45 seconds.
  2. Place the hot end of the glass stirring rod perpendicularly across the width of the plastic sample.
  3. Try to lift the longer end of the sample to form a 90° angle.
    • If the plastic softens, it is a thermoplastic.
    • If the plastic remains rigid, it is a thermosetting plastic.

1.


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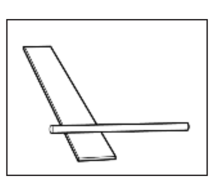

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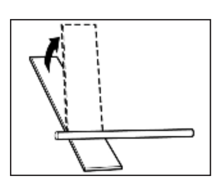


Lab number (Student book chapter)	Lab title (Type of lab)	Concept	Programs	Materials
TECH 4 (Chapter 12)	General arrangement drawings (Observation)	Multiview orthogonal projection (general arrangement drawing)	EST AST	• 8 white wooden blocks • 4 black wooden blocks • 2 pieces of black wooden quarter round • checkerboard

NOTE TO TEACHERS OR LAB TECHNICIANS

– To make the blocks, use pieces of wood measuring 254 mm × 254 mm (10 inches × 10 inches). For each team of students, cut 12 blocks measuring 19 mm × 19 mm × 19 mm. Also cut two 19-mm pieces of 19-mm (3/4-inch) quarter round. Paint eight blocks white, and paint four blocks and the two pieces of quarter round black.
– For each team, prepare a checkerboard base of 20 mm × 20 mm squares (see Transparency Tech 4.1). A 25-square checkerboard (5 squares × 5 squares) will suffice for this activity. Reinforce the checkerboard with cardboard or a plastic coating.
– For students experiencing difficulty, set up a workstation with a completed object that they can observe (Object 1, for example). Then, have them build the remaining objects.
– Transparency Tech 4.2 shows how each object should be built. You can photocopy the transparency illustrations or prepare models based on them for students to compare with their own work.

Lab number (Student book chapter)	Lab title (Type of lab)	Concept	Program	Materials
TECH 5 (Chapter 12)	Developments (Technique)	Developments (prism, cylinder, pyramid, cone)	AST	• piece of cardboard (at least 400 mm × 264 mm) • T-square • masking tape • drawing board • pencil • ruler • 45° set square • scissors • sheet of corrugated plastic (at least 400 mm × 264 mm × 2 mm) • cutting mat • retractable utility knife • cork-backed metal ruler • hot glue gun • self-adhesive Velcro strips • various materials for decorating the pencil case (student's choice)

NOTE TO TEACHERS OR LAB TECHNICIANS

– When students trace the template onto the corrugated plastic, make sure that the corrugations run in the same direction as the side measuring 264 mm. Although this is mentioned in the manufacturing process sheet, remind students so that they do not waste materials.
– To inspect the template at step 52 in the manufacturing process sheet, place Transparency Tech 5.1 on top of the student's template. If all the lines of the template match those on the transparency, the template has been made correctly.
– The flap and front of the pencil case may be given other shapes, for example:

– When cutting corrugated plastic:
  • If overseeing students' use of retractable utility knives is a problem or if you do not have enough knives for the class, ordinary scissors will cut 2-mm-thick corrugated plastic.
  • Art supply stores carry knives made especially for cutting corrugated plastic.
– Both art supply stores and hardware stores sell corrugated plastic, but art supply stores generally carry a wider range of colours and thicknesses.

TECH LABS – Overview chart (*continued*)

Lab number (Student book chapter)	Lab title (Type of lab)	Concept	Program	Materials
TECH 6 (Chapter 12)	Standards and representations (Technological analysis)	Standards and representations (diagrams, symbols)	AST	• locking pliers • piece of scrap wood

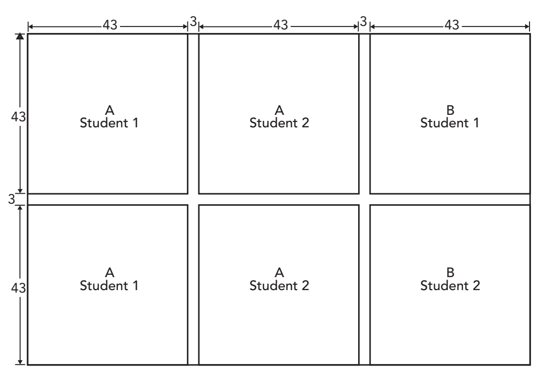
NOTE TO TEACHERS OR LAB TECHNICIANS

To support students in their learning, you can do this lab as a group, with the entire class, up to step 6. Then, let students finish the lab on their own or in small groups.

