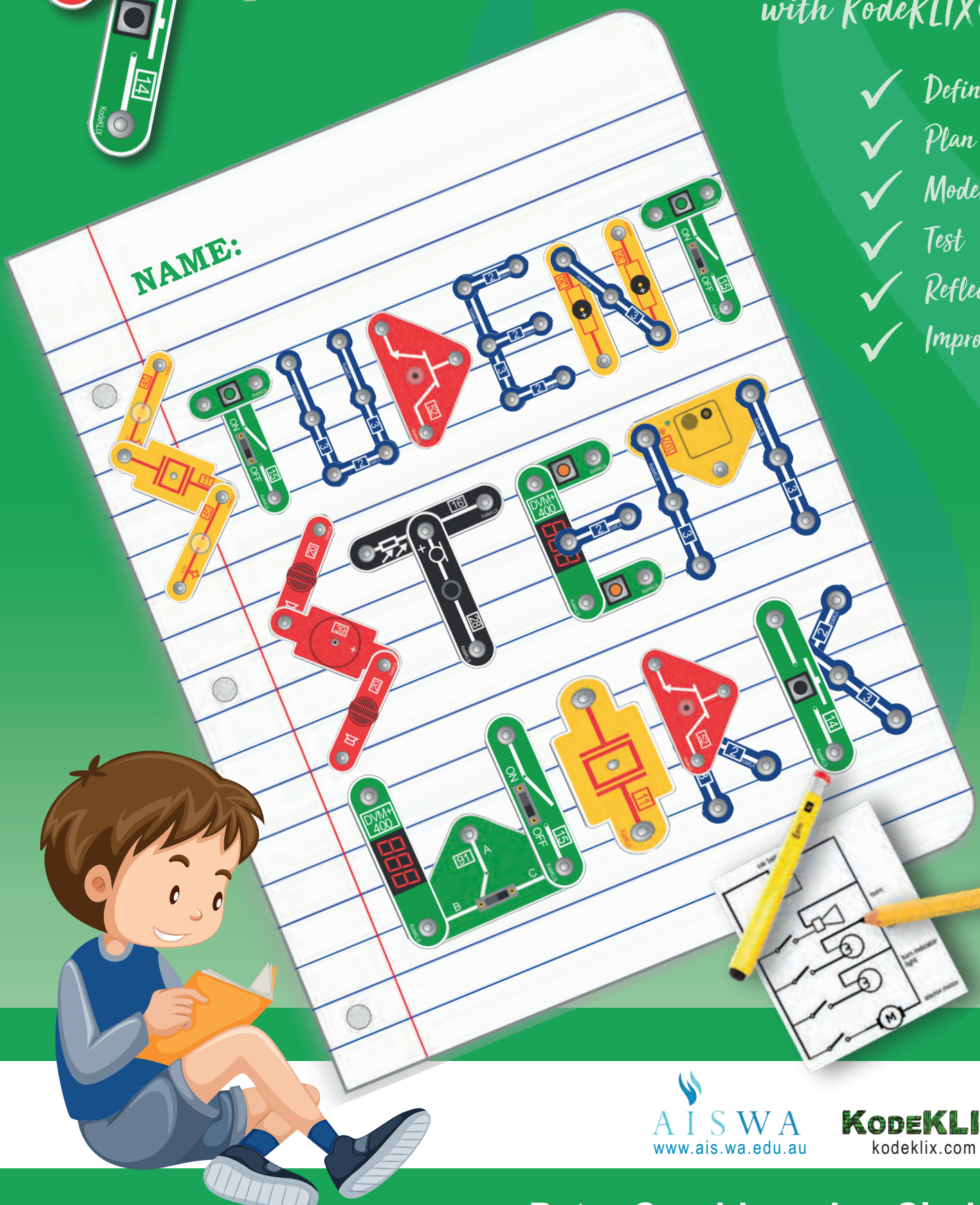
STUDENT WORKBOOK

STEM in Practice

with KodeKLIX®

- ✓ Define
- ✓ Plan
- ✓ Model
- ✓ Test
- ✓ Reflect
- ✓ Improve

AISWA SAMPLE



AISWA
www.ais.wa.edu.au

KODEKLIX
kodeklix.com

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W SECTION 1: CORE KNOWLEDGE - LEARN IT!

