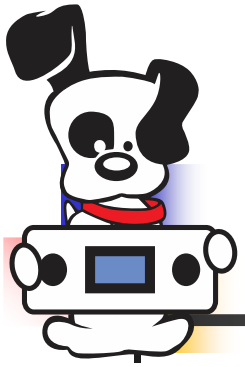

Coding for Young Engineers

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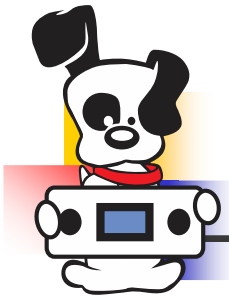

Class Roll

Name	W1	W2	W3	W4	W5	W6	W7	W8	Kit

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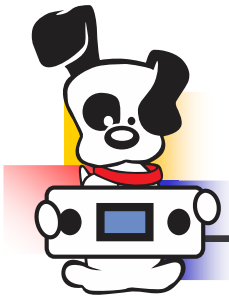

Timetable Overview

Week 1 • Introduction • Safety • Check out our kits • Quick start with Level 0	**Week 2** • Intro to BLOCKLY • Downloading code • Level 0 & 1 activities	**Week 3** • Quizzes and Challenges review 0 & 1 • Level 2 activities	**Week 4** Free play • Level 2 activities • Level 3 activities
Week 5 • Level 3 Quiz • Level 4 activities • Traffic Lights	**Week 6** • Level 4 challenge solution • Sound and tune basics • Level 5 activities	**Week 7** • Level 5 activities, quiz and challenges	**Week 8** • Survey sheet • Level 6 & 7 • Free play or Special Team Projects

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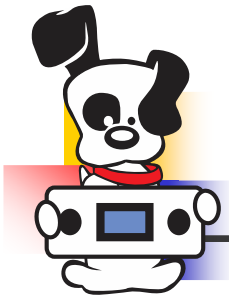

Week 1

- Introduction
- Safety
- Check out our kits
- Quick start with Level 0

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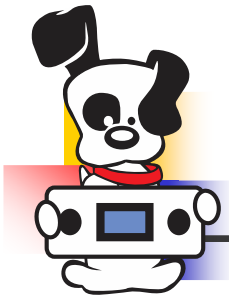

In School so far you have…

- Code for PC and pads using visual tools
  - Tynker
  - Scratch and Hopscotch
  - Code combat
  - ???

What have you been creating…

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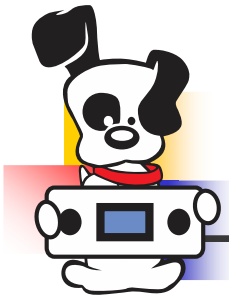

Computers are everywhere…

- In your house…
- In your school…
- In your car…

Most of the times your computer will control something…

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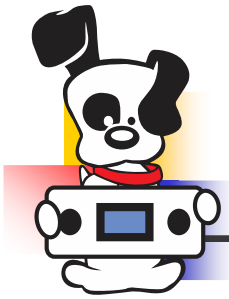

Computers that control…

- Read inputs
- Make decisions
- Control outputs

What are some examples of each…

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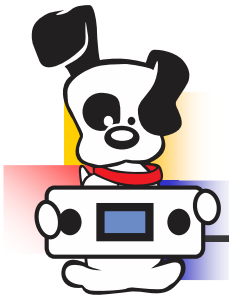

Introducing Snap Circuits…

- Basic parts…
- What is a circuit…
- The SnapCPU and SnapCPU circuits…
- How to code…

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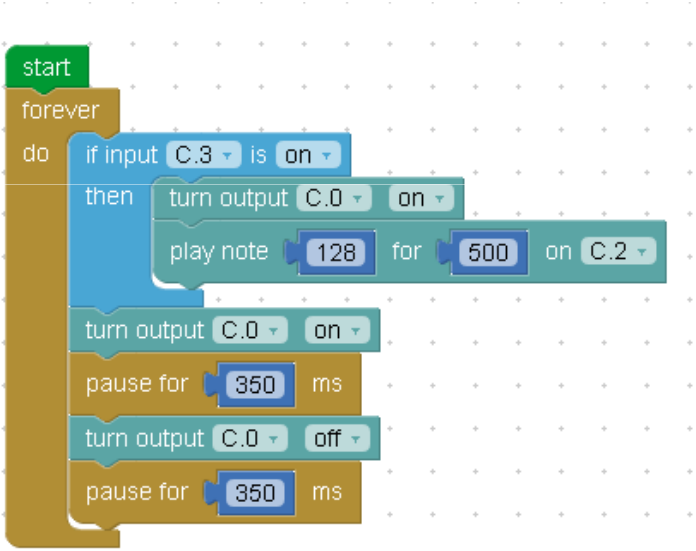
What is KodeKLIX?

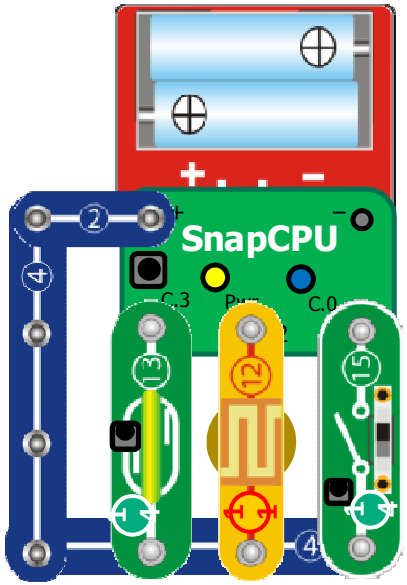
KODE + **KLIX**

Simplified coding…



BLOCKLY™: a Scratch-like coding language by Google, with support for inputs/outputs

Simplified construction…



Snap-type electronics: like Snap-Circuits, BrainBox… but with fewer connections

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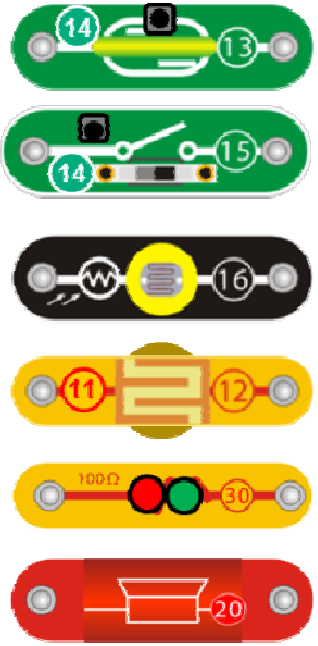
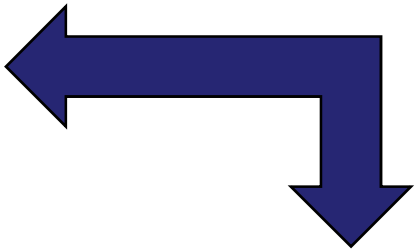
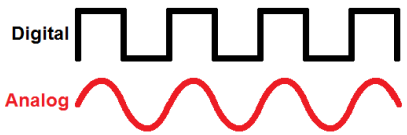
KodeKLIX Overview

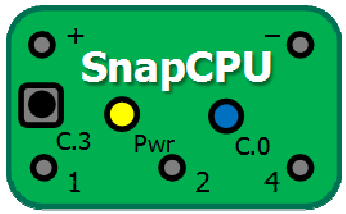
Sensors & Actuators



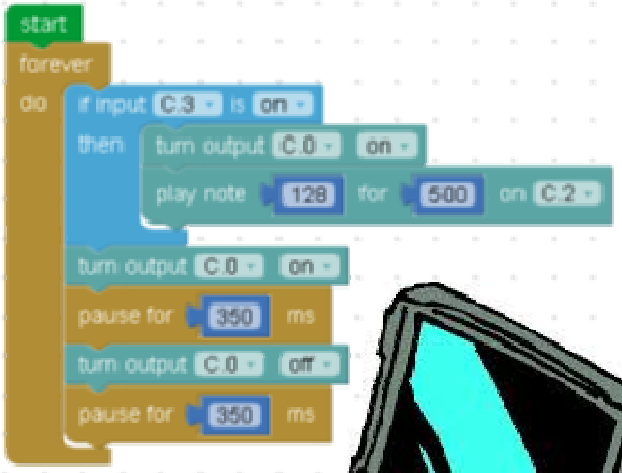


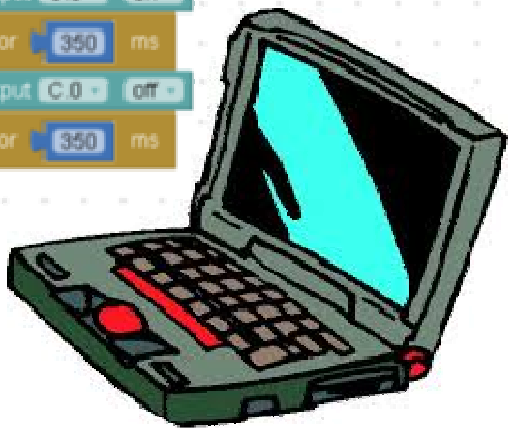


INPUT and OUTPUT signals

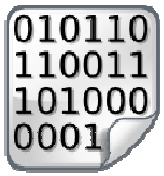


Processing





Laptop



Download Code/Data

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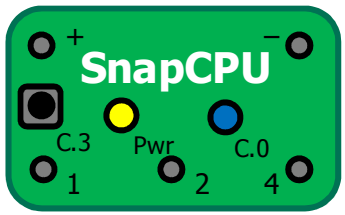
Snap Circuit Parts Included

Bonus: Some KLIX parts combine 2 or more functions

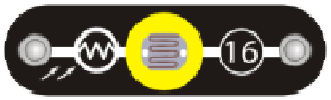


SnapCPU module (kit contains 1)
Custom Programmable PICAXE 08M2 System

Combo sensor touch/piezo [11][12] (kit contains 1)

Combo LED Red/Green [30] (kit contains 1)

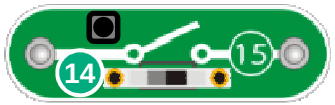
Speaker 8ohm [20] (kit contains 1)



Light level sensor [16] (kit contains 1)

Disc magnet
(kit contains 1)

Combo-switch Type #1 [13][14] (kit contains 1)

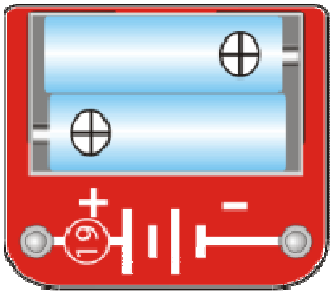


Combo-switch Type #2 [14][15] (kit contains 1)

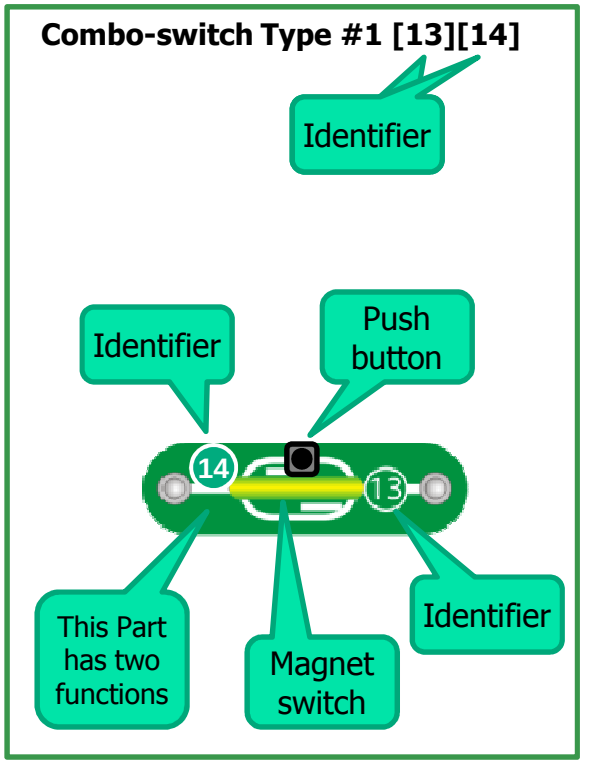
Link 4-long [4] (kit contains 2)

Link 3-long [3] (kit contains 3)

Link 2-long [2] (kit contains 2)



Battery Box [19] (kit contains 1)