Lab number (Student book chapter)	Lab title (Type of lab)	Concept	Program	Materials
TECH 7 (Chapter 12)	Manufacturing: tools and techniques (Technique)	Shaping (machines and tools)	EST	• pine plank (at least 90 mm × 89 mm × 19 mm) • pencil • combination square • band saw • cutting guide • flat rasp • woodworker's vise • hammer • centre punch • drill press • drill press vise • sanding block • 2-mm (5/64-inch) drill bit • 120-grit sandpaper • ruler • wooden dowel (13 mm (1/2-inch) diameter, at least 190 mm length) • piece of medium-density particleboard (at least 363 mm × 43 mm × 6 mm) • 13-mm (1/2-inch) drill bit • block of maple (38 mm × 38 mm × 38 mm) • gear template • coping saw • half-round rasp • piece of styrene (at least 120 mm × 40 mm × 3 mm) • 8-mm (5/16-inch) drill bit • polishing wax • polishing head (for drill) • screwdriver • 12-mm (1/2-inch) No. 4 wood screw • markers • 12 16-mm (5/8-inch) No. 6 wood screws • 3 32-mm (1 1/4-inch) No. 6 wood screws

NOTE TO TEACHERS OR LAB TECHNICIANS

– To give students a good idea of what a ratchet noisemaker looks like, show them Transparencies Tech 7.1 (a general arrangement drawing) and Tech 7.2 (an exploded-view drawing).
– For the pine wood, order 1 inch × 4 inch planks at a hardware store.
– For the blocks of maple, order 2 inch × 2 inch planks at a hardware store.
– To save on pine wood, you can have two students lay out their parts A and B per plank. In this case, choose planks at least 135 mm × 89 mm ×19 mm and have students lay out the parts as follows:

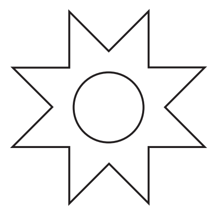


Lab number (Student book chapter)	Lab title (Type of lab)	Concept	Program	Materials
TECH 7 *(continued)*				

NOTE TO TEACHERS OR LAB TECHNICIANS *(continued)*

– You can use the template below to help students lay out the ratchet gear for their noisemakers. We recommend that you copy the template onto thick cardboard or a piece of acrylic and make several templates for the class. The hole at the centre of the template must be drilled with a 13-mm (1/2-inch) drill bit. You can give students who are good at technical drawing an additional challenge: draw and lay out the ratchet gear on their own.

– We recommend maple wood for the ratchet gears. Other types of hardwood are also suitable. Use pieces measuring at least 508 mm × 508 mm.



– Tell students to work slowly when they are cutting out the ratchet gear with the coping saw, to avoid breaking the blade.

Lab number (Student book chapter)	Lab title (Type of lab)	Concept	Programs	Materials
TECH 8 (Chapter 12)	Tapping and threading (Technique)	Manufacturing (characteristics of tapping and threading)	EST AST	• cylindrical steel rod (6.4 mm (1/4 inch) diameter, at least 25 mm length) • metal ruler • scratch awl • band saw • push block • bench vise • flat file • 6.4-mm (1/4-inch) die • diestock • applicator containing cutting oil • paper towels • hexagonal piece of steel (11 mm (7/16 inch) width across flats × 5.6 mm (7/32 inch) height) • hammer • centre punch • drill press vise • drill press • 5.6-mm (7/32-inch) metal drill bit • 6.4-mm (1/4-inch) tap • tap wrench • 6.4-mm (1/4-inch, nominal diameter) hex nut • 6.4-mm (1/4-inch, nominal diameter) screw

NOTE TO TEACHERS OR LAB TECHNICIANS

– To speed up students' completion of this lab, mount the 5.6-mm (7/32-inch) drill bits on the drill presses beforehand. Adjust the rotational speed of each machine tool according to the manufacturer's instructions—usually found on a table inside the pulley safety guard. Adjust the height of both the table and the depth stop on the drill presses so that students can drill the holes to make their nuts.