Consolidating, developing and reflecting on concepts introduced in the Core Activities

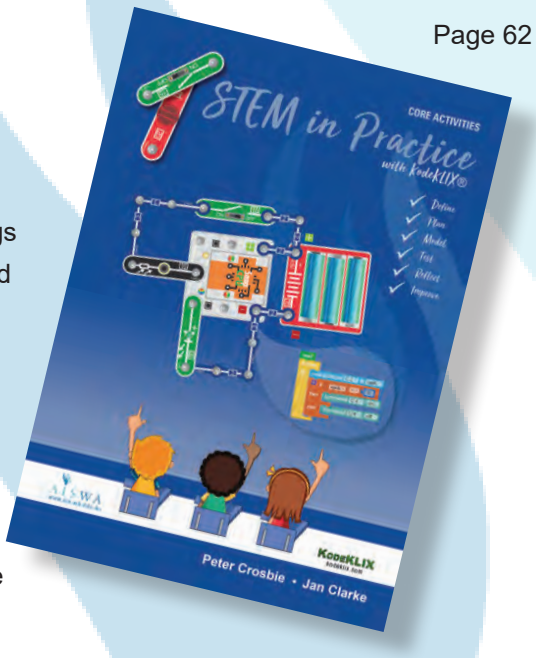
This is YOUR workbook.

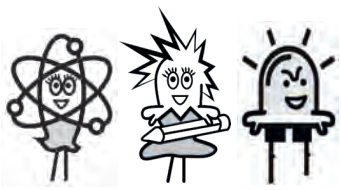
It is where you can clarify (make clearer, better understand) the things you have been learning from engineering the KodeKLIX® circuits and building the Blockly code.

The activities in this Student STEM Workbook match with the activities in the blue STEM in Practice Core Activities book.

For example, if you do (3a) in the blue book then look in this book for (3a) to build on that knowledge.

This book is also a place where you can show what you have been learning and how well you can think and solve problems!





Your teacher has some other interesting extension activities that link this learning to other subjects such as Music, English, Geography, History and Language. There are puzzles and codes to solve, interesting stories to read and QR codes to follow to interactive websites. Ask for them!

MAIN IDEA: COMPONENTS, BATTERIES and SAFETY

Safety must always come first. Electricity can be dangerous if you are not sensible.

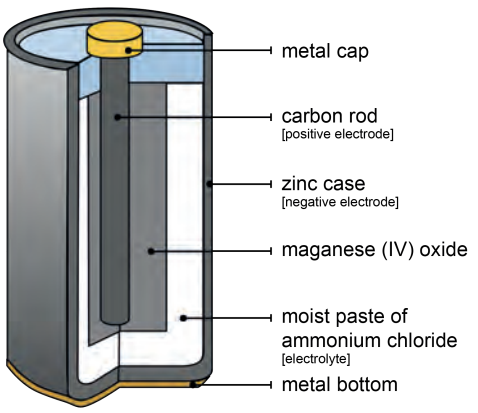
1. DRAW 2 examples of ways the kit has been designed to make it a **safe and useful** learning kit. ANNOTATE the drawing to help explain your reason.

2. LIST any 6 important things about using technology **safely.**
Only use a few words for each answer. The first one is done.