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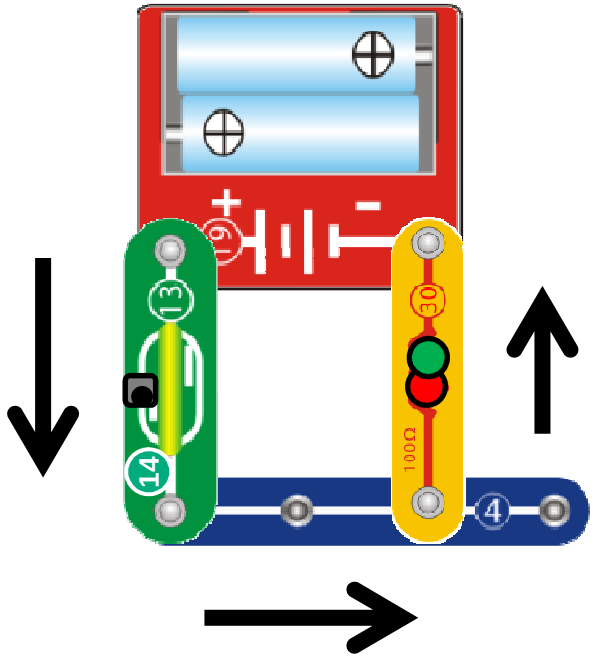
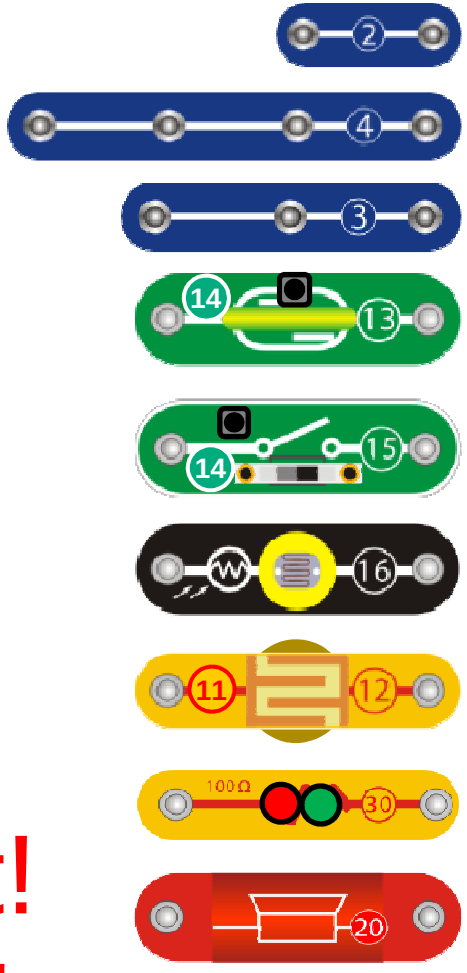
Snap Circuits Basics

Current is said to flow from the positive to the negative battery terminal, but only when the button is pressed so as to complete the circuit.





Linked parts form a circuit!

Electricity flows in a circle!

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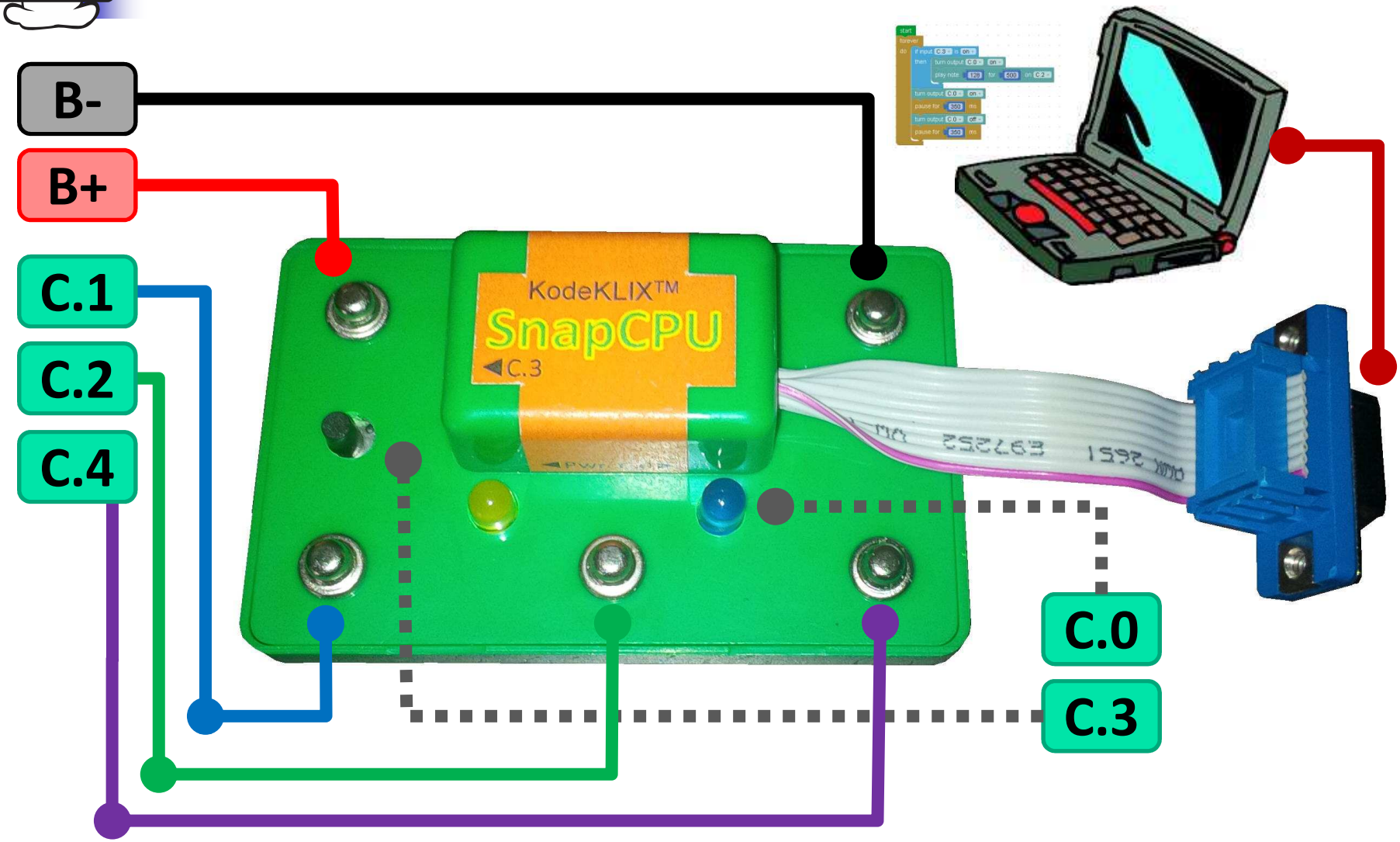
SnapCPU – adds the 'brain'



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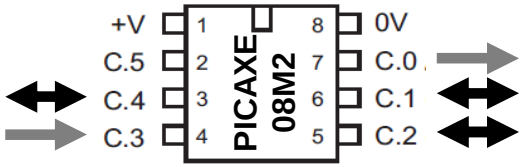
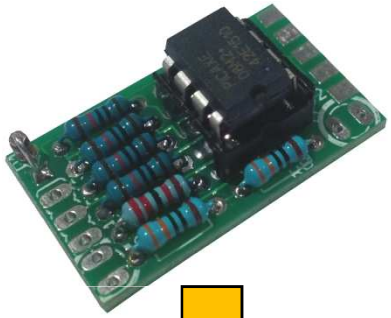
SnapCPU: How it works...

The CPU 'Chip'

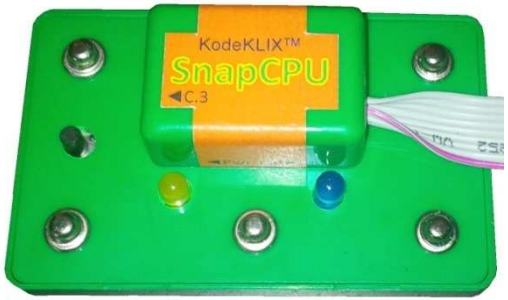


SnapCPU is powered by
a PICAXE microcomputer 'chip' – the chip
of choice in the UK school curriculum.

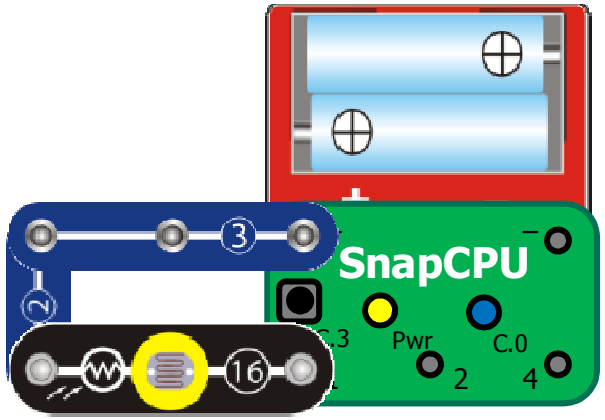
SnapCPU Core

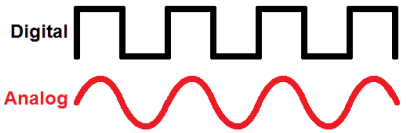


SnapCPU Component



External Circuit





Signals

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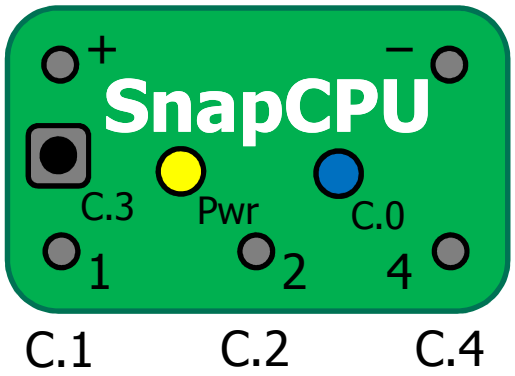
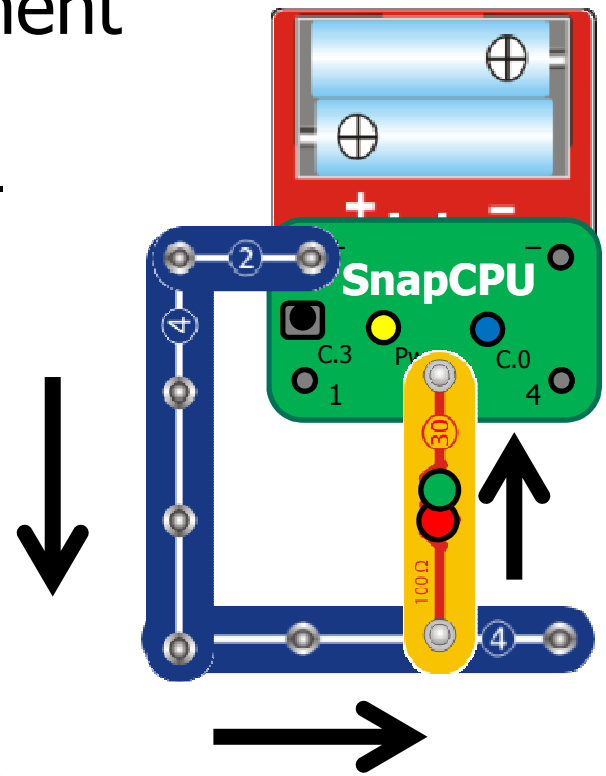
SnapCPU: CPU Circuits #1

- SnapCPU™ circuits are built similar to regular Snap and BrainBox circuits
  - Use links to connect components
  - Ensure each component is part of a "circuit" loop to either + or –





