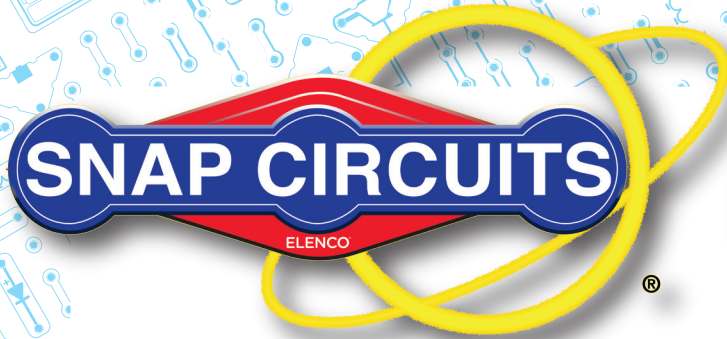
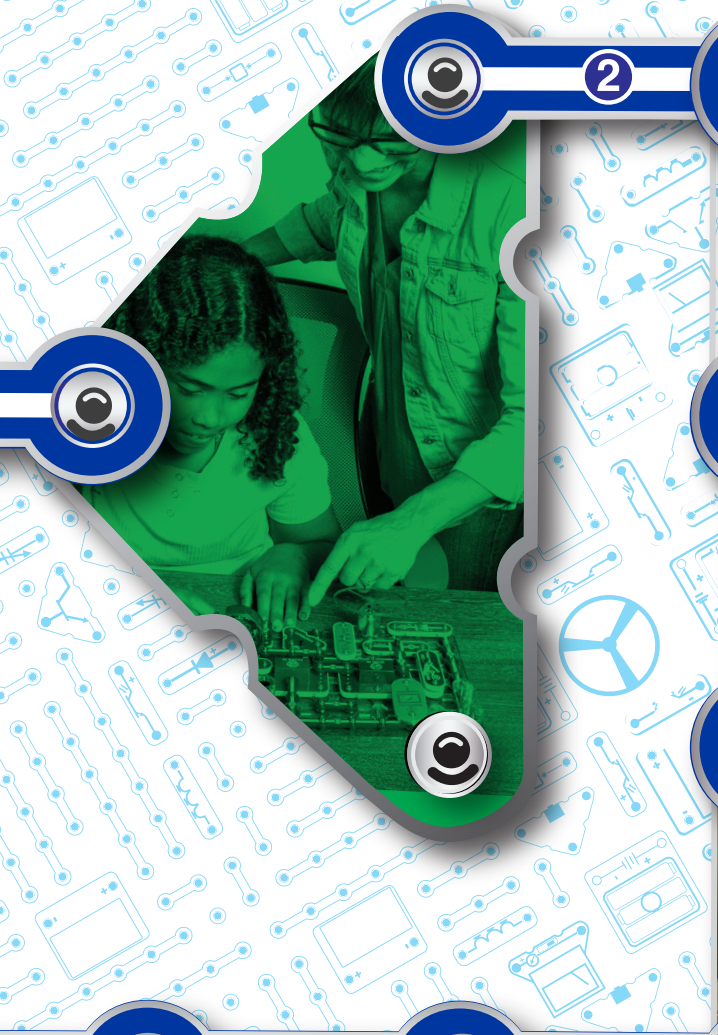




Instructor | Parent Guide



Home Learning Electronic Fun



An introduction to the
exciting world of electronics

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INTRODUCTION & IMPORTANT INFORMATION

This educational home learning version of the popular Snap Circuits® product is a tool for opening the exciting world of electronics. Following the Learn by Doing® concept, electronics will be easy for students to understand by using Snap Circuits® to build circuits as they learn about them. The Student Activity Book emphasizes the practical applications of electronics, without bogging down in mathematics. This course is as much about science as about electronics.

Why should students learn about electronics? Electronics plays an important and increasing role in their everyday lives, and so some basic knowledge of it is good for all of them. Learning about it teaches how to do scientific investigation, and the projects develop basic skills needed in today's world.

Much of the text in all chapters is color-coded so that parents can easily adapt the course based on the skills and interests of the learners. Blue shading is the basic lesson and green shading is basic experiments. The orange-shaded boxes are more advanced material while the brown-shaded boxes are considered additional/background material, either can generally be omitted without a significant impact on the course. Chapter previews and summaries are gray-shaded, and yellow shading introduces new parts.

It is estimated that each chapter will take an average of four 45 minute sessions to complete, but this varies depending on the age of the learners, the setup of the workspace, how many learners are working together, and how much the parent is aiding.

INSTRUCTOR PREPARATION/ ORGANIZATION (if product is used in a shared-learning setting)

- Determine what the learning environment will be. Will the students be learning independently or in small groups? How much teacher instruction will there be for each section? Will the students be reading the lesson as homework and then have limited teacher instruction before performing the experiments? Decide when quizzes will be given and how they will be organized.
- Allocate time within the session as needed for:
 - Teacher instruction about the topics being covered during the session.
 - Getting the Snap Circuits® components into the workspace.
 - Teacher instruction about the specific activities to be performed during that session.
 - Building and testing the circuits.
 - Performing experiments (and teacher verification if desired).
 - Dismantling the circuits and returning Snap Circuits® components to storage area.
 - Reassembling the class for review.
- Make sure the students know their objectives for the day, how much time they will need for cleanup, and where the materials are being stored.
- Students must understand that there are usually many ways of making the same circuit, and that the instructor may not know all the answers. They are doing scientific investigation, and many circuit projects suggest variations to experiment with.
- Have students review the DO's and DON'Ts of Building Circuits on page 4.

FIVE FRIENDLY AT HOME LEARNING TIPS FOR PARENTS

1. Find a quiet place work.

- Find a place in your home that will act as your child's classroom. This should be a quiet space, free from distractions.
- Your child can keep all their materials in this space, so they are prepared for each school day.