1	Think. Use your brain.	4	
2		5	
3		6	

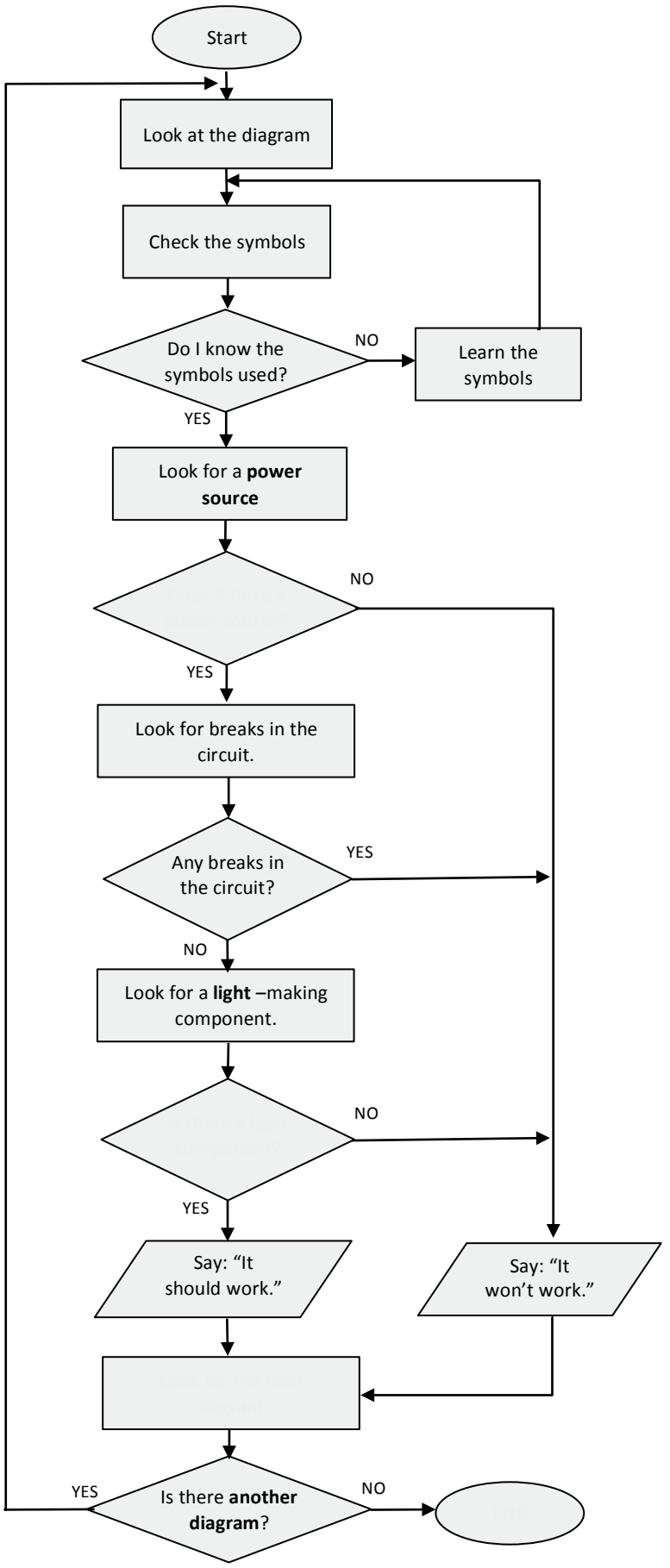
3. READ this battery diagram. What 3 **materials** inside a battery interact (work together) to make electricity?

- _____
- _____
- _____



4. ADD **+** and **–** to the diagram to show the POSITIVE (+) and NEGATIVE (-) **terminal**.

The **+** and **–** show the **polarity** (opposite ends).
Knowing which end is (+) and which is (-) is important for certain components.
(Remember "polarity" by thinking of the North Pole and South Pole of the Earth!)



SOLVING A PROBLEM *is easier if you have some steps to follow.*

Programmers make ***flowcharts*** *to help them work out the steps before they start their coding.*

Here is a flowchart (algorithm) to check ***whether a light is going to work*** *in a circuit with a switch.*

It's quite easy to follow. Just answer the yes/no questions and see where the arrows take you.

Electra says…

4. ADD in the **missing steps.** Choose from these 4 instructions:

   a) Is there a **light** component?
   b) Search for **next diagram**
   c) End
   d) Is there a **power source**?