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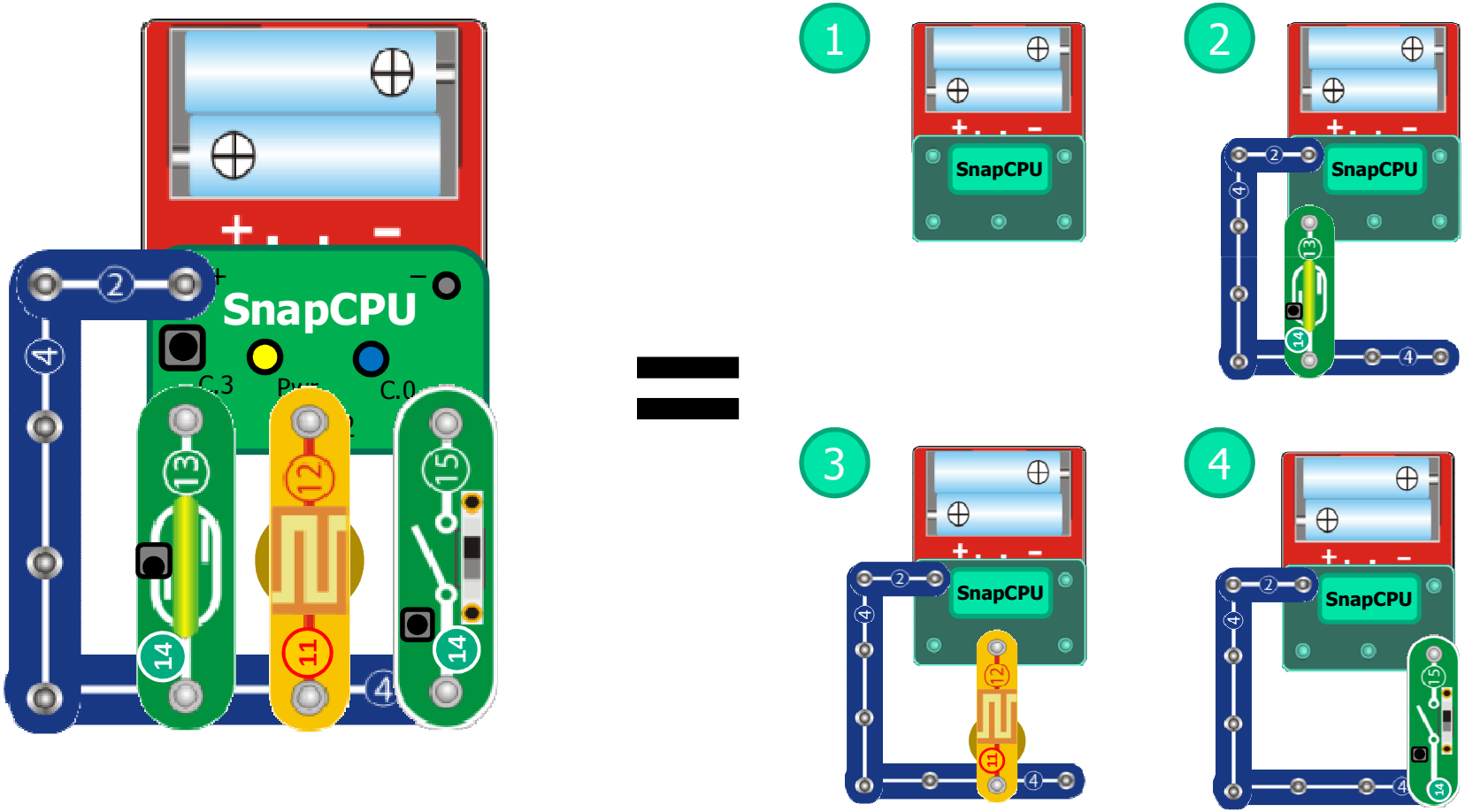
SnapCPU: Circuits #2

This complex layout has 4 circuits...



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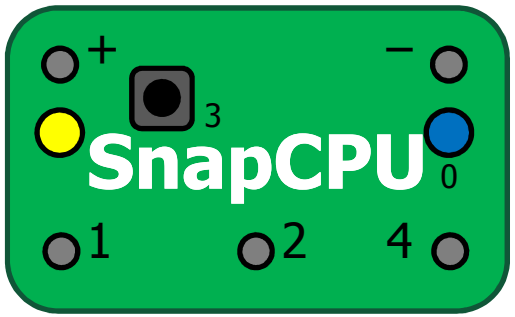
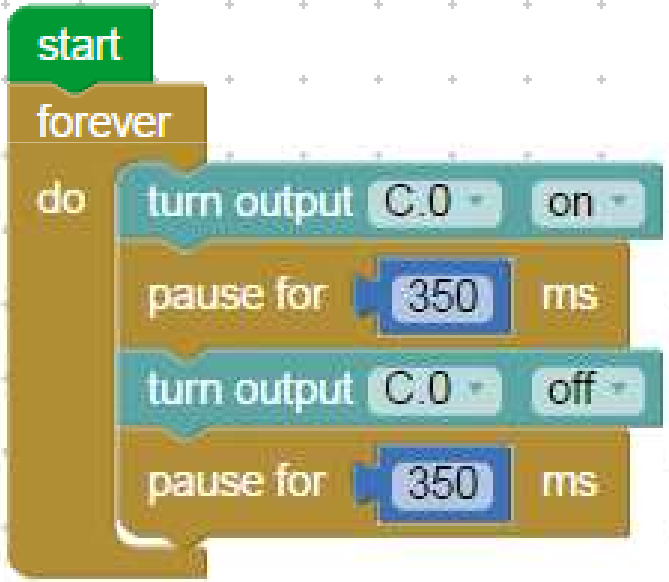
SnapCPU: How to Code #1

- Visual languages, like BLOCKLY





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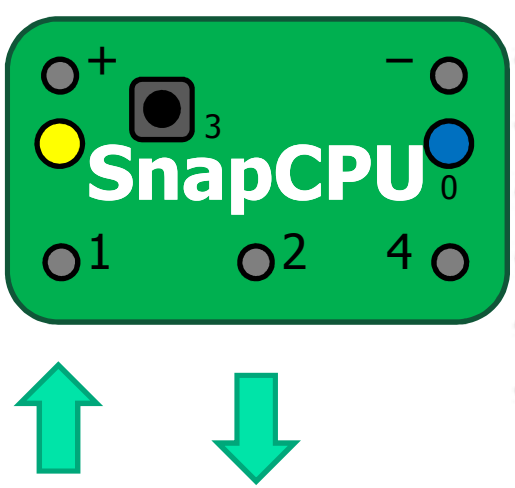
SnapCPU: How to Code #2

- Visual languages, like BLOCKLY



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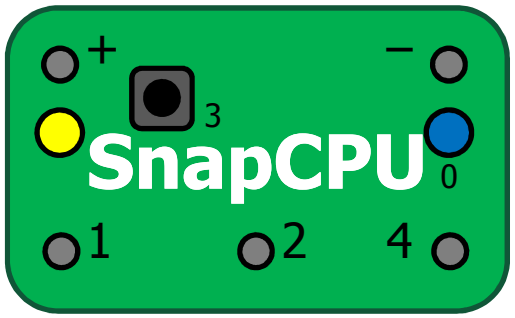
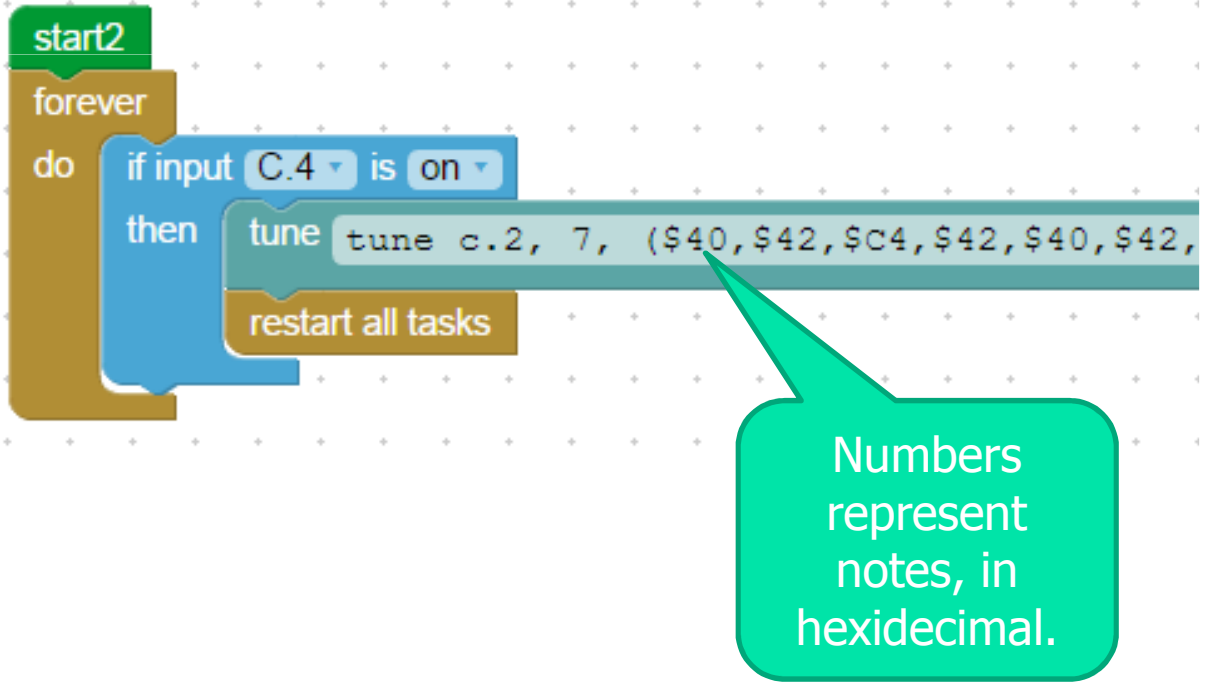
SnapCPU: How to Code #3

- Visual languages, like BLOCKLY





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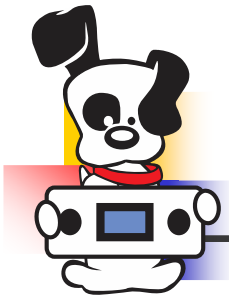

SnapCPU: How to Code #4

- Written languages, like BASIC

```
start0:
        do
        high C.0
        pause 350
        low C.0
        pause 350
        loop
        stop
```

```
start1:
        do
        if pinC.1 = 1 then
        sound C.2, ( 64, 21)
        endif
        loop
        stop
```

```
start2:
        do
        if pinC.4 = 1 then
        tune c.2, 7, ($40,$42,$C4,$42,$40,$42,$47,$C7,$45,$44,$00,$E9,$67,$65,
                $62,$64,$E2,$4C,$40,$42,$C4,$42,$40,$42,$47,$C7,$44,$47,$C9,$C7,$42,$44,$C2)
        reset
        endif
        loop
        stop
```


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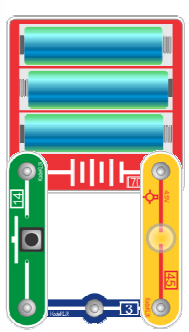
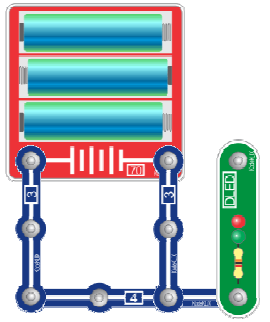
Snap Circuit DO's and DON'Ts



Always include "parts" between + and - terminals



This layout has a "SHORT-CIRCUIT" directly between + and - terminals

DOs

"Snap Circuits" are available in a range of brands including the original Snap-Circuit, BrainBox, Heebie-Jeebies, Clip Circuit, Electro-Lab, etc.

All components are generally inter-connectable, however care should be taken to not over load components or apply a higher voltage than instructions prescribe.

KLIX parts describes the KodeKLIX® variant. These KLIX parts may be standard, customised or combo (dual function) parts.

DON'Ts

The SnapCPU™ is designed to work only with:

- 3V battery box
- 4.5V battery box
- USB adaptor

Do not connect to higher voltage, like a 6V battery box as this will damage the SnapCPU™.

Only connect high powered devices like motors and light globes to SnapCPU™ prescribed pins.

Battery Safety

- Use only 1.5V AA type batteries with this kit
- Insert batteries with the correct +/– polarity
- Do not mix battery types, old with new
- Remove batteries when project not used
- Batteries are harmful when swallowed, so keep away from small children
- Do not short circuit the battery +/– terminals (see manual for details)

WARNING: CHOKING HAZARD - Small parts not for children under 3 years.