2. Keep your child on a schedule.

- Maintaining a similar routine each day is very beneficial for students.
- Create a certain time and day for each week that your child will be working on this Snap Circuit.
- See the schedule for our student guide on page 3.

3. Create goals for each day.

- What do you want your child to achieve during this lesson?
- What must they have completed before moving on to another lesson or activity?

4. Take Breaks!

- The average attention span of a middle schooler is only 10-12 minutes.
- It is important that your child does not get burnt out before reaching their daily goal.
- Appropriate stopping points may be between experiments and readings.
- Breaks can include, jumping jacks, quick games such as eye spy, stretching, and more! Get creative and keep your children moving!

5. Stay Connected.

- Maintain in contact with your child's peers and teachers.
- Show your child's teacher what your child has been working on while home from school.
- Have your child show their peers different experiments they have completed or anything they have learned from Snap Circuits®!

NSTA STANDARDS

Grades 3-5

3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

Middle school

MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

SCHEDULE FOR LEARNING

Here is a tentative schedule for you and your learner to follow while completing the Snap Circuits® Home Learning Electronic Fun Student Activity Book. If this exact schedule does not work for your learning environment, that is alright. The most important thing is to keep your learner on a routine. Below is an outline on how the schedule might be laid out.

Reading - The reading is the first thing your learner should complete each day. Your learner should be able to do most of the reading on their own. Some words might be tricky for your children to decode and will require adult assistance. Throughout the reading, different pieces will be introduced. When you see a new piece, encourage your learner to find it in the box as they read about it. This will be helpful when it comes to building circuits.

Activities - Throughout the chapters, you will see multiple Activities. This is the chance for your learner to build a circuit based on what they have read and learned, and for your learner to make connections to everyday life. When building a circuit, your learner should pull out the materials needed first. They must follow the drawing to build the circuit. Remind your learner this is not the only way to build this circuit. Under the activity are questions for the adult to use to lead a meaningful discussion with your learner. You may use these at your own leisure. Your learner does not need to write anything down for the activities.

Preliminary Reading - Pages 1-5 (an introduction to the product) and pages 6-8 (an introductory description of the parts).

Chapter 1: Basic Components & Circuits

Introduces electricity with the components and circuit types listed here. By building circuits using Snap Circuits®, students begin to understand the electrical world.

4 days minimum

Day 1: pages 9-13, 30-45 minutes:

Preface & Introduction

1-1 Electricity

1-2 Wires

1-3 Batteries

1-4 Switches

Day 2: pages 13-17, 30-45 minutes:

1-5 Lamps

1-6 Base Grid - includes two circuit activities

Day 3: pages 18-20, 30-45 minutes:

1-7 Series and Parallel Circuits - includes two circuit activities

1-8 Short Circuits

1-9 Solder

Day 4: page 21, 20-30 minutes:

Review and Quiz Day! Review the summary of Chapter 1 with your learner, and have them take the Chapter 1 Quiz on the same page. When your learner feels ready, they may take the Chapter 1 Exam on page 12 of this book.

Tips for Quizzes:

1. Do not let the word, “quiz”, worry your learner. Remind them this is just a way to see what they remember from the chapter.
2. Encourage your learner to take the quiz on their own. Remind them they can go back in the chapter to help them answer the questions.
3. Once completed, review the answers with your learner. If they missed one, try to explain what they missed.
4. Congratulate your learner! They completed a chapter!

Chapter 2: Motors & Electricity

Students learn how electricity and magnetism are used in motors and generators, about the electricity that runs their homes, and about lightning.

4 days minimum

Day 1: pages 22-24, 20-30 minutes:

Introduction

2-1 Motors - includes one circuit activity

Day 2: pages 25-29, 60 minutes:

2-2 Motor Circuits - includes six circuit activities

2-3 Fuses - includes one circuit activity

Day 3: pages 30-33, 60 minutes:

2-4 Your Electric Company - includes three circuit activities

2-5 Static Electricity

2-6 Types of Lamps

2-7 Types of Switches

2-8 Electricians

Day 4: page 34, 20 minutes:

Review and Quiz Day! Review the summary of Chapter 2 with your learner, and have them take the Chapter 2 Quiz on the same page. When your learner feels ready, they may take the Chapter 2 Exam on page 14 of this book.

See “Tips for Quizzes” above.

Chapter 3: Resistance & Electronic Sound

Students learn how electricity and magnetism are used in motors and generators, about the electricity that runs their homes, and about lightning.

5 days minimum

Day 1: pages 35-38, 60 minutes:

Introduction

3-1 Resistors

3-2 LEDs - *includes two circuit activities*

3-3 The Photoresistor - *includes one circuit activity*

Day 2: pages 38-41, 60 minutes:

3-4 Resistors in Series and Parallel - *includes three circuit activities*

3-5 Resistance - *includes one circuit activity*

Day 3: pages 42-44, 45 minutes:

3-6 Electronic Sound - *two circuit activities*

3-7 Resistance of Water - *includes one circuit activity*

Day 4: pages 45-47, 45 minutes:

3-8 Introduction to Logic - *includes five circuit activities*

3-9 Digital Electronics

Day 5: page 48, 20 minutes:

Review and Quiz Day! Review the summary of Chapter 3 with your learner, and have them take the Chapter 3 Quiz on the same page. When your learner feels ready, they may take the Chapter 3 Exam on page 15 of this book.

See “Tips for Quizzes” above.

Chapter 4: Other Electrical Components & Circuits

Students learn how electricity makes sound. They also learn about the integrated circuit modules included in Snap Circuits® and what is inside them. They have the opportunity to use ICs in many types of circuits.

4 days minimum

Day 1: pages 49-52, 45 minutes:

4-1 Schematics

4-2 Transistors - *includes three circuit activities*

Day 2: pages 52-56, 45 minutes:

4-3 Electromagnetism - *includes one circuit activity*

Day 3: pages 56-59, 60 minutes:

4-4 Integrated Circuits - *includes five circuit activities*

Day 4: page 60, 20 minutes:

Review and Quiz Day! Review the summary of Chapter 4 with your learner, and have them take the Chapter 4 Quiz on the same page. When your learner feels ready, they may take the Chapter 4 Exam on page 17 of this book.