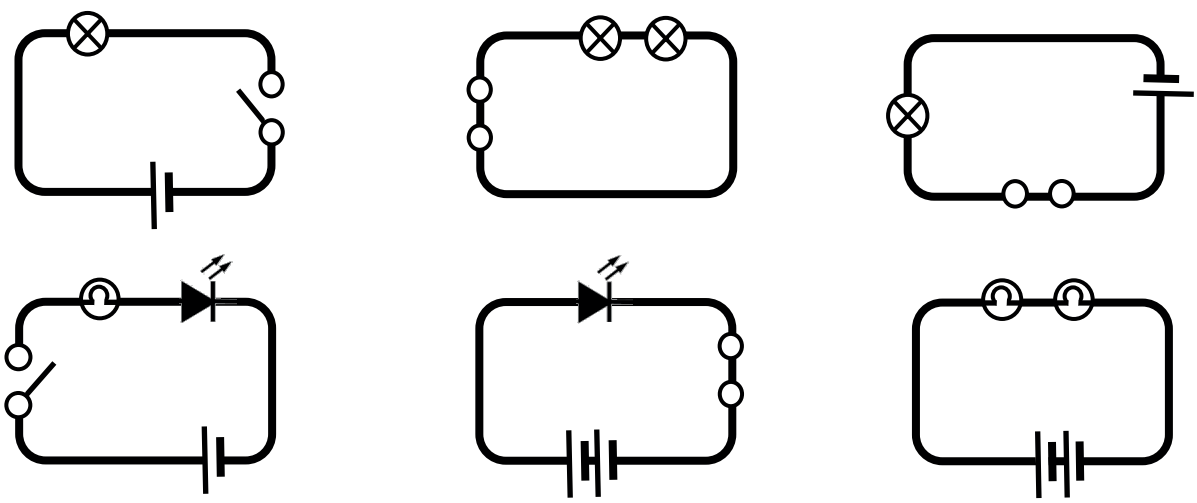
5. TICK the **two messages** that are OUTPUTS.

6. There are **2 loops** in this flowchart. Find them. TRACE the loops with a coloured pencil.

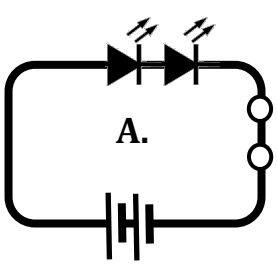
7. There are 5 places where you can see **branching**. LABEL them 1 to 5.

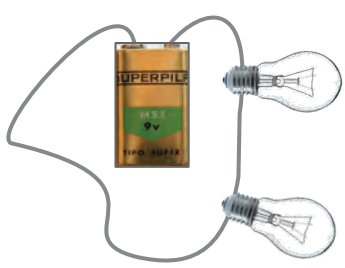
8. In these circuit diagrams, TICK the circuits where the **light can shine.** CROSS the ones where it won't be able to shine.

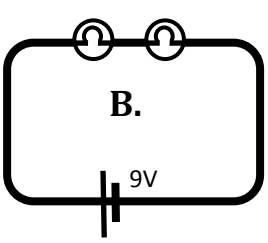
Different light symbols have been used so that you learn to recognise them.
Use the checking steps from the flowchart if it helps.

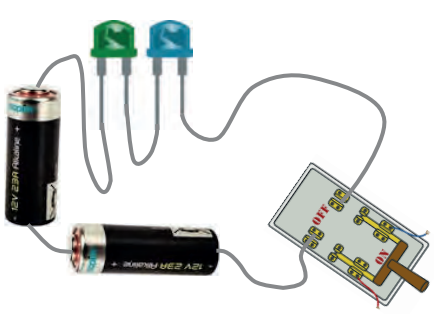


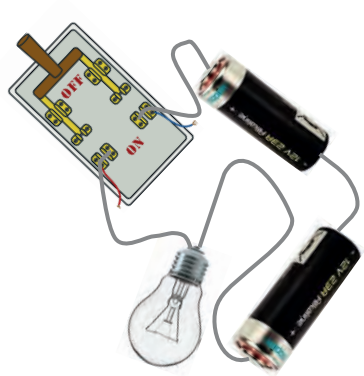
9. DRAW a line to **match** the picture diagram to the correct circuit diagram.