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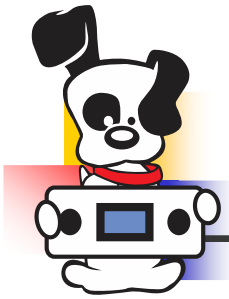
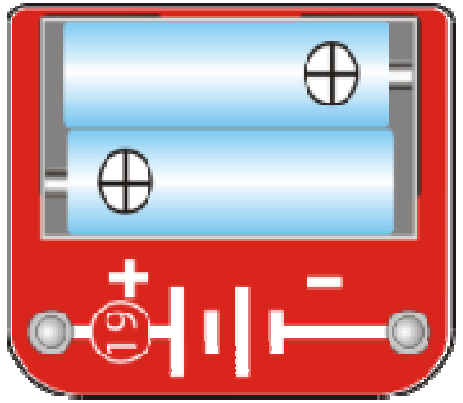
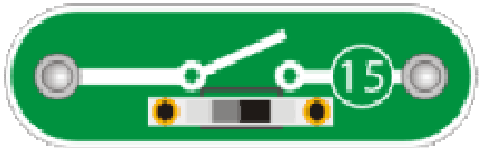


Power and Battery Safety!

- Only use the battery pack provided with the kit; or power the SnapCPU™ circuit with the USB dongle
  - Having both connected is Ok
- **Do not** link multiple battery packs
- Use alkaline AA batteries for best results; these last longer too
- Remove batteries when not in use
- Including a switch to power your project on / off is a great idea
- Do not short-circuit your power source
  - The computer's USB power may be disabled if you do; reboot to reset





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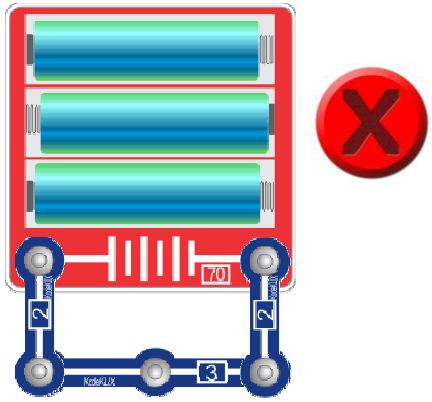
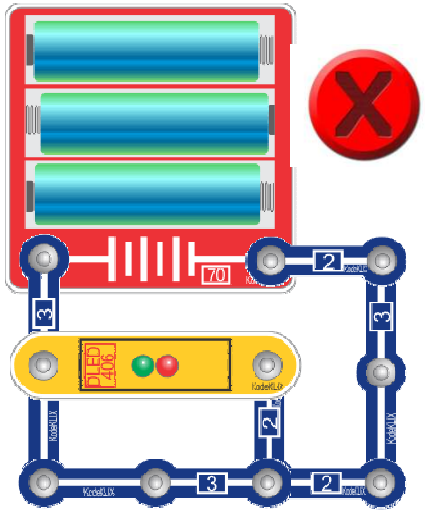
Short Circuits and Safety!

- All these circuits have problems!!!
- Electricity will always take the path of lowest resistance; the short path!
- NEVER connect battery +ve directly to –ve; if you do lots of electric current flows and parts can get very hot!

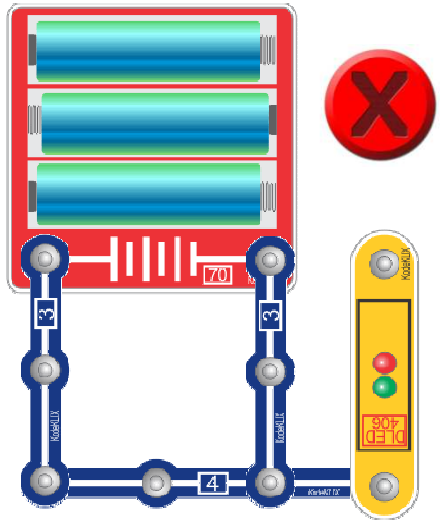


Short-Circuit A

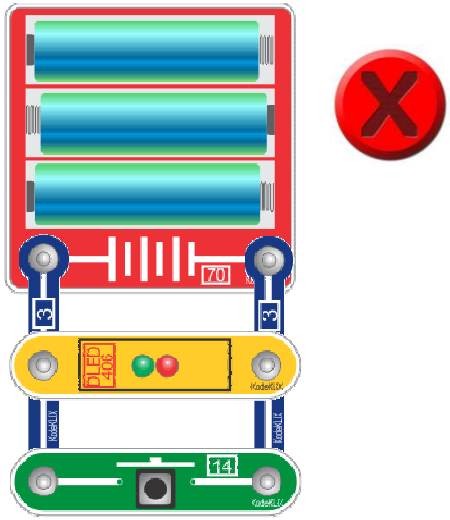
Short-Circuit B



Short-Circuit C



Short-Circuit D

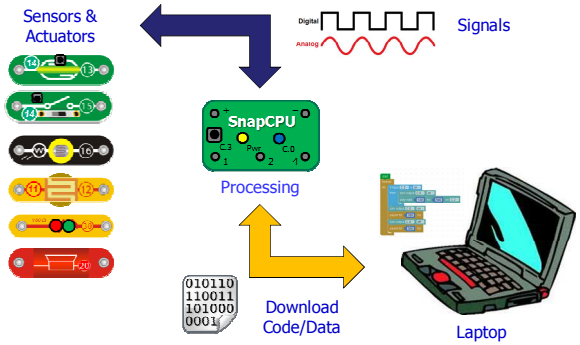


The Three KodeKLIX Levels

Level A

SnapCPU

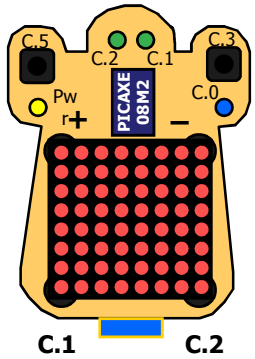
- Introduction to the basics of systems control
- Includes CPU, sound basics



Level B

SnapBug

- A fun way to integrate more complex coding
- Includes CPU control of displays

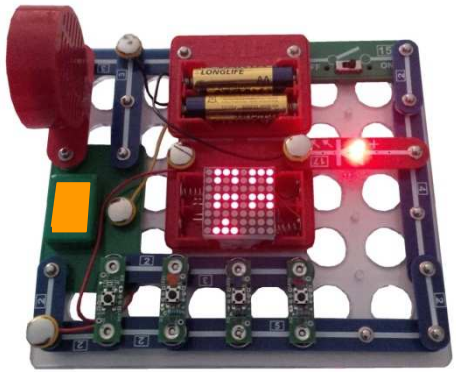


Level C

NEXT LEVEL

Snap4STEM

- Curriculum focused activities with more complex parts and projects



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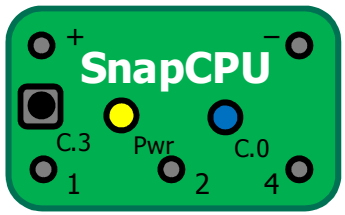
Snap Circuit Parts Included

Bonus: Some KLIX parts combine 2 or more functions

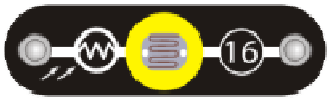


SnapCPU module (kit contains 1)
Custom Programmable PICAXE 08M2 System

Combo sensor touch/piezo [11][12] (kit contains 1)

Combo LED Red/Green [30] (kit contains 1)

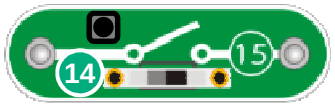
Speaker 8ohm [20] (kit contains 1)



Light level sensor [16] (kit contains 1)

Disc magnet
(kit contains 1)

Combo-switch Type #1 [13][14] (kit contains 1)

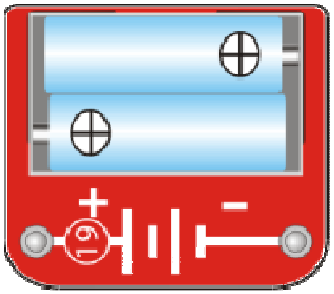


Combo-switch Type #2 [14][15] (kit contains 1)

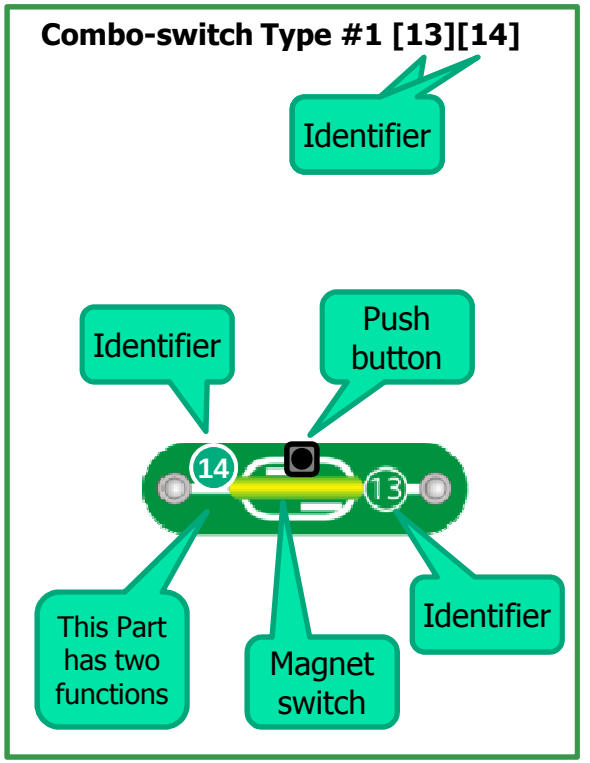
Link 4-long [4] (kit contains 2)

Link 3-long [3] (kit contains 3)

Link 2-long [2] (kit contains 2)



Battery Box [19] (kit contains 1)



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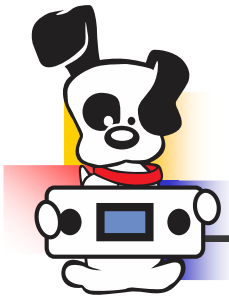

Week 2

- Introduction to BLOCKLY
- Downloading new code
- Level 0 & 1 activities

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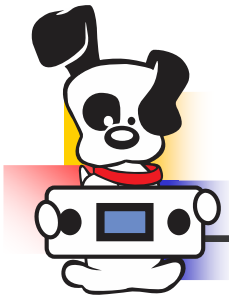

KodeKLIX thus far…

- Basics of circuits
- Basics of coding in BLOCKLY
- Checked out our kits
- Example projects A and B
- Some have started DOWNLOADING project B

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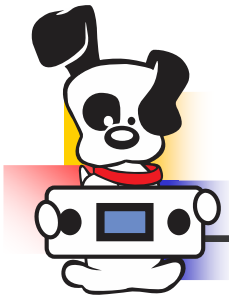

KodeKLIX this week... #1

- Everyone will check their computer/laptop
  - BLOCKLY
  - Examples
  - Website
  - Cable
  - DOWNLOAD OK!