See “Tips for Quizzes” above.

Additional Material:

Definition of Terms on pages 61-62

Test Your Knowledge on pages 63-65

Answers:

Solutions to chapter quizzes are at the bottom of the quiz. Solutions to Activity questions are on pages 6-12 of this booklet. Solutions to the chapter exams in this booklet are on page 19 of this booklet.

ANSWERS TO QUESTIONS IN STUDENT ACTIVITY BOOK

Chapter 1:

Activity 1, Electric Light and Switch:

Q. What happens when you close the switch?

A. *The lamp turns on.*

Q. What happens when you open the switch?

A. *The lamp turns off.*

Q. What do the two circuits have in common?

A. *They are the same electrically.*

Q. How can you tell when electricity is flowing through the circuit?

A. *The lamp will light.*

Q. Explain how the switch works.

A. *When the switch is closed (ON) it closes the gap, electricity flows through the circuit and the lamp lights. When the switch is open (OFF) there is gap so the electricity cannot flow and the lamp is off.*

Q. What could you do to open and close this circuit without a switch?

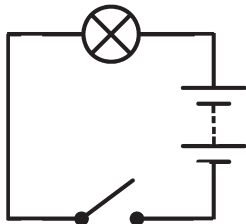
A. *Remove a battery or disconnect a part.*

Q. Give two examples of switches used in everyday life.

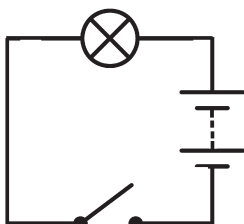
A. *Light switch, door bell, others*

Q. Use the circuit diagram symbols to draw the two circuits you have made on the previous page.

Answer 1:

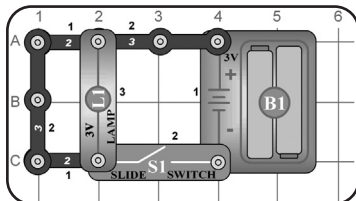


Answer 2:



Q. Tell why these three circuits will not light the bulb, then explain a way to fix the circuits.

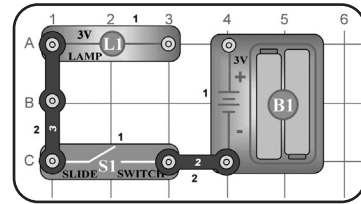
A.



Circuit A will not light the bulb because
The lamp is shorted by the 3-snap.

Repair by: *Removing the 3-snap that is causing the short.*

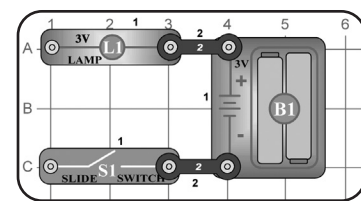
B.



Circuit B will not light the bulb because
Missing the 2-snap from the battery to the lamp creates an open circuit.

Repair by: *Add the missing 2-snap.*

C.



Circuit C will not light the bulb because
Missing the 3-snap from the lamp to the switch creates an open circuit.

Repair by: *Add the missing 3-snap.*

Activity 2, Morse Code:

Q. How does a telegraph work?

A. *A telegraph sends messages with sound signals across a wire.*

Q. How is your telegraph similar to an actual telegraph?

A. *They both open and close a switch to send a message.*

Q. How is it different?

A. *It sends messages with light signals.*

Q. Why were telegraphs important in the past?

A. *It was the only way for people to communicate over long distance.*

Q. Why are telegraphs less important today?

A. *Most devices are wireless.*

Q. Name two devices used for communication over great distances.

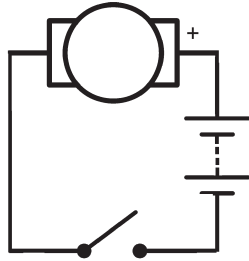
A. *Radio, satellite, others.*

Chapter 2:

Activity 5, Motor and Switch:

Q. Use the circuit diagram symbols to draw the circuit shown below.

A. Circuit Diagram:



Q. What happens when you close the switch?

A. *The fan spins.*

Q. What happens when you open the switch?

A. *The fan stops spinning,*

Q. What is the electrical energy changed into?

A. *Mechanical - the spinning motor*

Q. How is this circuit similar to the lamp circuit in Activity 1?

A. *Turns electrical energy into another form of energy.*

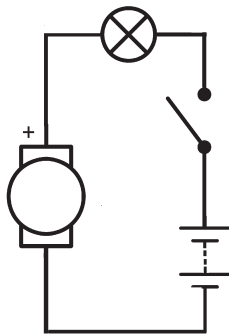
Q. Think of several examples of tools or toys powered by a motor.

A. *Drill, electric saw, remote control car, drone*

Activity 6, Lamp and Fan in Series:

Q. Use the circuit diagram symbols to draw the circuit shown below.

A. Circuit Diagram:



Q. What happens when you close the switch?

A. *The lamp lights and the motor spins.*

Q. What happens when you open the switch?

A. *The lamp turns off and the motor stops.*

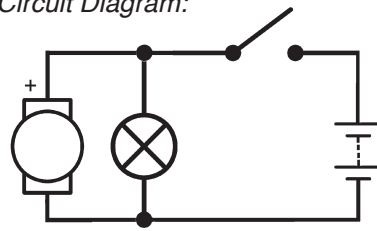
Q. Open the switch. Take the fan off the motor. Close the switch. Describe What happens.