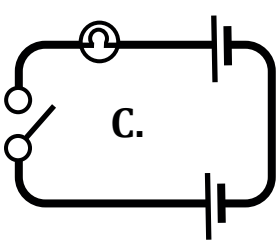


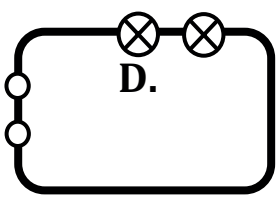












10. WHICH circuit would **never work** because the **polarity** of the batteries is not correct? LABEL it 'WRONG POLARITY'.

11. In another circuit the lamps will also not glow. FIND the problem and give it a **logical** LABEL.

PROCEDURES – mini-programs input into main programs

A PROCEDURE is a mini program inside the main program.
It is **given a name** and when it is needed it is **called** in by that name.

A procedure creates a **module** of code (a useful, re-usable block of code). Programmers love modules of code because they can use them over and over without having to write the same instructions every time.

Programmers always look for **patterns of instructions** in code. When they see these patterns they save them as modules. Instead of writing the code every time they just **call** for the one they want and the whole module of instructions will run (**execute**) from one pre-programmed block! It saves such a lot of time.

Programmers like to make code collections (**libraries**) full of procedure modules. Often they **share them** with other programmers. Sometimes they have competitions to see who can write a program that does the same thing with the LEAST amount of code! Clever programmers need fewer lines of code because they make good use of ready-made modules.

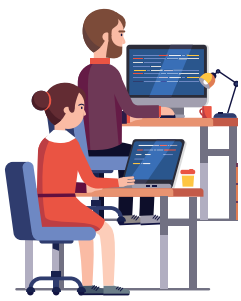
The name of a PROCEDURE must be ONE WORD that briefly describes what the code does.

*Programmers use the **underscore __ character** to take the place of a space between words.*

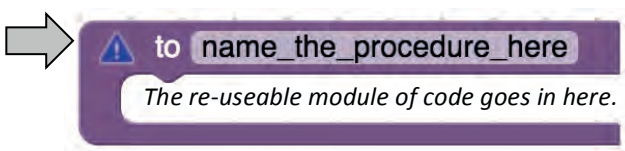
*Sometimes they use **capital letters with no spaces** to show where the different words start.*

English teachers might not like this punctuation but it MUST be done this way when coding.

Sparkie says…



*This **warning symbol** reminds the coder that it won't work until the code is put in.*



*The procedure is given a **logical name** so that a programmer knows what it does.*

6. The procedure in the activity was called **FlashingLED** because that's what the code created. RENAME these procedures so that a program could **call** them. They are not useable yet.

Saying what the procedure code does	**A logical one_word name for it**
play a tune using 6 notes	
make the cat run fast	FastCat
make police car lights and siren work	
draw a big square that is green	
make a motor turn on with a fan	
Make an LED flash when a sound is detected	noise_flash

IF-THEN–ELSE BLOCKS – decisions in code

If-then-else statements can be used in coding to give more control over circuits.
If-then-else statements check to see if a condition is TRUE or FALSE.

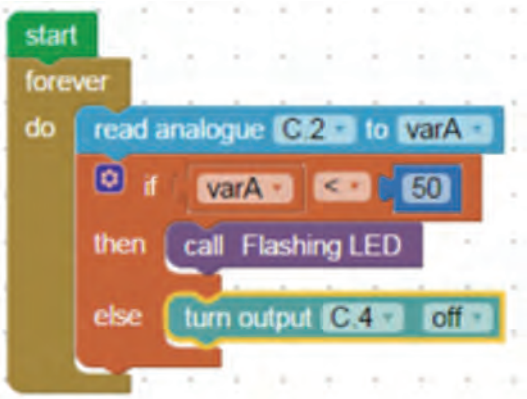
1. The flowchart is missing some values.
   ANALYSE the *Blockly* code. ANNOTATE the flowchart.