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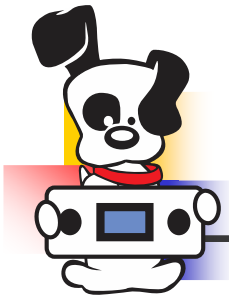

KodeKLIX this week... #2

- Level 0
  - Projects
  - Quiz
  - Challenges
- Level 1
  - Projects
  - Quiz
  - Challenges
- Prizes x2

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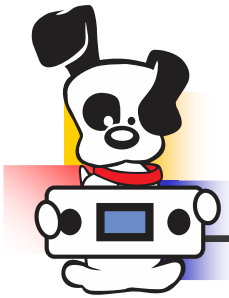

Week 3

- Quizzes and Challenges review 0 & 1

- Level 2 activities

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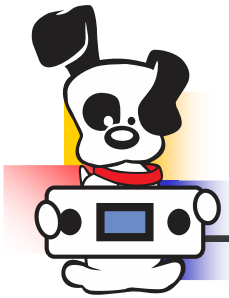
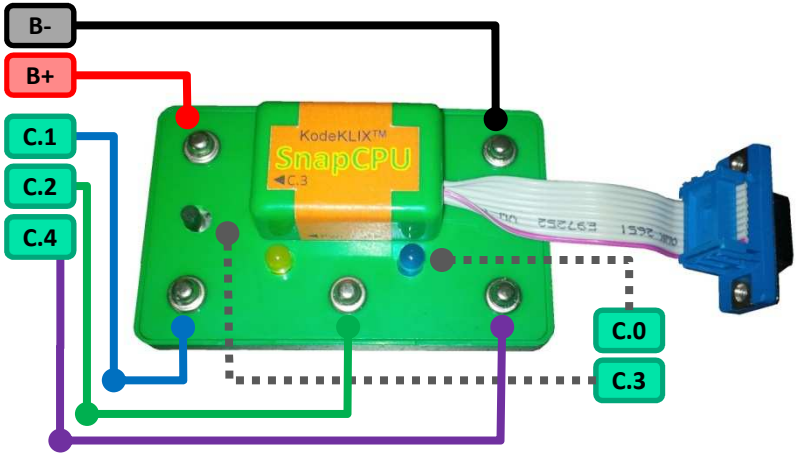
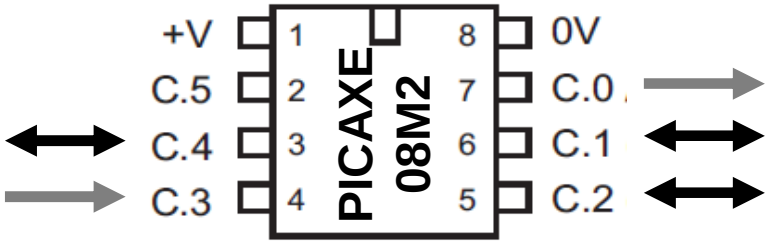


SnapCPU: Quick Quiz

True or False

- Chip pin C.0 connects to the BLUE LED
- Chip pin C.3 reads the push button
- Chip pins C.1; C.2 and C.4 connect to snaps
- Snap pins can be used for both input and output
- Power needs to be connected to wake up your SnapCPU





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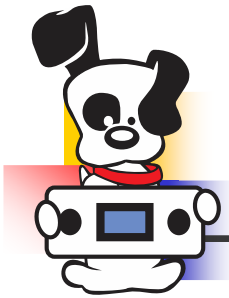

Quick Start ➔ Refresh!

- Connect USB cable to computer
  - You might need to [refresh] to find it in the drop down COM port box
- Connect battery to the SnapCPU
- Build the project circuit
- Build the project code in Blockly
  - Check snap pins the code refers to
- "Check" the code; fix any errors
- Download the "Program" code
- Test the project

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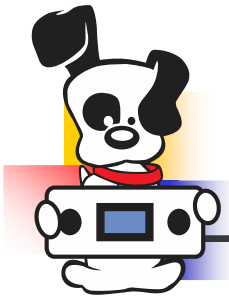

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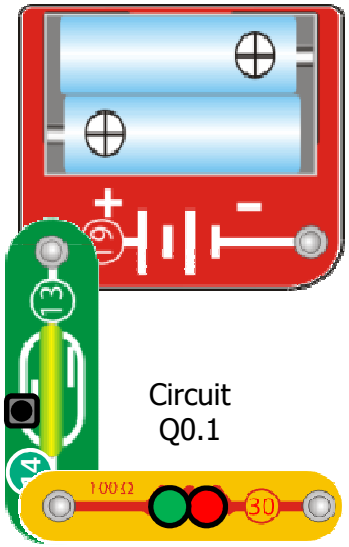
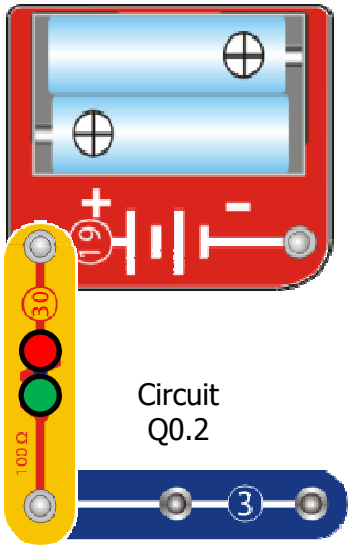
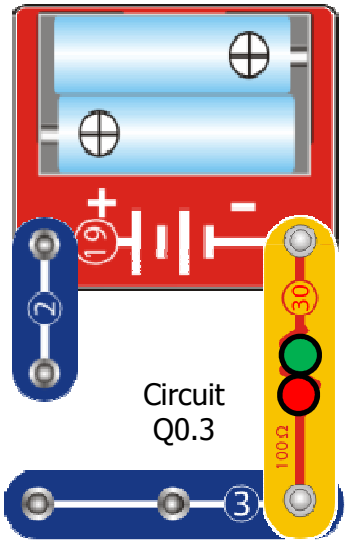
Level 0: Quick Quiz

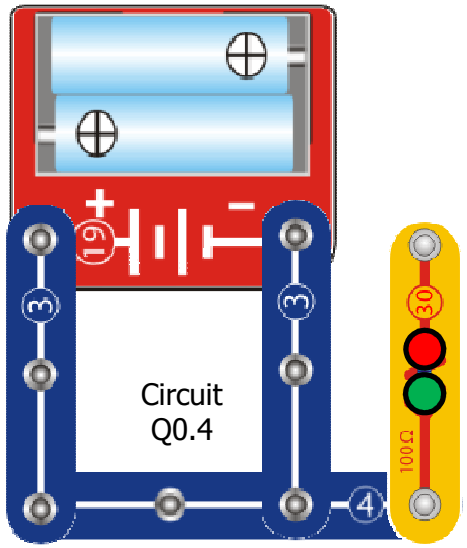
- What is missing? Complete circuits Q0.1, Q0.2 and Q0.3 by adding a KLIX part.







- There is something wrong in circuit Q0.4; DO NOT build it. What is it that is wrong?



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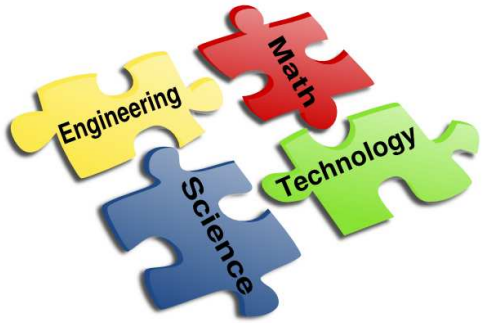
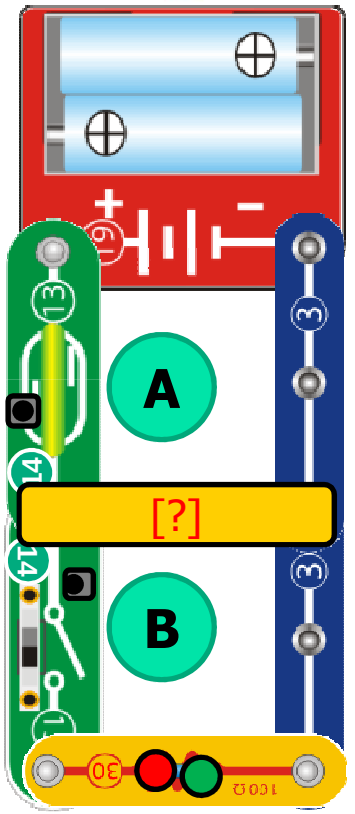
Level 0: Challenges

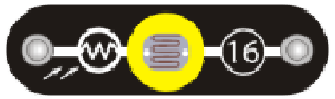


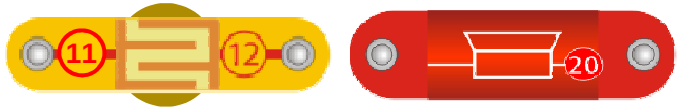
STORING ELECTRICAL ENERGY

- Build the circuit as shown, but without part [?] fitted
- Test the circuit until the LED lights; describe the logic of it
- Try the parts below for [?], does the logic change?
- Try this, with part [20] fitted:
  - Push button A; release, then…
  - Push button B (LED will flicker)
  - Why, and does it do so with other parts?

Hint: Look closely at the parts. You might have to Google how the components inside the parts work or ask for help to understand why.







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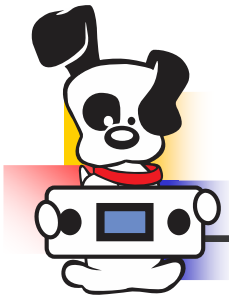

Level 1: Quick Quiz

This Quiz will check how well you can read the basic coding statements and functions

- How many times is this loop performed?

- What values should varA, varB and varC have if you want to count from 1 to 10 in steps of 2?

- True or False:
  - All programs must include one START
  - You can have more than one START
  - C.3 is an OUTPUT
  - C.0 is an INPUT
  - C.1 can be both an INPUT or OUTPUT

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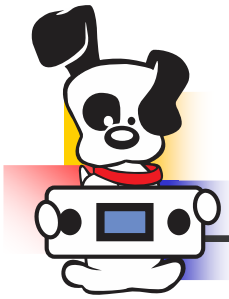
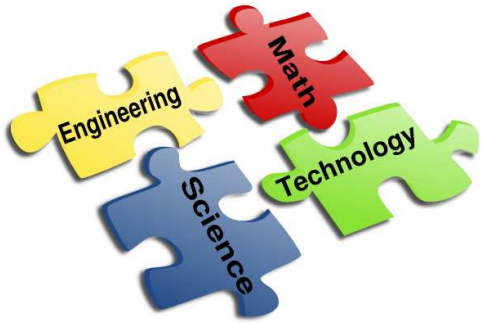
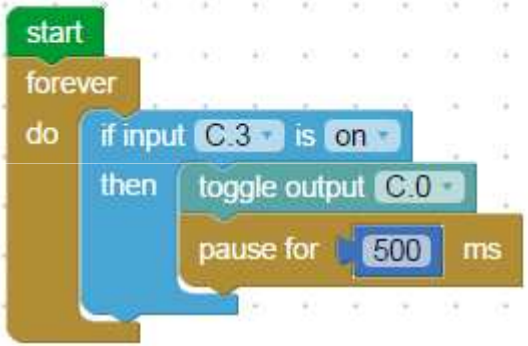


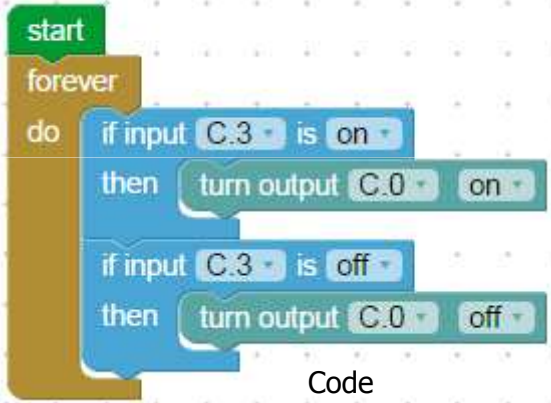
Level 1: Challenges



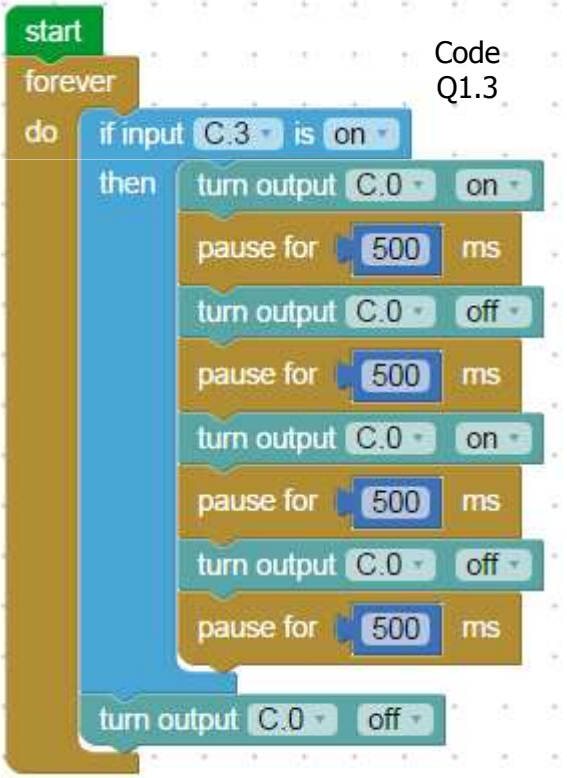
- Make these code examples as short as possible using loops and/or procedures, but still do the same things:



Code Q1.1



Code Q1.2



Code Q1.3

- Shorten the code in 1.6 further by using a second procedure for the "S"