A. *The motor spins faster and the lamp turns off. The voltage drop is higher across the motor and lower across the lamp, so there is not enough voltage to light the lamp.*

Activity 7, Lamp and Fan in Parallel:

Q. Use the circuit diagram symbols to draw the circuit shown here.

A. Circuit Diagram:



Q. What happens when you close the switch?

A. *The lamp lights and motor spins.*

Q. What happens when you open the switch?

A. *The lamp turns off and the motor stops.*

Q. Remove the lamp. What happens to the motor?

A. *The motor spins faster.*

Q. Install the lamp again. Open the switch. Remove the fan blade from the motor. Close the switch.

What happens to the lamp?

A. *The lamp shines brighter.*

Q. How is a parallel circuit different from a series circuit?

A. *In a parallel circuit, the voltage across each of the components is the same, and the total current is the sum of the currents through each component.*

In a series circuit, the current through each of the components is the same, and the voltage across the circuit is the sum of the voltages across each component.

Activity 8, Lamp, Speaker, and Fan in Parallel:

Q. What happens when you press the switch S2?

A. *The motor spins and the lamp lights. You hear some clicking sounds from the speaker generated by the motor.*

Q. Circle the number of paths that exist for the electric current to follow?

A. *3*

Q. Put the fan on the motor when the motor stops spinning. Press the switch. What changes do you notice?

A. *The lamp is not as bright and the sound is louder.*

Q. What is the purpose of the speaker in the circuit?

A. *The speaker is another path for current to flow. .*

Q. Remove the speaker from the circuit. What changes do you notice?

A. *The fan spins faster and the lamp is brighter.*

Q. Unscrew the lamp. Press the switch. What effect does this have on the motor?

A. *The motor spins faster and you now have a series circuit.*

Q. Do you think the lights in your home are wired in series or parallel?

A. *Parallel*

Activity 9, Flying Saucer:

Q. What happens and why?

A. *The fan flies up. As the motor slows enough the fan disconnects from the motor top and flies off.*

Activity 10, Decreasing Lift:

Q. What does the lamp do to the motor in the circuit?

A. *The lamp slows the motor down.*

Q. When the motor has reached maximum speed, slide the switch off. What happens?

A. *The motor stops spinning and the fan does not fly off.*

Q. Is this a series circuit or parallel circuit?

A. *Series circuit.*

Activity 11, Two-Speed Fan:

Q. What is the path of the current through this circuit when only the slide switch is closed?

A. *The current flows through the motor and lamp.*

Q. What happens when you close the press switch?

A. *The S2 switch shorts out the lamp, turning it off.*

Q. Is this a series or parallel circuit?

A. *Series*

Q. What is the purpose of the lamp in this circuit?

A. *The lamp adds resistance to the circuit and reduces the amount of electricity flowing so the motor spins slower.*

Q. If you have a multiple speed fan at home, how can you increase or decrease the speed?

A. *Change its control switch setting for faster or slower.*

Activity 13, Spinning Rings:

Q. Describe what you see when the press switch is pushed.

A. *The lines form four colored circles.*

Q. Is this a series or parallel circuit?

A. *It is a series circuit.*

Activity 14, Strobe the House Lights:

Q. What do you notice happening with the disc?

A. *As the speed changes the white lines first seem to move in one direction then they start moving in another direction.*

Q. How does the disc look under flashlight light?

A. *The white lines are always blurry and do not change direction.*

Q. Normal house lights blink at a rate of 30 times a second. How is this different from the flashlight?

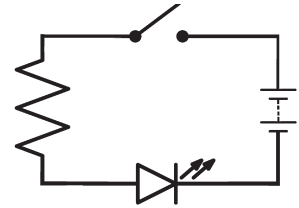
A. *The flashlight uses DC current so it doesn't blink. In direct current (DC) the electric charge (current) only flows in one direction. House lights use AC current. The electric charge in alternating current (AC) changes direction periodically.*

Chapter 3:

Activity 16, Light Emitting Diode:

Q. Draw the circuit using the circuit diagram symbols.

A. *Circuit Diagram:*



Q. Is this a series or parallel circuit? How do you know?

A. *It is a series circuit. There is only one path for current to flow.*

Q. What happens when you close the switch?

A. *The LED lights.*

Q. How is this circuit like the circuit in Activity 1? How is it different?

A. *They are both series circuits. This circuit has an LED instead of a lamp.*

Q. What is the function of the resistor?

A. *The resistor limits the current.*

Q. List several devices you have seen that use LEDs in them.

A. *Flashlights, TVs, cell phones, to name a few.*

Q. Why are LEDs used instead of an incandescent light bulbs in these devices?

A. *They use less energy and last longer.*

Activity 17, One Direction for the LED:

Q. What happens when you close the switch?

A. *The LED does not light.*

Q. What path is the electric current following?

A. *The current does not flow because the LED is in backwards.*

Q. What effect did turning the LED around have on the flow of electric current?

A. *Placing the LED backwards blocks the flow of current.*

.

Activity 20, Conduction Detector:

Q. What do all conductors have in common?

A. *They allow electricity to flow.*

Q. List 2 examples of uses for conductors.

A. *Connecting lights. Making switches.*

Q. Which materials are good insulators?

A. *Chalk, rubber, plastic, cardboard, string, others*

Q. List 2 examples of insulators used in everyday life.

A. *Plastic cover on electrical wires. Air separating electrical components & circuits.*

Activity 22, Simple Water Alarm:

Q. Build the circuit as shown, but leave the jumper wires out of the cup of water. Turn on the switch. What happens?

A. *The music IC is not connected to power so there is no sound or light.*

Q. Place the ends of the jumper wires in the cup of water. Now what happens?

A. *The speaker sounds and the LED lights.*

Q. If the alarm did not sound, add 1 teaspoon of table salt to the water. Place the ends of the jumper wires in the salt water. What happens?