– To speed up students' completion of this lab, have half of the class work on threading while the other half works on tapping.

– To cut the cylindrical steel rods, make sure that a metal-cutting blade is installed in the band saw. You can also use a hacksaw or cut the rods beforehand.

Lab number (Student book chapter)	Lab title (Type of lab)	Concept	Programs	Materials
TECH 9 (Chapter 13)	Linking in technical objects (Observation)	Characteristics of the linking of mechanical parts	ST EST AST	• beaker tongs • overflow can • screwdriver • retractable utility knife • plastic cutter • water pump pliers • Petri dish • universal clamp • try square • retort stand • C-clamp

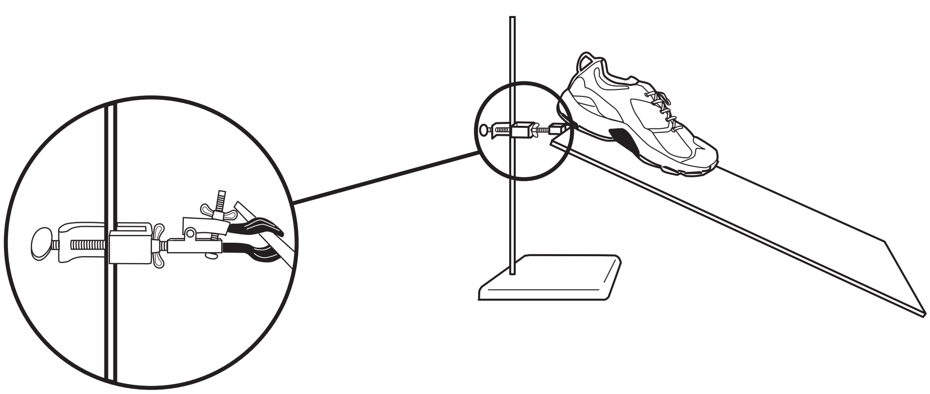
NOTE TO TEACHERS OR LAB TECHNICIANS

– You can prepare for this lab in one of two ways, depending on the availability of tools and lab equipment:
  - Prepare one sample of each object per team of two.
  - Use one set of objects for the entire class and place them at different workstations. Have teams go from one workstation to another to observe each object.

Lab number (Student book chapter)	Lab title (Type of lab)	Concept	Programs	Materials
TECH 10 (Chapter 13)	Adhesion and friction of parts (Experiment)	Adhesion and friction of parts	EST AST	• ceramic tile (305 mm × 610 mm [12 in × 24 in]) • piece of polystyrene (305 mm × 610 mm) • piece of wood (305 mm × 610 mm) • piece of aluminum (305 mm × 610 mm) • universal clamp • shoe • retort stand • stopwatch • ruler

NOTE TO TEACHERS OR LAB TECHNICIANS

– Note the experimental setup below for this lab:



– The procedures were tested with a nearly new shoe—therefore, a shoe with good adhesion. The wood sample was free of varnish, paint or stain.

– The wood sample we used was cherry, but other varieties of wood can be used.

– The lab was tested with 305 mm × 610 mm samples of the materials.

– Corrugated plastic may be used instead of polystyrene.

– Aluminum may be replaced by copper or iron for the metal sample. Both materials are available in home renovation centres.

– To reduce costs, especially for the ceramic tiles, you can set up workstations. For a class of 32 students, for example, you could have:
  - 2 “ceramic” workstations
  - 2 “wood” workstations
  - 2 “aluminum” workstations
  - 2 “polystyrene” workstations

Lab number (Student book chapter)	Lab title (Type of lab)	Concept	Programs	Materials
TECH 11 (Chapter 13)	Motion transmission (Observation)	Motion transmission	ST EST AST	• demonstration setups of various motion transmission systems

NOTE TO TEACHERS OR LAB TECHNICIANS

– We recommend that you have students work in teams of two. You must therefore prepare two series of setups, to be used by all teams, if you choose to organize the lab in workstations. Allow five minutes of observation time for each setup, and then have the teams change workstations.