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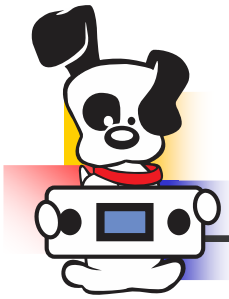
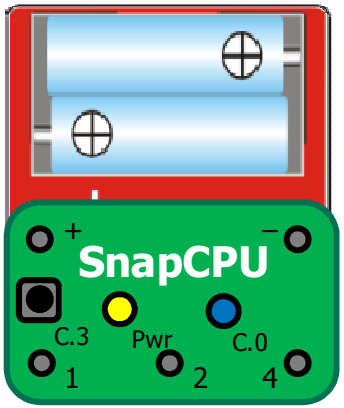


Completed ☐

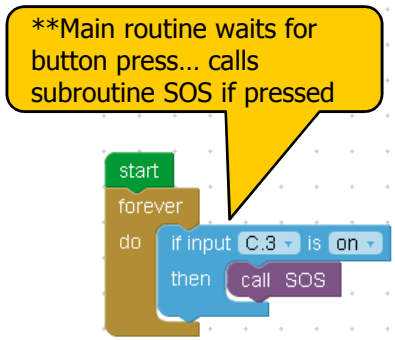
Project 1.6

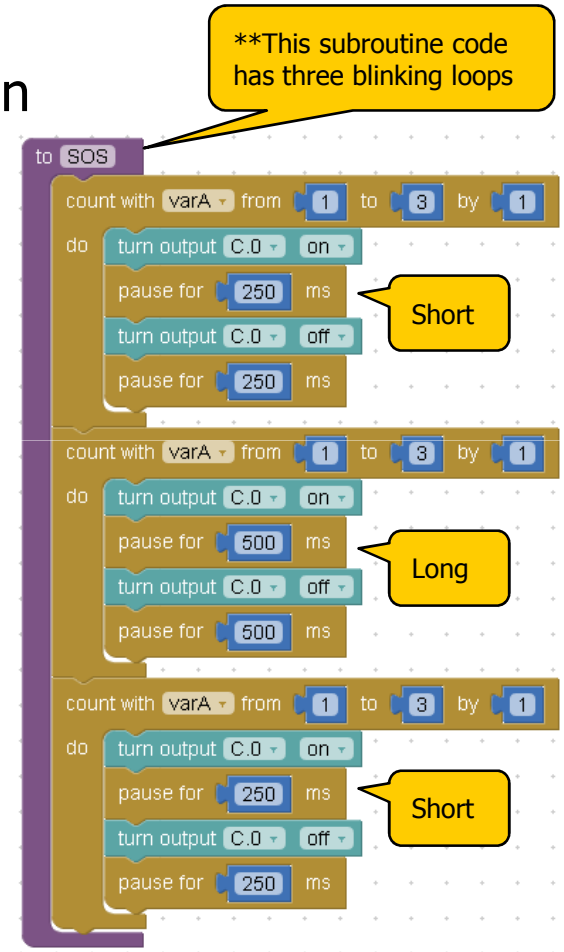
LED Blinking Morse code for SOS

- Assemble the snap components as shown in circuit 1.6; Construct the BLOCKLY code and download to the SnapCPU
- Observe the LED marked C.0 blink out the SOS code when button C.3 pressed
- Review the following BLOCKLY code to understand what is happening



Circuit 1.6





Challenge: 1) modify the code to repeat the sequence 3 times; 2) modify the code to send A-B- C instead

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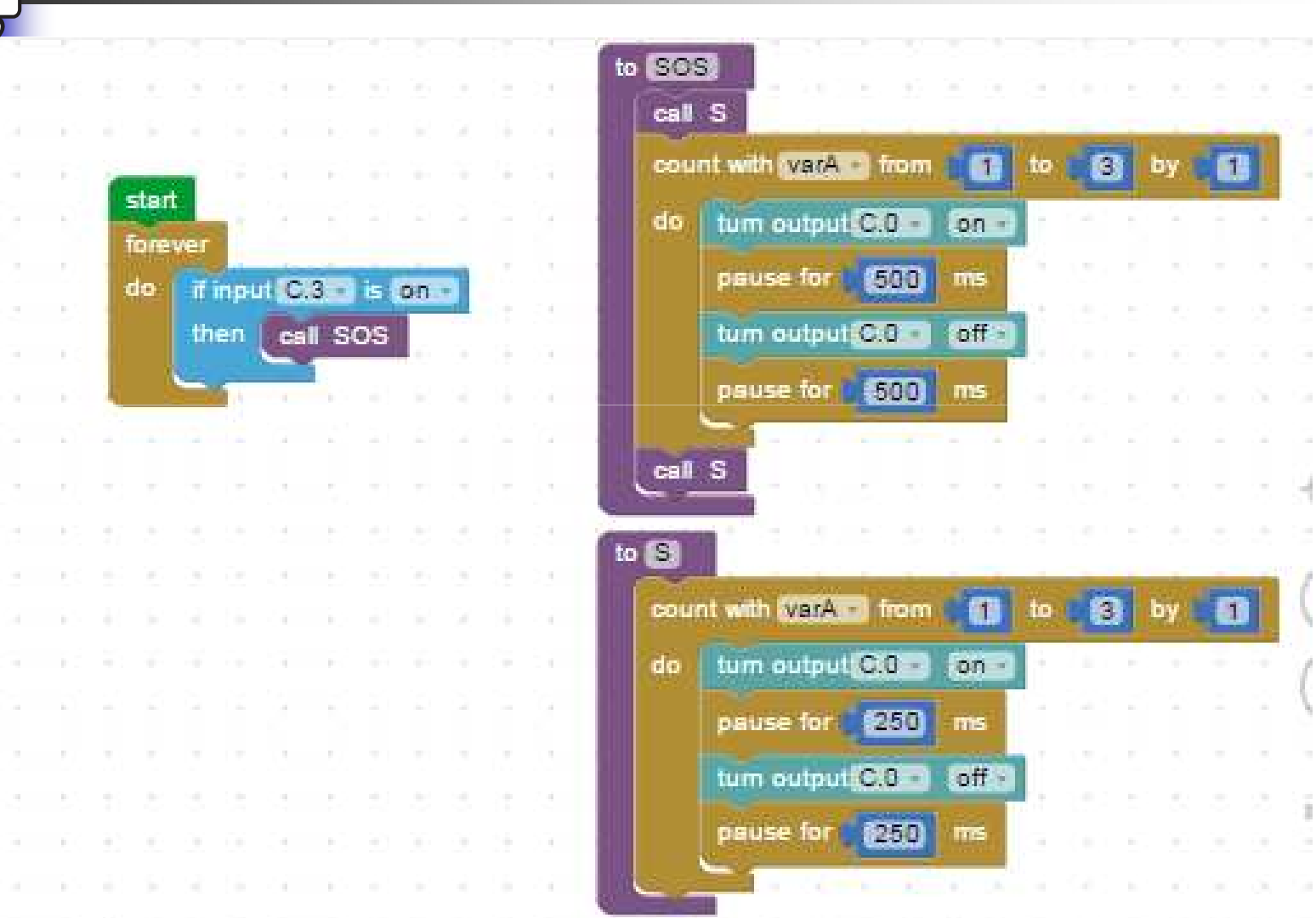
Challenge 1.6



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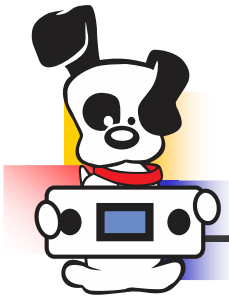

Week 4

- Free play

- Level 2 activities
- Level 3 activities

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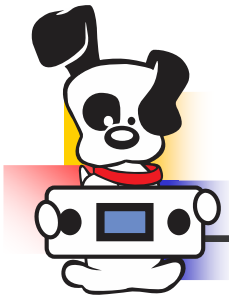

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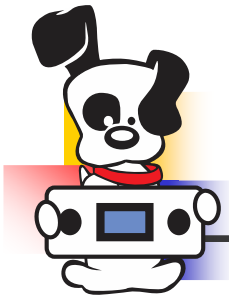

Week 5

- Level 3 Quiz
- Level 4 activities
- Traffic Lights

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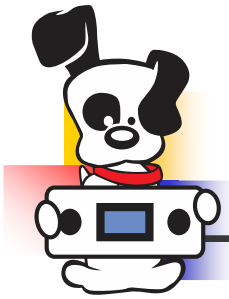

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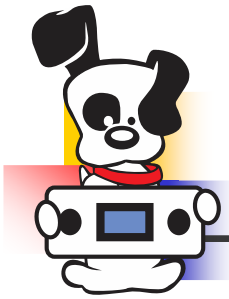

About Digital Logic…

- Digital logic is very similar to human logic
  - AND means multiple things must all be true
  - OR means only one needs to be
  - NOT is the opposite, or negative
  - NOR is the negative of OR, "NOT OR"
  - NAND is the negative of AND, "NOT AND"
  - XOR is a case of either one, not both
- Logic is used to group decisions in code
  - for example checking for multiple input conditions before making a decision

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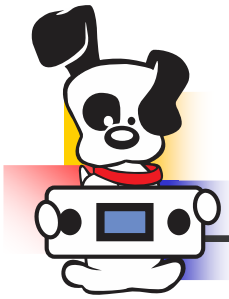

Level 3: Quick Quiz

- Complete these logic truth tables for inputs A and B; you want check with a circuit you built earlier...

A	B	AND
0	0	
0	1	
1	0	
1	1	

A	B	OR
0	0	
0	1	
1	0	
1	1	

A	B	XOR
0	0	
0	1	
1	0	
1	1	

A	B	NAND
0	0	
0	1	
1	0	
1	1	

A	B	NOR
0	0	
0	1	
1	0	
1	1	

A	NOT
0	
0	
1	
1	

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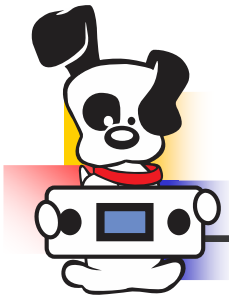

Week 6

- More About Numbers

- Level 4 – Controlling Outputs

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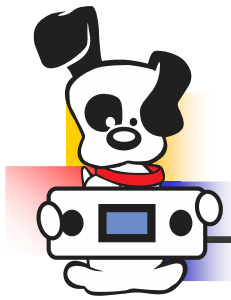
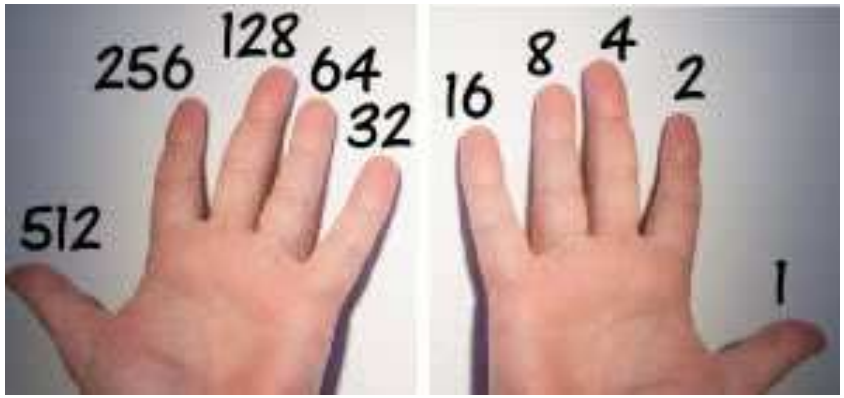


About Binary Numbers…

- Binary numbers are how computers count
  - Humans count in "tens" because we have 10 digits on our hands
  - Computers count with digits 0 and 1 only



Decimal	Binary	
0	0	000
1	1	001
2	10	010
3	11	011
4	100	100
5	101	101
6	110	110
7	111	111

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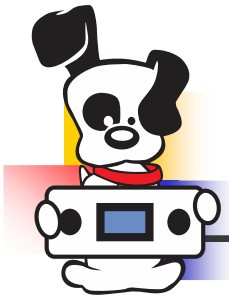
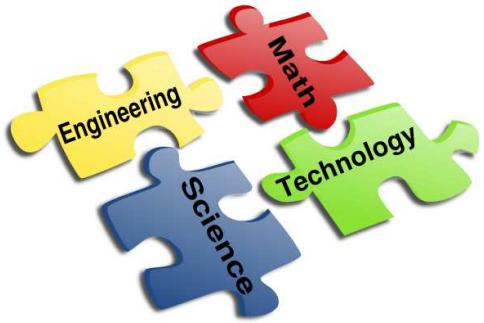
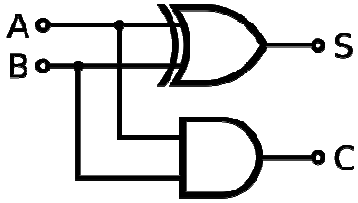