A. *The speaker sounds and the LED lights.*

Q. Try holding the ends of the jumper wires with your fingers. Does your body set off the alarm?

A. *No, your body has too much resistance.*

Q. Are you a conductor or insulator for this circuit that uses only 3 volts?

A. *You are an insulator.*

Activity 23, This OR That OR Both:

Truth Table:

S1	S2	D1
OFF	OFF	OFF
ON	OFF	ON
OFF	ON	ON
ON	ON	ON

Q. What do you think the name of a circuit with the same truth table would be called?

A. *OR Gate*

Q. This logic is not good for a two way light switch because once one switch is closed the other has no affect on the light. Where would this type of logic be useful in the home? Think about home protection from people that might want to break into your house.

A. *An alarm is activated if any of the sensors are triggered.*

Activity 24, This AND That:

Truth Table:

S1	S2	D1
OFF	OFF	OFF
ON	OFF	OFF
OFF	ON	OFF
ON	ON	On

Q. Build the circuit as shown. What do you have to do to make the LED light up? Use the Truth Table to help you with your answer.

A. *Turn both switches on.*

Q. Is this a series or parallel circuit?

A. *Series*

Activity 25, Music AND Gate:

Truth Table:

S1	S2	SP
OFF	OFF	OFF
ON	OFF	OFF
OFF	ON	OFF
ON	ON	ON

Q. What do you need to do to turn on the music?

A. *You need to turn S1 on and press switch S2.*

Activity 26, Neither This NOR That:

Truth Table:

S1	S2	D1
OFF	OFF	ON
ON	OFF	OFF
OFF	ON	OFF
ON	ON	OFF

Q. Which combination makes the LED go on?

A. *Both switches must be off.*

Q. What do you notice about the D1 Column?

A. *The D1 results for the OR gate is opposite the NOR gate*

Activity 27, Not This AND That:

Truth Table:

S1	S2	D1
OFF	OFF	ON
ON	OFF	ON
OFF	ON	ON
ON	ON	OFF

Q. Compare your observations with the AND circuit in activity 26.

A. *The D1 results are opposite the AND gate in activity 26.*

Chapter 4:

Activity 28, LED Night Light:

Q. Cover the RP Photo Resistor with a piece of paper. Turn the switch on. What happened?

A. *The LED turns on.*

Q. Remove the paper over RP and place the unit in the light. What happens?

A. *The LED is very dim or may turn off.*

Q. Place the circuit in a dark room. What happens?

A. *The LED turns on bright.*

Q. Turn on the room light. What Happens?

A. *The LED is very dim or may turn off.*

Q. Is this circuit similar to an automatic night light?

A. *Yes.*

Activity 29, Motor Running LED:

Q. Turn the S1 slide switch on. Is the LED on?

A. *No*

Q. Is the motor running?

A. *No*

Q. Push the S2 Push Button Switch. Is the LED on?

A. *Yes*

Q. Is the motor running?

A. *Yes*

Q. Remove the motor and repeat the experiment. Does the LED act differently? Explain

A. *The LED is not as bright. Removing the motor changes the resistance, so the current at the base of the transistor is less.*

Activity 30, Light Activator:

Q. Turn on the switch (S1). Does the LED (D1) glow?

A. *Yes*

Q. Adjust the light on the photoresistor (RP) by covering with your hand. What happens?

A. *The LED turns off.*

Activity 31, The Electromagnet:

Q. What happens to the paper clip when the current is turned off?

A. *It falls off.*

Q. How is an electromagnet like a permanent magnet?

A. *They both have a magnetic field.*

Q. How is an electromagnet different than a permanent magnet?

A. *An magnetic field in a electromagnet is created using an electric current -- created by electricity.*

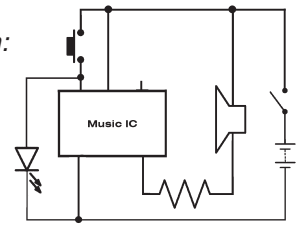
Q. How are electromagnets used in real life?

A. *They are used in motors, speakers, hard disk drives and generators.*

Activity 33, Musical Doorbell:

Q. Use the circuit diagram symbols to draw the circuit here.

A. *Circuit Diagram:*



Q. When you close the slide switch, what happens?

A. *The song plays once and then stops.*

Q. Do you need to hold the button down to keep the music playing?

A. *No, it plays once and stops.*

Q. What kinds of toys do you think could have integrated sound circuits?

A. *Cars, handheld video games, dolls, others*

Activity 34, Musical Alarm:

Q. Is this louder or softer than the music in activity 25?

A. *Louder*

Q. Why?

A. *The R1 resistor is not used.*

Q. How are the circuits in activity 33 and 34 different?

A. *The music IC continues to play if S2 is pressed.*

Q. What happens when you hold the press switch down?

A. *The music plays.*

Q. What happens when you release the press switch?

A. *The music stops.*

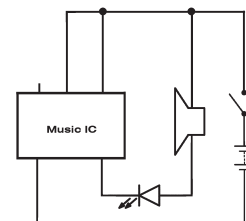
Q. What can you do to keep the song playing?

A. *Hold the press switch down. Replace the press switch with a 3-snap or jumper wire.*

Activity 35, Happy Birthday with Light:

Q. Use the circuit diagram symbols to draw the circuit here.

A. *Circuit Diagram:*



Q. What happens when you push the press switch?

A. *The music plays.*

Q. How can you change the length of time the Song & LED stay on?

A. *It depends how long you press the switch down.*

Q. Are the LED and Speaker connected in series or in parallel?

A. *They are connected in series.*

Activity 36, Reflection Detector:

Q. Place it where there will be no room light hitting the photoresistor (RP), such as under a piece of paper, or under the table. Turn on the switch. What happened?

A. *The light turns on and you may hear some noise if enough light shines on the photoresistor (RP).*

Q. Take a small mirror and hold it over the lamp and photoresistor (RP). Try and reflect the light from the bulb into the top RP hole. What happened?