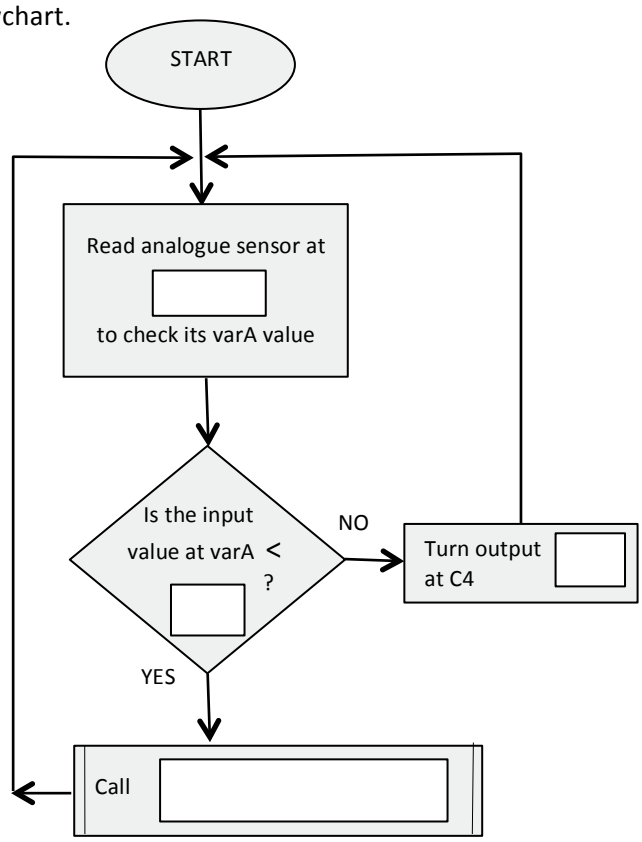
   a) FILL IN the missing values.

   b) TICK the **if-then-else decision.**

   c) TRACE and LABEL the 2 **loops**.

   d) LABEL the **procedure** (input code).



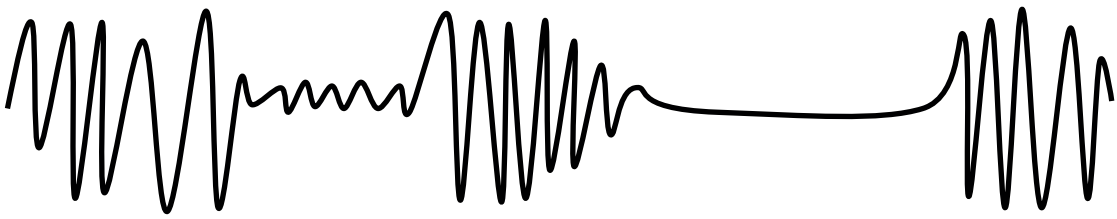


2. TICK the automatic **systems** that might use an **LDR sensor**.

   A system to automatically:

   - ☐ turn on street lights when it gets dark at night.
   - ☐ shut off the stereo if it's too loud.
   - ☐ turn on a kettle for a cup of tea at sunrise.
   - ☐ open the dog food dispenser when it rains and the dog is barking.
   - ☐ ring a bell if somebody walks past a light beam in a doorway.
   - ☐ turn on the outside house security lights at night.
   - ☐ stop the music playing when a music box lid is closed.
   - ☐ turn on the headlights when you drive through a tunnel.
   - ☐ make the fridge colder when you open the door and press the switch.

3. IDENTIFY and CIRCLE an area of **loud** sound (use an **L**) and **quieter** sound (use a **Q**) and **silence** (use an **S**) in this soundwave.



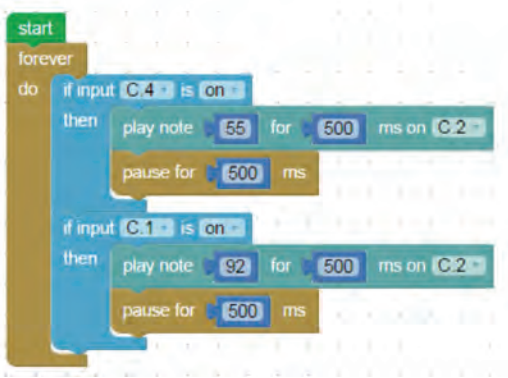
Electronics systems can make and detect waves like this. If you add **certain values** to the code and send this to a speaker you can **make exactly the sounds you want**.

Speakers are sensitive to vibrations. They have a surface that can sense the vibrations and components that turn vibrations into electrical signals. There are other components that amplify the sound (make it louder).