– You can also build these parts out of wood, but this will be more expensive.

– You can also purchase friction gears and pulleys from various lab material suppliers.

– With students who work well independently, you can suggest they prepare their own setups, following the procedures below.

Making and assembling the system parts

Friction gears

1. With scissors, cut out the parts in the templates on page 7 of the lab.
2. Glue the shapes onto a piece of foam core.
3. Cut out the parts, using a retractable utility knife or a compass cutter. (You can find compass cutters at renovation centres or crafts supply stores.)
4. Place each part, one after another, on a piece of scrap material and punch a hole through the centre with a nail.

Pulleys

1. Repeat steps 1 to 4 from the friction gear procedure, using the templates on pages 8 and 9 of the lab.
2. To make the pulleys:
   – Place a nail through the centre of one part 1A.
   – Apply hot glue to the bottom of part 1B.
   – Place part 1B on the 1A part with the nail (keeping the same nail through the centres).
   – Apply hot glue to the top of part 1B.
   – Place another part 1A on top of part 1B (lining up the centres).
   – Pulley 1 is completed.
   – Repeat the same steps for the other pulley 1 parts, as well as for pulleys 2, 3 and 4.

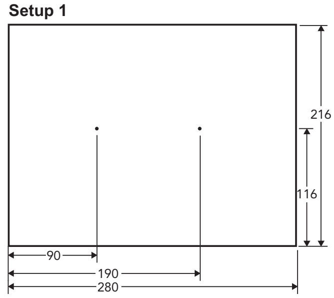
Assembling the systems

Assemble the friction gear systems and the belt and pulley systems by inserting round-head paper fasteners through the centres of the gears and pulleys and attaching the parts to the bases, at the points indicated. Connect the pulleys in each belt and pulley system with an elastic.

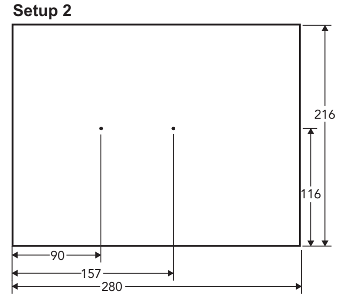
Bases for assembling the systems

Cut out eight pieces of foam core, each 280 mm × 216 mm × 4 mm, to make bases for the motion transmission systems. Refer to the drawings below to attach the gears and pulleys in the correct places for each system setup.

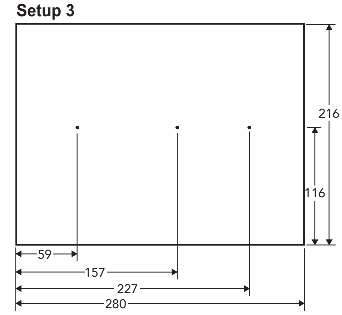
Setup 1



Setup 2



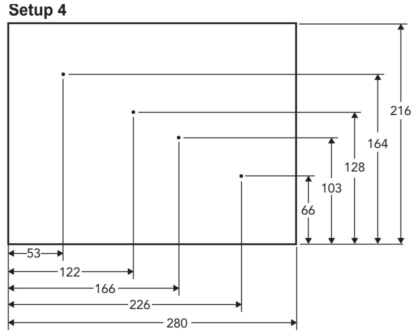
Setup 3



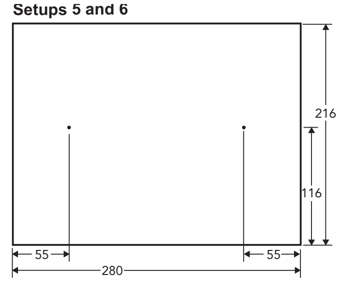
Lab number (Student book chapter)	Lab title (Type of lab)	Concept	Programs	Materials
TECH 11 *(continued)*				

NOTE TO TEACHERS OR LAB TECHNICIANS (*continued*)