A. *The speaker sounds.*

Q. What happens as more light is reflected onto the photoresistor?

A. *The sound is louder. The photoresistor (RP) is a light-sensitive resistor, its value changes from nearly infinite in total darkness to about 1000Ω when a bright light shines on it.*

Q. Use a white card or piece of paper to reflect light instead of the mirror. What do you think will happen?

A. *The sound is not as loud and may turn off.*

Q. Try the card as a reflector. What happened?

A. *The sound turns off because paper reflects less light than a mirror.*

Activity 37, Sounds, Light, and Motion:

Q. Build the circuit as shown, with the "+" side of the motor (M1) on top. Turn on the slide switch. What happens?

A. *The speaker sounds, LED lights and the fan spins.*

Q. When the sound stops, what happens?

A. *The LED and motor turn off.*

Q. Are the sound, light, and motion circuits connected in series or parallel?

A. *Parallel*

Q. What happens when you remove the 4 snap wire on level 3 and why?

A. *Only the speaker sounds.*

Q. Explain what you think are the functions of the various components in this circuit.

A. *Music IC (U1) - converts electrical energy to Music.*

Motor (M1) - converts electrical energy into kinetic energy (motion).

Slide switch (S1) - allows current to flow only when it is closed (ON) position.

Batteries (B1) - produce an electrical voltage using a chemical reaction.

LED (D1) - converts electricity into light.

Speaker (SP) - converts electrical energy into sound.

Snap wires - pass current from one part of the circuit to another.

ANSWERS FOR TEST YOUR KNOWLEDGE

1. Look at the four circuit diagrams.

A. Which bulbs will light up?

Answer: *B, C, D*

B. What could you do to repair this circuit?

Answer: *Replace the 2-snap wire with a 3-snap wire.*

C. What could you do to repair this circuit?

Answer: *Remove the 3-snap wire.*

D. What could you do to repair this circuit?

Answer: *Remove the 3-snap wire on the right.*

2. What is a circuit?

Answer: *A series of wires or electric devices that form a closed path for the flow of electricity.*

3. What does a switch do in a circuit?

Answer: *Allows current to flow only when it is in the closed (on) position.*

4. What is the function of the battery in a circuit?

Answer: *Batteries supply electrical energy to the circuit.*

5. In a series circuit with a motor and a lamp will the motor spin faster with or without the lamp?

Answer: *The motor will spin faster since there less resistance.*

6. Label each of the following items as a conductor or an insulator.

<u>Material</u>	<u>Conductor or Insulator</u>
Steel nail	<i>Conductor</i>
Brass fastener	<i>Conductor</i>
Piece of chalk	<i>Insulator</i>
Plastic straw	<i>Insulator</i>
Penny coin	<i>Conductor</i>
Strip of aluminum foil	<i>Conductor</i>

<u>Material</u>	<u>Conductor or Insulator</u>
Pencil lead	<i>Conductor</i>
Rubber eraser	<i>Insulator</i>
Cardboard strip	<i>Insulator</i>
Wooden craft stick	<i>Insulator</i>
String	<i>Insulator</i>
Coated paper clip	<i>Insulator</i>

7. What do all of the conductors have in common?

Answer: *Allow electric current can pass easily.*

8. List two uses for insulators in everyday life.

Answer *Glass, rubber*

9. Label the following four circuits as series or parallel.

Answer A. *Parallel*

Answer B. *Series*

Answer C. *Parallel*

Answer D. *Series*

10. If a lamp and a motor are in the same series circuit, how does the resistance of the motor affect the brightness of the lamp?

Answer: *Increasing the resistance the current goes down so the lamp is not as bright.*

11. Does placing an iron rod inside an electromagnet increase or decrease the magnetic effects?

Answer: *Increase.*

12. List 3 uses for electricity in your life.

Answer: *House lights, cell phone, air conditioner, others*

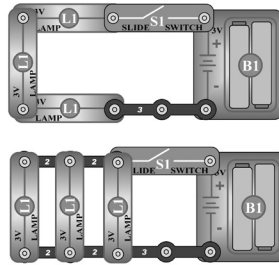
EXAM QUESTIONS

Chapter 1

- 1.1 Which of the following statements is false?
- A. Electricity is closely related to magnetism.
 - B. Electricity is an attraction and repulsion between small particles in a material.
 - C. Electricity is stronger than gravity because its effects are never balanced out.
 - D. Electricity can be created by pressure, chemistry, light, friction, and magnetism.
- 1.2 Which of these products is electrical but not electronic?
- A. Something using transistors and capacitors.
 - B. Drill
 - C. Computer
 - D. Radio
- 1.3 Which of the following statements is false?
- A. Wire length and size never matter.
 - B. Wires are made of metals like copper.
 - C. Wires offer low resistance to the flow of electricity.
 - D. Most wires have a colored coating for protection and identification.
- 1.4 An electrical ground is . . .
- A. the bottom point on which circuits are constructed.
 - B. the 0V or “–” side of a battery or other voltage source, sometimes connected to lightning rods.
 - C. a board used as a frame for building circuits.
 - D. All of the above.
- 1.5 Advantages of printed circuit boards include . . .
- A. metal strips are “printed” on the surface to make interconnections.
 - B. they are a stable platform for mounting components.
 - C. they allow circuits to be made smaller and less expensive.
 - D. All of the above.
- 1.6 Which of the following would all be connected in series?
- A. A lamp and a switch on the wall controlling it.
 - B. Two lamps in a room controlled by the same switch.
 - C. Two lamps in different rooms of a house.
 - D. The air conditioner and microwave oven in your home.
- 1.7 Which of the following would all be connected in parallel?
- A. A lamp and a switch on the wall controlling it.
 - B. The streetlamps in your neighborhood.
 - C. A string of inexpensive Christmas lights that all go out if one bulb is loose.
 - D. None of the above.
- 1.8 It is better to connect lamps in a parallel circuit configuration when . . .
- A. the power source can supply enough current but not enough voltage to light them all.
 - B. if one bulb burns out, you want the others to still light.
 - C. you are also adding switches to control each lamp separately.
 - D. All of the above.
- 1.9 A short circuit is . . .
- A. a special condition that improves circuit performance in most cases.
 - B. an accidental no-resistance path between different parts of a circuit.
 - C. the shortest wiring path between two points in a circuit.
 - D. All of the above.
- 1.10 Solder is . . .
- A. glue that holds components in place, it resists the flow of electricity.
 - B. always applied by hand.
 - C. a metal that is melted to make solid electrical connections.
 - D. a special metal made of copper and other alloys that melts at a low temperature.