Level 3: Challenges



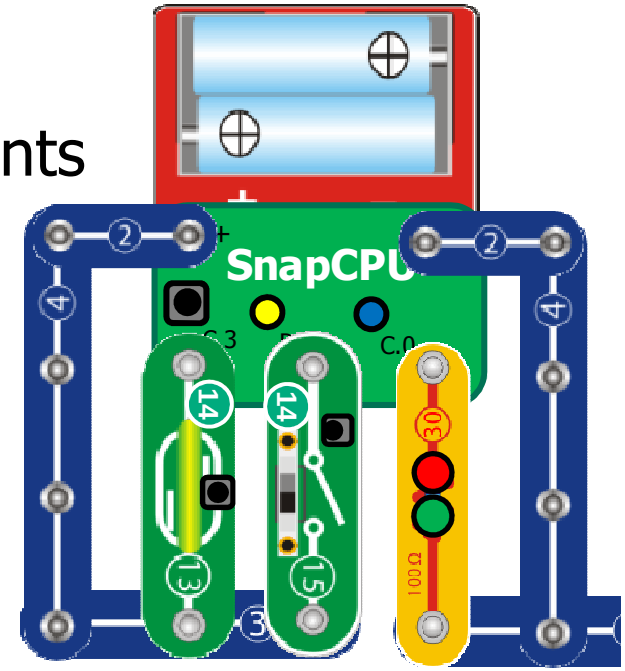
BINARY ADDER

- Use the circuit below. Create code to do the binary maths; in this case two "bits"
  - Bit0 (C.4) uses an XOR function (see 3.3)
  - Bit1 (C.0) uses an AND (see 3.2)
- The truth table below helps!



Hint: use multiple if…then… statements

A C.1	B C.2	SUM A B	Bit1 C.0	Bit0 C.4	Decimal Value
0	0	00	0	0	0
0	1	01	0	1	1
1	0	01	0	1	1
1	1	10	1	0	2



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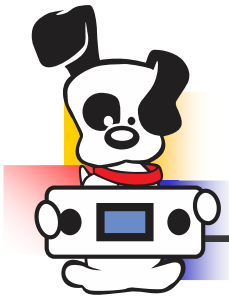

Week 7

- Level 4 – Controlling Outputs
- Level 4 – Challenge Solution(s)
- Introduction to Sounds and Sound Effects

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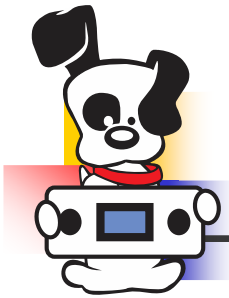
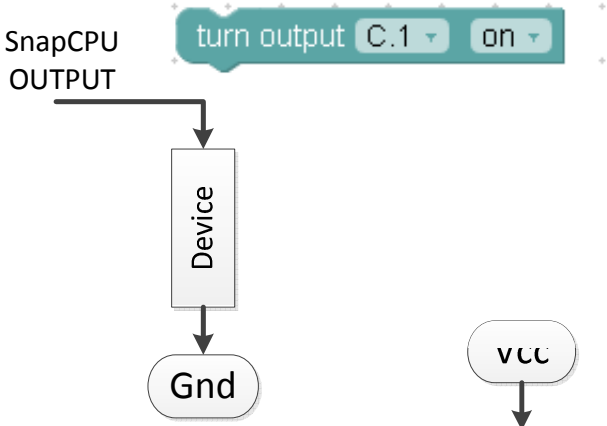
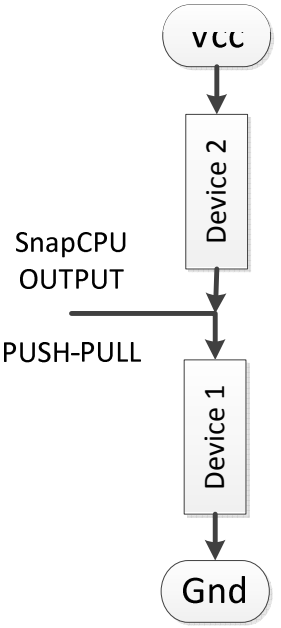


Level 4: Output Circuits

- Flash LED C.2 when C.1 connected high
  - Push button
  - Slide switch
  - Magnet sensor
  - Light sensor
- Rework circuits to light the other LED on component [30]
- Driving LEDs as push-pull
- Controlling output levels between extremes of "OFF" and "ON"





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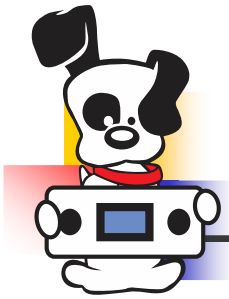
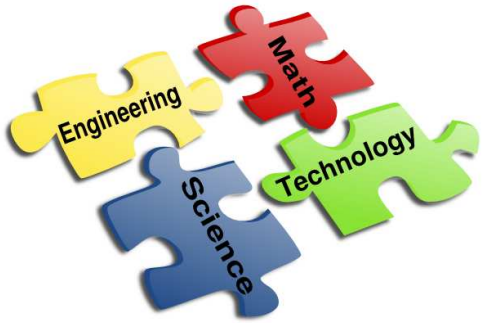
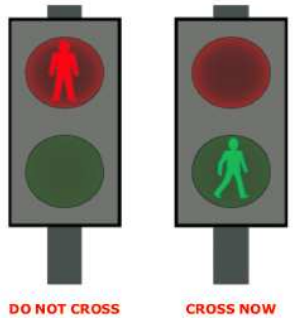


Level 4: Challenges



TRAFFIC WALK LIGHTS



- Modify circuit 4.3 and code to act like a traffic crossing
  - Add /use a switch to request "I want to cross the road"
  - Upon request, wait 10seconds then change lights from RED to GREEN for 20seconds, and then back to RED
- If you want to be extra tricky
  - Modify your code to flash RED for 5seconds before staying RED

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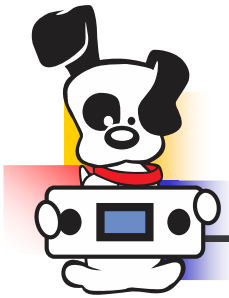


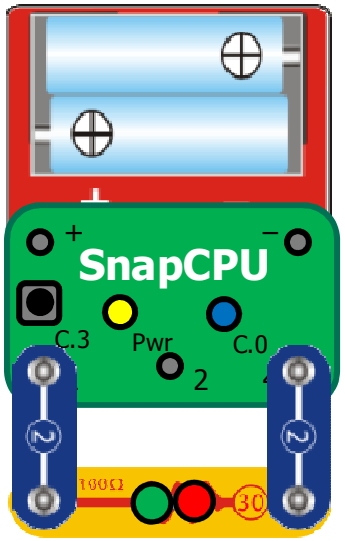
Project 4.3 or 4.4

Completed ☐

Push-Pull LED Output via the SnapCPU™

- Assemble the snap components as shown in circuit 4.4 (WARNING: only do with LEDs#)

Circuit 4.4



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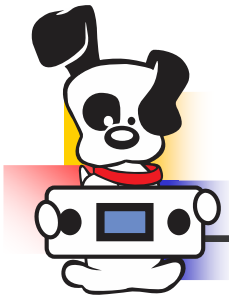
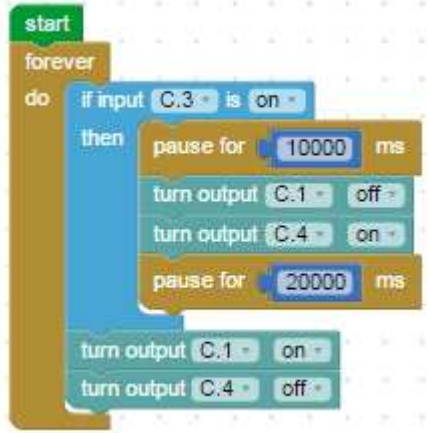


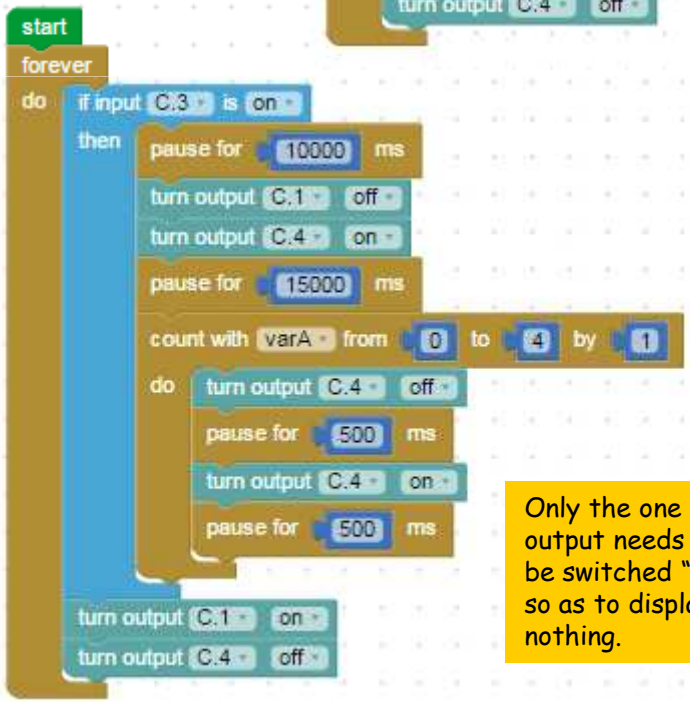
Challenge Solutions – Level 4

Sample* solutions only:

- Simple traffic walk light changer



- Detailed traffic walk light changer with signal change flashing



Only the one "on" output needs to be switched "off" so as to display nothing.

* There may be other ways to achieve the same outcome.

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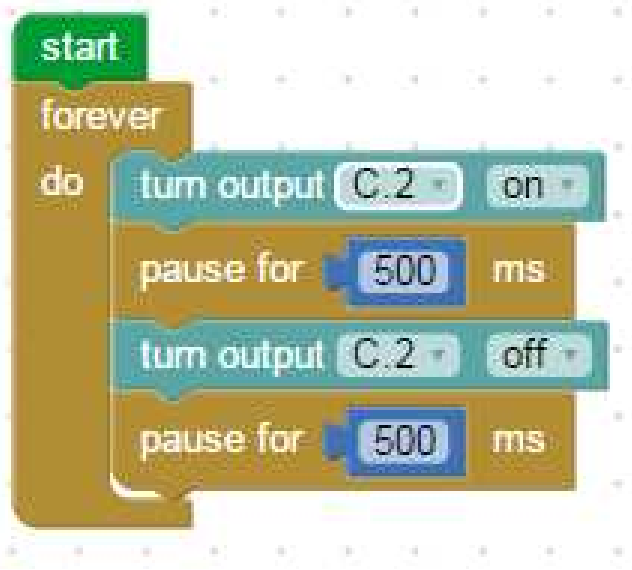
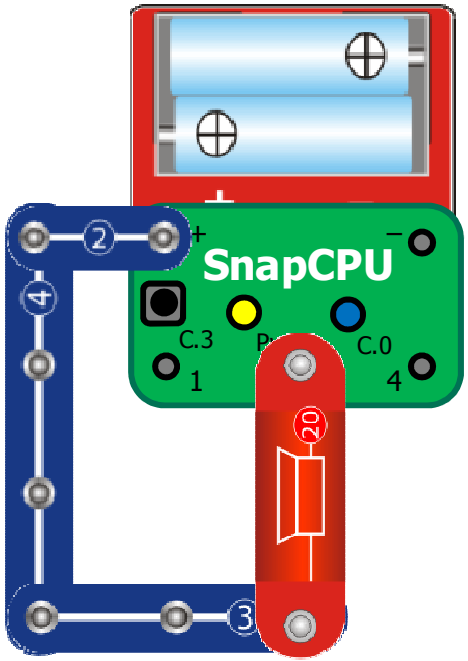
Sound Fundamentals