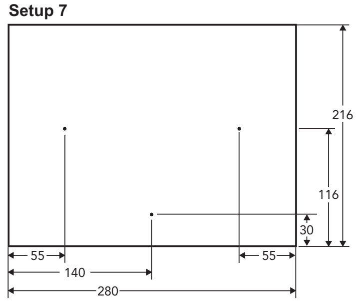
Setup 4



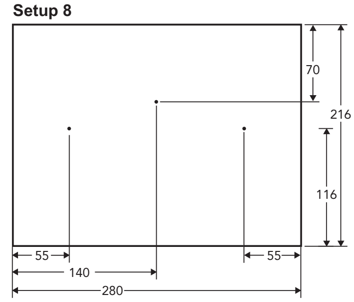
Setups 5 and 6



Setup 7



Setup 8



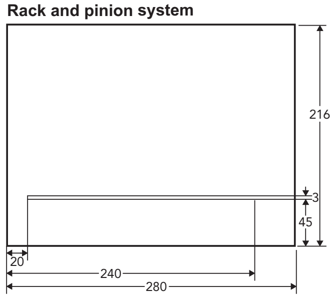
Lab number (Student book chapter)	Lab title (Type of lab)	Concept	Programs	Materials
TECH 12 (Chapter 13)	Motion transformation (Modelling)	Motion transformation	ST EST AST	• system parts for each model • 3 sheets of foam core (216 mm × 280 mm), slit • adhesive putty • 9 25.4-mm (1-inch) round-head paper fasteners

NOTE TO TEACHERS OR LAB TECHNICIANS

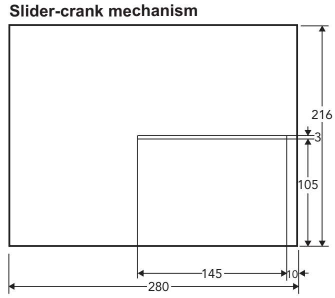
– We recommend that students work in teams of three. Each student can then build a model of one of the three systems under study. Students should consult one another to match the parts with the appropriate systems.

– Prepare three 216 mm × 280 mm sheets of foam core for each team. Make a slit in each sheet (see the illustrations below) and write the name of the transformation system to be modelled.

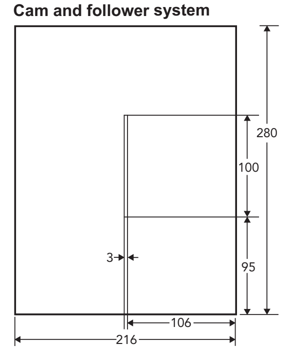
Rack and pinion system



Slider-crank mechanism



Cam and follower system

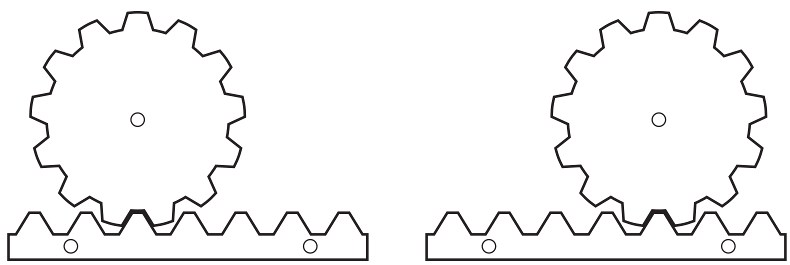


Lab number (Student book chapter)	Lab title (Type of lab)	Concept	Programs	Materials
TECH 12 *(continued)*				

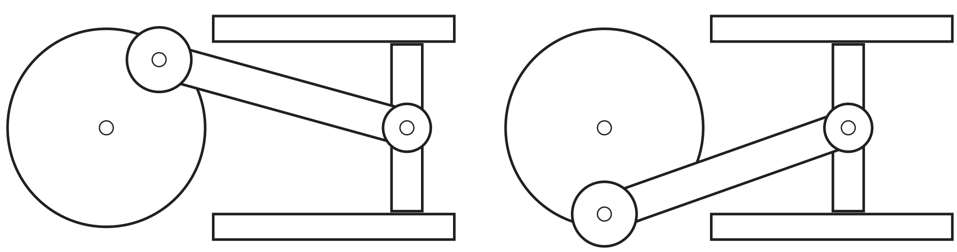
NOTE TO TEACHERS OR LAB TECHNICIANS *(continued)*

- The parts on pages 6 to 8 of the lab must also be made out of foam core. Each black circle marks the location of a centre hole for a round-head paper fastener. It is important that you do not use a hole punch because the hole will be too large for the fastener and the parts will shift on their base. Write the appropriate number on each part. You can also suggest that students colour the parts.
- With students who work well independently, you can suggest they make their own parts, using the templates provided, if necessary.
- You can also build these parts out of wood, but this will be more expensive. Students should assemble the three systems for this lab according to the models below.