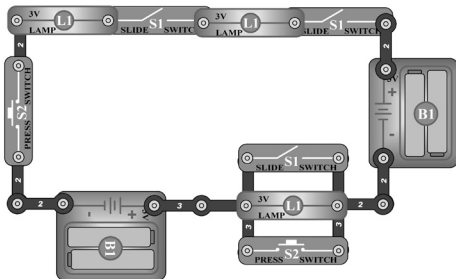
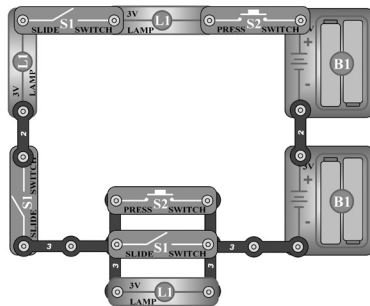
1.11 Which of these circuits has the three lamps connected in parallel?

- A. Top only
- B. Bottom only
- C. Both
- D. Neither



1.12 Will these circuits work the same?

- A. Yes
- B. No
- C. Depends on which switches are closed.
- D. Impossible to tell from these schematics.



1.13 The two basic ways of arranging parts in a circuit are in series and in parallel, all large circuits are made up of combinations of these.
TRUE or FALSE?

1.14 At its most basic level, electricity is an attraction and repulsion between sub-atomic particles within a material.
TRUE or FALSE?

1.15 Voltage is a measure of how fast electricity is flowing in a wire.
TRUE or FALSE?

Chapter 2

- 2.1 What is the most important benefit of electricity?
- A. Energy can be easily transported.
 - B. Radio communication.
 - C. Television.
 - D. The Internet.
- 2.2 How does a generator work?
- A. An electric current in a coil of wire creates a current in another coil through magnetism.
 - B. The magnetic field from an electric current in a coil of wire spins a magnet.
 - C. Pressurized water or steam spins a magnet, creating an electric current in a coil of wire around it.
 - D. Electricity creates mechanical motion.
- 2.3 A circuit uses batteries to run a motor with fan. How could you reduce the speed of the motor?
- A. Using more batteries to increase the voltage.
 - B. Place a lamp in series with the motor to reduce the voltage to it.
 - C. Remove the fan from the motor.
 - D. None of the above.
- 2.4 A circuit uses batteries to run a motor with fan. How could you reverse the direction of airflow?
- A. Place a lamp in parallel with the motor.
 - B. Place a switch in series with the motor.
 - C. Reverse the batteries.
 - D. None of the above.
- 2.5 Which product would probably NOT have a fuse?
- A. Hand-held radio or CD player.
 - B. Electric saw.
 - C. Tabletop stereo/radio/CD player.
 - D. Microwave oven.
- 2.6 What is the voltage at the electrical outlets in your home?
- A. 5V
 - B. 12V
 - C. 60V
 - D. 120V
- 2.7 When clothes cling together due to static electricity, they are . . .
- A. storing a large electrical charge at a low voltage.
 - B. storing a small electrical charge at a high voltage.
 - C. storing a large electrical charge at a high voltage.
 - D. storing a small electrical charge at a low voltage.
- 2.8 Why do incandescent light bulbs have a glass bulb?
- A. To prevent the filament from reacting with oxygen and burning up.
 - B. To protect people if the filament explodes.
 - C. To protect the copper in the filament.
 - D. The glass looks nicer.
- 2.9 Which of the following would NOT cause a blackout?
- A. A problem in the electrical distribution network cuts off electricity to part of a city.
 - B. All the lights in a city are turned off at night to confuse attacking bombers during a war.
 - C. The power company reduces the voltage it supplies when unable to supply enough current.
 - D. A storm damages the electrical distribution network in a city.
- 2.10 Why do local governments have building codes regulating the electrical wiring of buildings?
- A. To make money for the government through building permit fees.
 - B. To ensure the building will be safe after many years and different owners.
 - C. To ensure local electricians will always have jobs.
 - D. To meet standards imposed by the local power companies supplying the electricity.

Chapter 3

3.1 Which statement applies to LEDs?

- A. They can be used with very high currents.
- B. They have a turn-on threshold of about 5V that must be exceeded before current can flow.
- C. They block the flow of electricity in one direction.
- D. They appear brightest when viewed from the side.

3.2 Placing resistors in _____ increases the total resistance while placing them in _____ decreases total resistance.

- A. parallel; series
- B. series; ohm
- C. watt; kirchhoff
- D. series; parallel

3.3 Which of these is Ohm's Law?

- A. Current equals Power divided by Resistance.
- B. Current equals Voltage divided by Resistance.
- C. Voltage equals Current divided by Resistance.
- D. All current flowing into a point must flow out of it.

3.4 Kirchhoff's Laws are . . .

- A. a basic set of rules for analyzing circuits.
- B. variations of Ohm's Law.
- C. a method of calculating the total resistance of resistors in series and in parallel.
- D. a method of marking resistors with colored bands for easy identification.

3.5 Electrical power is . . .

- A. calculated by multiplying the voltage and current together.
- B. a measure of how much energy is moving through a wire.
- C. expressed in Watts.
- D. All of the above.

3.6 Which of these statements about resistors is wrong?

- A. Resistors get warm because they convert electrical energy into heat.
- B. They are made from materials like tin and lead.
- C. Resistance is friction between an electric current and the material it is moving through.
- D. Resistors control and limit the flow of electricity.