If you place your hand lightly on a speaker box while music is playing you can probably feel the different kinds of vibrations. Deaf people are able to 'listen' to music in this way. Your eardrums pick up sound vibrations like this too. Your skull, jawbone and cheek bones work like in-built amplifiers.

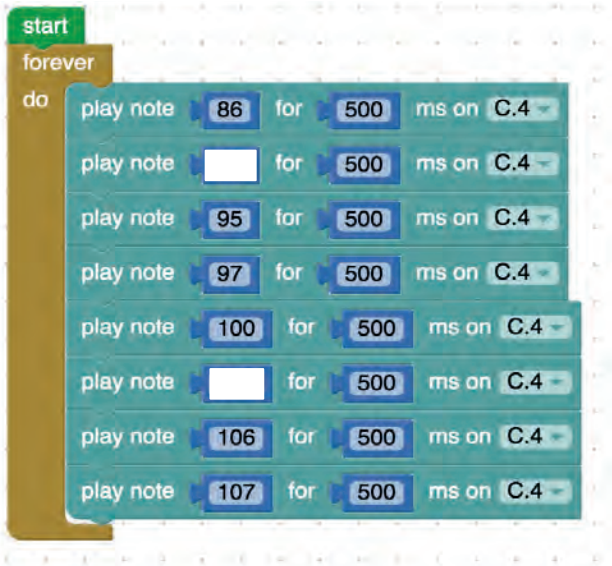
4. CIRCLE the values in the code that identify the **frequency (pitch)** of the sound you want to make with the code.

The notes of a scale on a xylophone.



Here is some code that makes a musical **scale**. That means that the notes **change in pitch, step-by-step**. They are in sequence.

LOOK at the **pattern** of the **sound frequency data**.
APPLY the knowledge from what you just read about the relationship between **pitch** (high and low sounds) and **frequency**.



5. Do you think the note sounds will be **getting higher** or **getting lower** as they play in this sequence?

_____

6. Make a **logical guess** about what the missing values would be. ADD them in.

7. BUILD this code in *Blockly.* DOWNLOAD it. PLAY it. How accurate was your guess? **Adjust the values** it if you need to make it more accurate.

MAIN IDEA: SERVO MOTORS CAN CONTROL MOTION IN A SYSTEM

Engineers use servo motors when they need to control the movement in systems.
Direction and positions of movement can be controlled.
Servos can change rotary motion into linear motion.

Servo motors (or 'servos') **behave differently** to other motors.

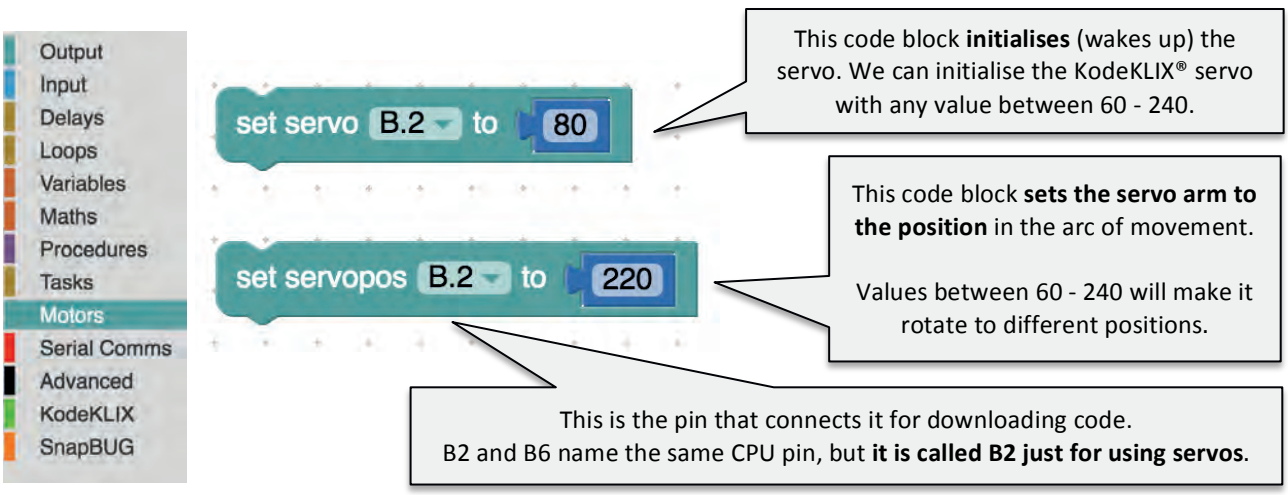
Servos:

- don't turn their shaft in a full revolution (360° of a circle); they only **turn through an arc** of a circle;
- they can be instructed to **turn to exact positions** by code; this is very useful in controlled systems;
- they have **little gears** built in; gears make them quite powerful for their size;
- different **arm attachments** can be added for different functions;
- they are controlled by tiny bursts of voltage not a constant current;
- they are **used in devices** that need precise control, like remote control models, factory robots, ship rudders and plane flaps;
- they **need instructions** to work.

Controlling a servo motor

Servos take their instructions from a series of little **electrical pulses** sent from the CPU. A pulse is like a tiny burst of voltage. The pulses that work servos are a bit like heartbeats, which are actually made by tiny electrical pulses in people's bodies. The **code instructs the pulse rate** (like your brain controls your body's heartbeat and pulse rate). The pulse rate **tells the motor where to move to** in its arc.

In the KodeKlix® *Blockly* code, the basic blocks to control servos are:



5. COLLECT some data to calibrate the servo in your kit.
Get a **protractor** to help you. The one below is labelled in jumps of 10 degrees.

Find the number of degrees between a **servopos value of 60** (farthest left) and a servopos **value of 240** (farthest right). **ADD the data** onto the protractor diagram into the boxes.

The value for as far **LEFT** as your servo will go. ☐ degrees

The value for the **MIDDLE** position. ☐ degrees

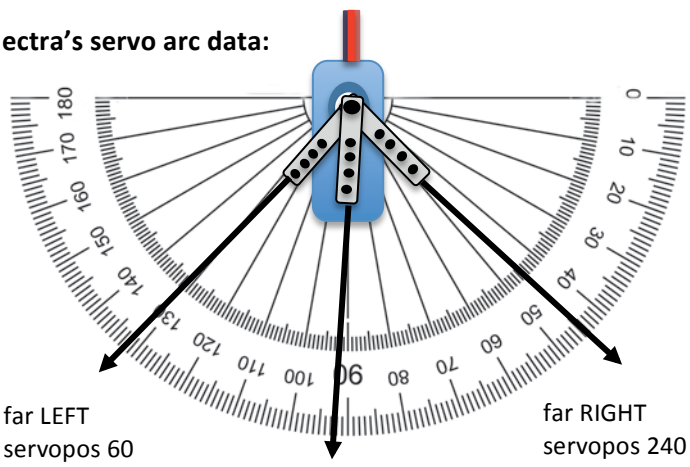
The value for as far **RIGHT** as your servo will go. ☐ degrees

6. A 'difference between 2 numbers' (subtraction) algorithm will work for **calculating** the arcs:

- **The full arc** (range of values) LEFT value – RIGHT value = ☐ degrees
- **Left-arc** LEFT value – MID value = ☐ degrees
- **Right-arc** MID value – RIGHT value = ☐ degrees

7. Is the **mid point exactly in the middle**? COMPARE the left and right arcs? What is the difference between the arc on one side and the other? ☐ degrees

Electra's servo arc data:



Hers = 132^0 Hers = 93^o Hers = 45^o

Your servo arc data:

LEFT	MIDDLE	RIGHT

I had to look very carefully at the protractor to do mine.

I needed to fix a toothpick to the end of the arm so I could read the numbers!

When I tested mine this is what I found.

My far LEFT was 132^o.
My far RIGHT was 45^o.
The arc (the difference) was 132-45 = 87^o.
That is a lot less than 180^o.

The MID value was not in the exact middle. The right arc was 48^o. The left arc was 39^o.

Some of the other groups had ranges of 135, 120 and 169.
My servo doesn't have a range that big.

*I can **use this knowledge when I'm designing and building models** that need the arm to move to certain places.*