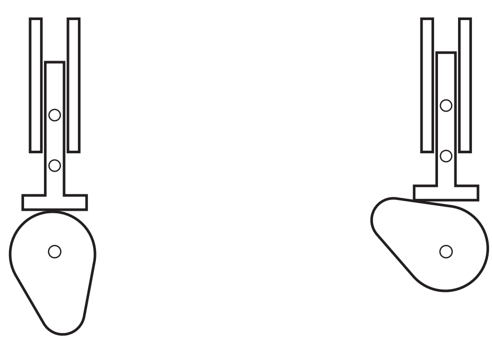
Rack and pinion system



Slider-crank mechanism



Cam and follower system



Lab number (Student book chapter)	Lab title (Type of lab)	Concept	Programs	Materials
TECH 13 (Chapter 14)	Electrical functions (Observation)	Electrical functions • power supply, conduction, insulation and protection • typical controls, transforma-tion of energy	ST EST AST	• rechargeable flashlight, intact (flashlight 1) • rechargeable flashlight, disassembled (flashlight 2) • rechargeable flashlight with part of its housing removed to show the inner parts assembly (flashlight 3) • screwdriver Note: The flashlight illustrated in this lab is a hand-press LED flashlight.

NOTE TO TEACHERS OR LAB TECHNICIANS

– The flashlight model used in this lab can be purchased from specialty suppliers of promotional products. If you use another model, you will have to adjust the procedure, the observations and the answers to questions accordingly.

– Regardless of the type of flashlight you choose, be very careful when handling it: the wires are small and easily damaged.

– To avoid losing disassembled flashlight parts, you can glue them in a display, using hot glue or epoxy adhesive.

Lab number (Student book chapter)	Lab title (Type of lab)	Concept	Programs	Materials
TECH 14 (Chapter 14)	Circuit protection (Observation)	Protection	ST EST AST	• variable-intensity direct-current (DC) power supply • 2.5-V light bulb with socket and contacts • 4 electrical wires with alligator clips • 300-A fuse • switch

NOTE TO TEACHERS OR LAB TECHNICIANS

– You can purchase 300-A fuses in electronics stores.

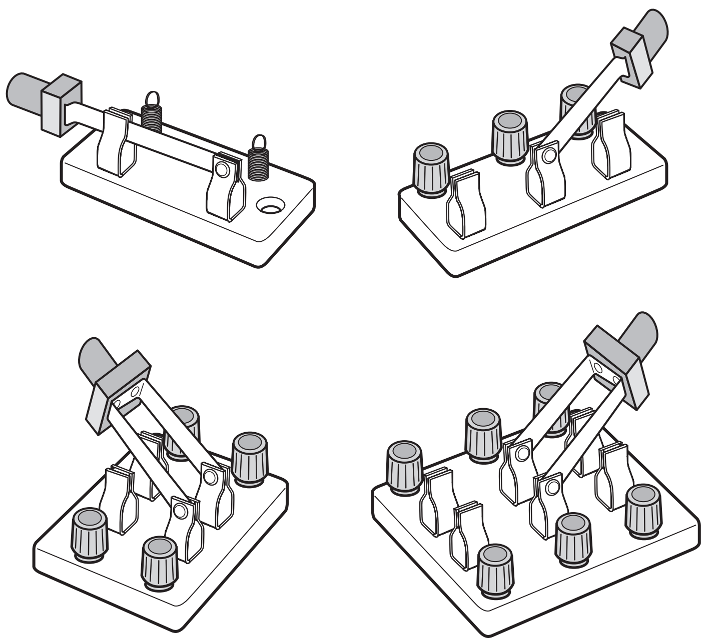
– You can show students how the light bulb would shatter with increased voltage in an unprotected circuit by doing a demonstration. In this case, remember to have a store of replacement bulbs.