3.7 Copper is a good _____ while paper is a good _____.

- A. resistor; conductor
- B. insulator; conductor
- C. conductor; insulator
- D. semiconductor; insulator

3.8 Nearly all electricity eventually becomes . . .

- A. heat.
- B. information.
- C. garbage.
- D. chemical energy.

3.9 How does a speaker create sound waves?

- A. A changing signal through a coil makes a magnet vibrate, creating variations in air pressure.
- B. A changing signal through a coil creates variations in air pressure.
- C. An unchanging signal through a coil makes a magnet vibrate, creating variations in air pressure.
- D. A resistor is changed in value, creating sound waves.

3.10 Which has the lowest frequency?

- A. Raindrops during a thunderstorm.
- B. Planes taking off at a busy airport.
- C. Christmas.
- D. The seconds hand passing 12 on a clock.

3.11 The range of frequencies that can be heard by the human ear are called the _____ range.

- A. radio
- B. audio
- C. microwave
- D. sub-sonic

3.12 Sound waves are variations in electric current created by mechanical vibrations.

TRUE or FALSE?

3.13 If you are increasing the pitch of a sound, then you must be decreasing its frequency.

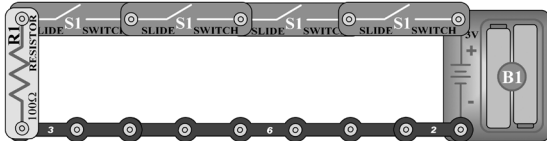
TRUE or FALSE?

3.14 Frequency is measured in Hertz.

TRUE or FALSE?

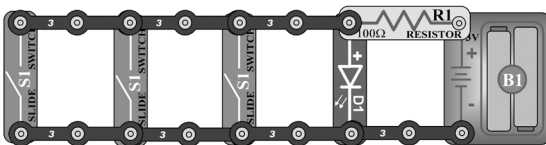
3.15 What type of logic circuit is this?

- A. OR
- B. AND
- C. NAND
- D. NOR



3.16 What type of logic circuit is this?

- A. OR
- B. AND
- C. NAND
- D. NOR



3.17 Digital electronics . . .

- A. uses computers to process electronic information.
- B. uses a series of numbers to represent an electronic signal.
- C. always gives better performance at lower cost.
- D. always has a display with at least one digit.

3.18 The accuracy of a digital representation of a signal depends on . . .

- A. the speed of the microprocessor in the computer.
- B. the voltages used in the measurement.
- C. how accurately and how often the original

signal was measured.

D. the complexity of the circuit.

3.19 Which of these is the name of a circuit that is a basic building block in computers, made up of transistors?

- A. NEVER
- B. ALWAYS
- C. SOMETIMES
- D. AND

Chapter 4

TRUE OR FALSE?

- 4.1 How do transistors work?
- A. They are like one-way low-current resistors.
 - B. They are resistance amplifiers.
 - C. They are voltage amplifiers.
 - D. They use a small current to control a larger current.
- 4.2 What was the transistor originally developed to replace?
- A. Diode
 - B. Vacuum Tube
 - C. Collector
 - D. Silicon
- 4.3 Which of these are advantages of integrated circuits?
- A. Cost
 - B. Size
 - C. Reliability
 - D. All of the above.
- 4.4 The average American home has fewer than five integrated circuits used throughout all the electronic products in it.
TRUE or FALSE?
- 4.5 The integrated circuits in some modern computers have more than a million transistors in them.
TRUE or FALSE?
- 4.6 Integrated circuit manufacturing is so specialized that particles of dust can ruin parts.
TRUE or FALSE?
- 4.7 Placing an iron core inside a coil of wire _____ the magnetic effects of a current flowing through the wire.
- A. Decreases
 - B. Increases
 - C. Does not change
 - D. Eliminates
- 4.8 If you want to be able to turn a magnetic field on and off, you should use an electronic magnet instead of an ordinary magnet.

ANSWERS TO EXAM QUESTIONS

Chapter 1

1.1 C	1.2 B	1.3 A	1.4 B
1.5 D	1.6 A	1.7 B	1.8 D
1.9 B	1.10 C	1.11 B	1.12 A
1.13 True	1.14 True	1.15 False	

Chapter 2

2.1 A	2.2 C	2.3 B	2.4 C
2.5 A	2.6 D	2.7 B	2.8 A
2.9 C	2.10 B		

Chapter 3

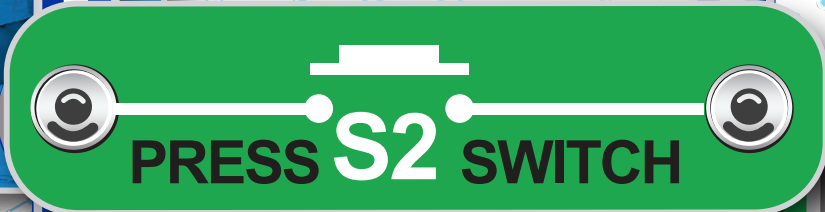
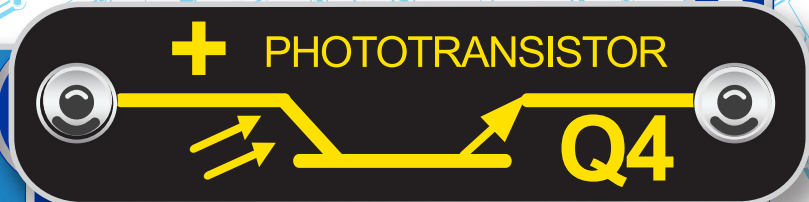
3.1 C	3.2 D	3.3 B	3.4 A
3.5 D	3.6 B	3.7 C	3.8 A
3.9 A	3.10 C	3.11 B	
3.12 False	3.13 False	3.14 True	3.15 B
3.16 D	3.17 B	3.18 C	3.19 D

Chapter 4

4.1 D	4.2 B	4.3 D
4.4 False	4.5 True	4.6 True
4.7 B	4.8 True	

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