- Start with the circuit and code shown below, then adjust the pause numbers to make different notes, effects, etc





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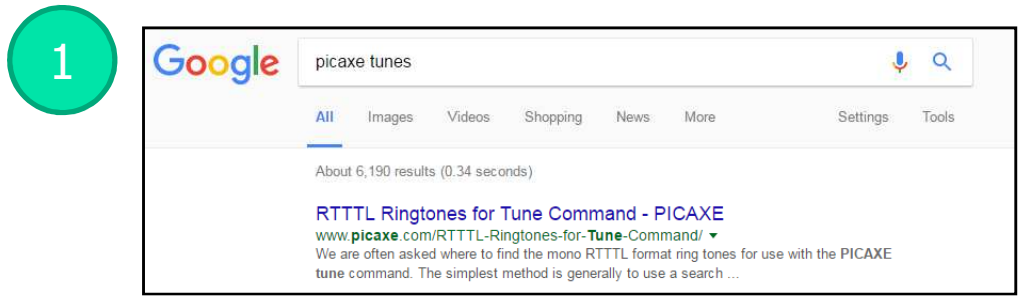
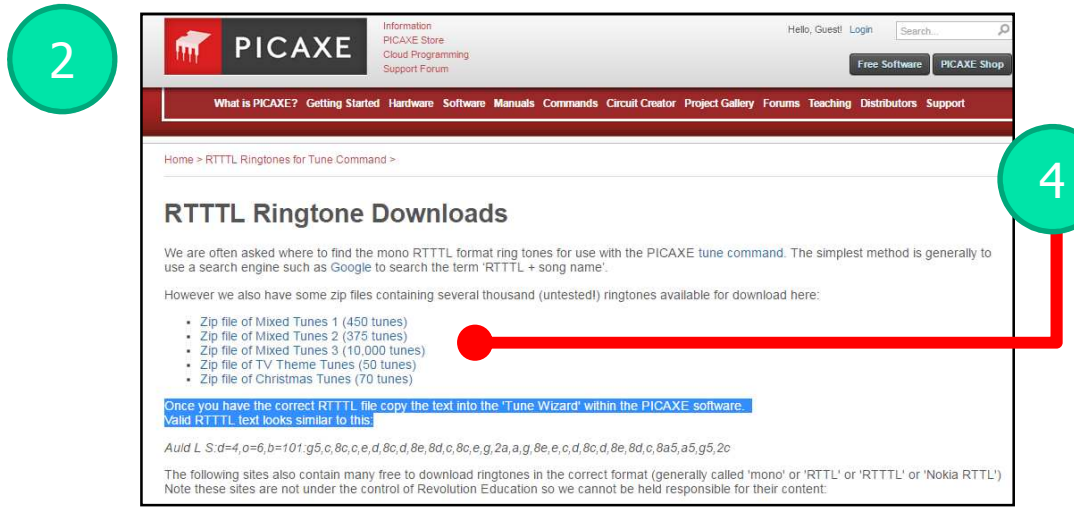
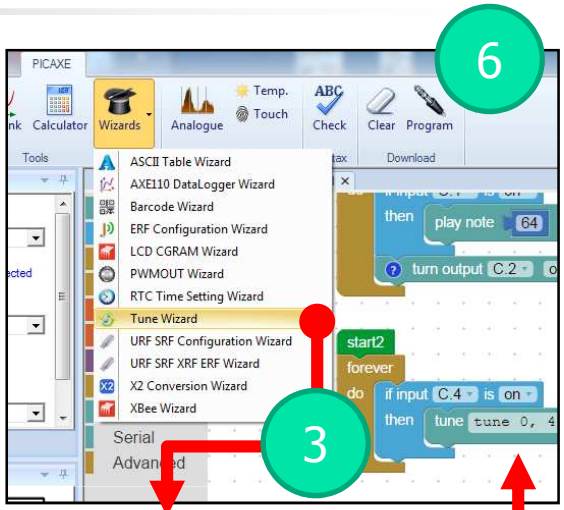
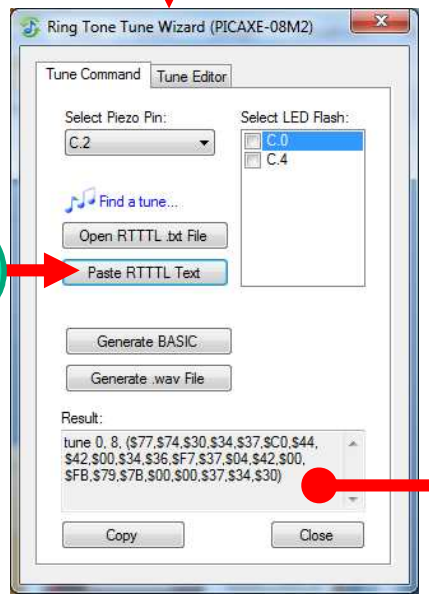
Using PICAXE's TUNE Library

- Find the PICAXE Tune website
- Open the RTTTL for the Tune you want
- Copy/paste RTTTL "txt" to Tune Wizard; or BAS code direct into TUNE command



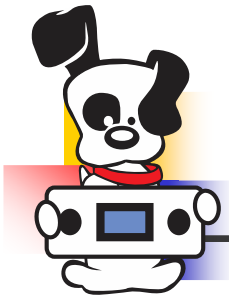






4

5



Week 8

- Survey – did you like KodeKLIX?
- Certificates and Term 2 and 3
- Keep going with level 6 and 7
- Special Project – the Modern Automobile

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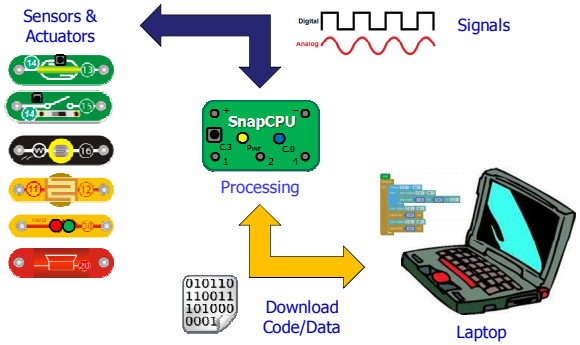
The Three KodeKLIX Levels

Level A

SnapCPU

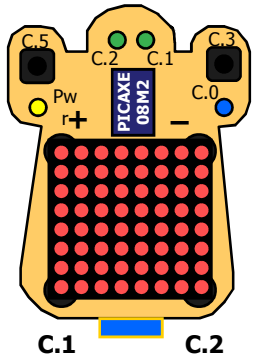
- Introduction to the basics of systems control
- Includes CPU, sound basics



Level B

SnapBug

- A fun way to integrate more complex coding
- Includes CPU control of displays

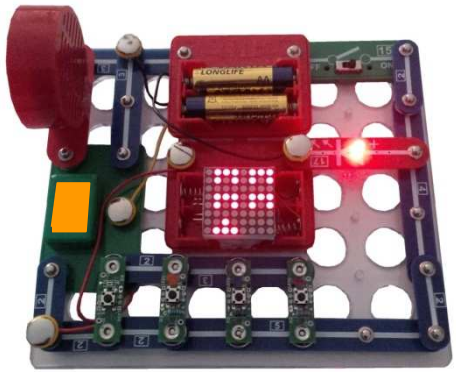


Level C

NEXT LEVEL

Snap4STEM

- Curriculum focused activities with more complex parts and projects



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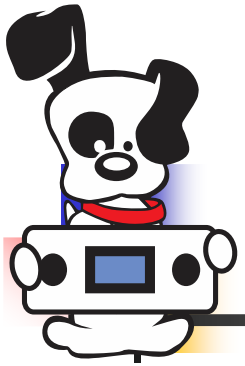

Modern Automobile Controls

SnapCPU Project Guide

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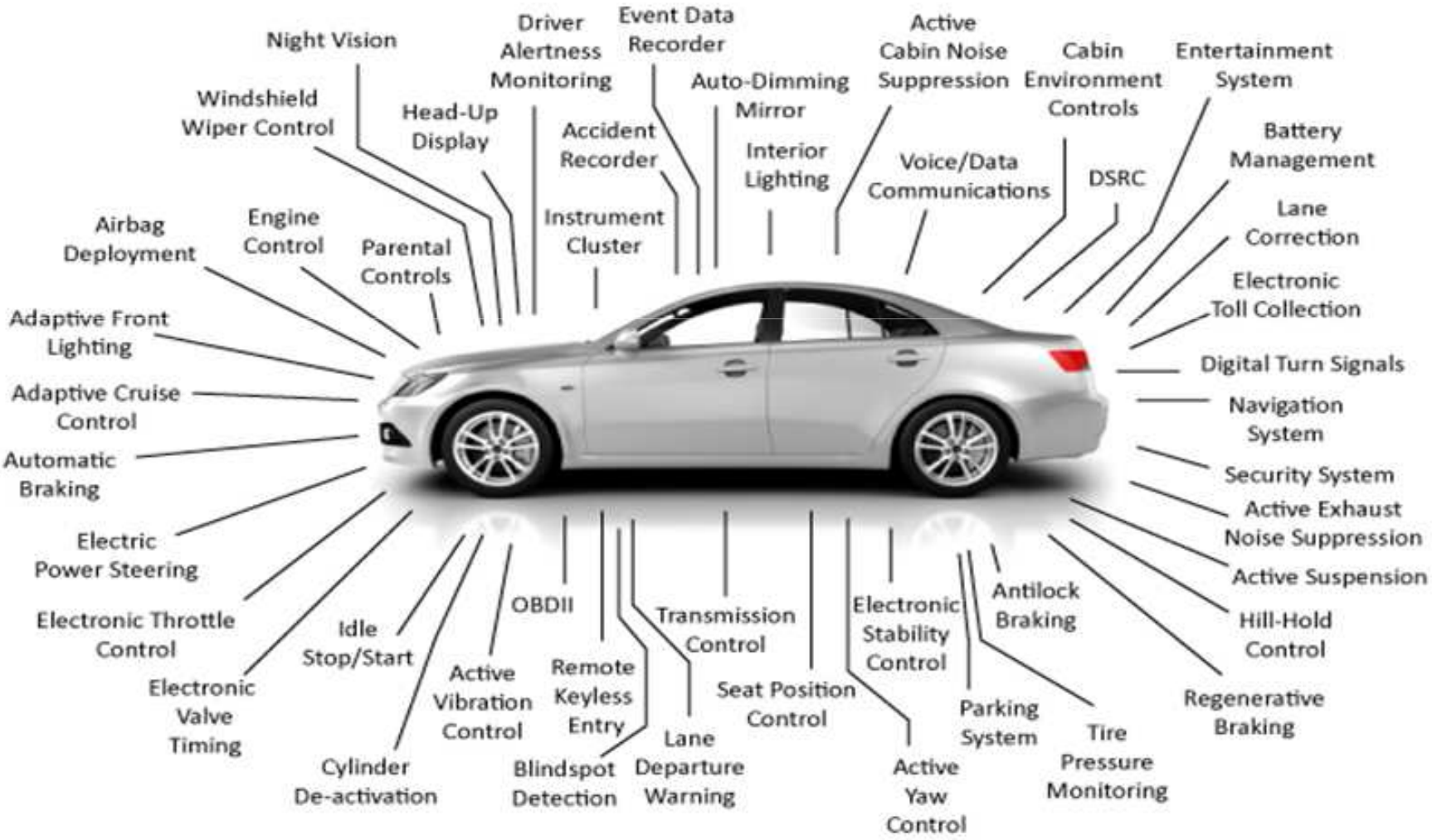
Modern Automobile Controls

A modern vehicle has hundreds of computer controlled functions



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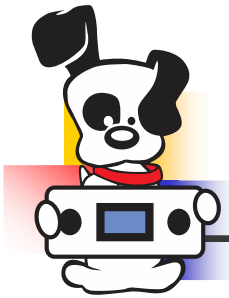

Automobile Control Projects

Powertrain
- Battery / Solar (for motor)
- Acceleration (incl. assisted)

Automatic Climate Control (Aircon)
- Turn on fan when over-temperature

Digital Entertainment
- Play tunes from stored memory

Vehicle Security
- Bump or Tilt detection alarm

Automatic Headlights
- Light them up in dim conditions

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