– You can also integrate an ammeter into the circuit to show that the current intensity increases with increased potential difference.

Lab number (Student book chapter)	Lab title (Type of lab)	Concept	Programs	Materials
TECH 15 (Chapter 14)	Circuit control (Observation)	Control	ST EST AST	• 4 workstations, each with a different electrical circuit containing light bulbs

NOTE TO TEACHERS OR LAB TECHNICIANS

– The switches used in this lab resemble those shown below. You can obtain switches like these at specialty suppliers of electronic or physics lab equipment.



– For this lab, you can have students work in teams of two. For a class of 32 students, you will thus need four workstations of each type. Student teams will take turns observing four different workstations.

Materials for Workstation 1, with a single-pole, double-throw switch
• 9-V battery or other source of direct current
• 2 6-V light bulbs, each mounted on a plastic base
• single-pole, double-throw knife switch
• 5 electrical wires with alligator clips

Materials for Workstation 2, with a double-pole, single-throw switch
• 9-V battery or other source of direct current
• 2 6-V light bulbs, each mounted on a plastic base
• double-pole, single-throw knife switch
• 6 electrical wires with alligator clips

Materials for Workstation 3, with a single-pole, single-throw switch
• 9-V battery or other source of direct current
• 6-V light bulb mounted on a plastic base
• single-pole, single-throw knife switch
• 3 electrical wires with alligator clips

Materials for Workstation 4, with a double-pole, double-throw switch
• 9-V battery or other source of direct current
• 4 6-V light bulbs, each mounted on a plastic base
• double-pole, double-throw knife switch
• 10 electrical wires with alligator clips

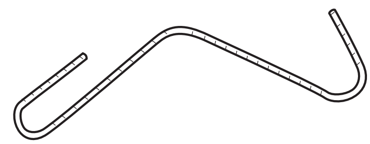
– See pages 2 and 3 of the answer key for the circuit diagram for each workstation.

Lab number (Student book chapter)	Lab title (Type of lab)	Concept	Programs	Materials
TECH 16 (Chapter 14)	The transformation of energy (Observation)	Transformation of energy	ST EST AST	• D battery • wide elastic band • 2 large metal paper clips (modified for this lab) • 7-coil solenoid • permanent magnet • piece of cardboard

NOTE TO TEACHERS OR LAB TECHNICIANS

– Rectangular permanent magnets work best for this lab.

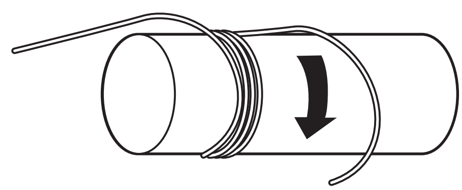
– For each team, prepare two paper clips by bending them into the shape opposite.



– To prepare the solenoids, the best wire to use is enamelled copper wire. Follow the steps below:

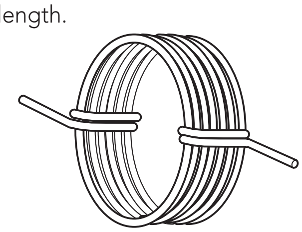
1. Starting about 10 cm from one end of the wire, wrap it around a cardboard toilet paper roll.

2. Make seven turns around the roll, taking care to place each new coil right beside the previous one.



3. Remove the roll, leaving another 10-cm length of wire at the opposite end from your starting point. Cut the wire. The two branches at the ends of the solenoid should be equal in length.

4. Roll each branch once or twice around all seven coils as shown, forming two knots. Make sure the branches are perpendicular to the solenoid coils.



5. To sand the insulator on the solenoid branches, follow the steps below:

a) For the **left** branch, leave about 1 cm of insulator at the end of the wire.

b) Leave another 1 cm of insulator on the wire before the knot.

c) Sand off all the insulator from the rest of the branch.

d) For the **right** branch, also leave about 1 cm of insulator at the end of the wire and before the knot. Sand off only half of the insulator from the rest of the branch. A cross section of the branches would appear as follows: