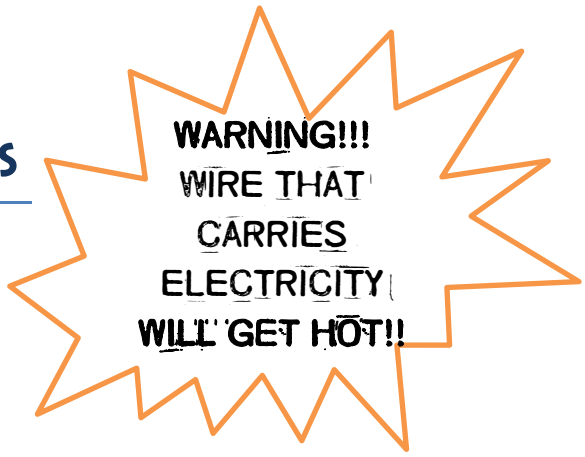
Creating Science – Art Bots

Can you use the amazing power of an offset motor to make a robot that'll dance and draw! ***#CreatingScienceArtBots***



Suggested outcomes

(NOTE: This is by no means an exhaustive list of possible outcomes, neither is it intended that ONLY these outcomes can or should be met. Science is a deeply interrelated activity, and you may find cross curriculum links you can and should use.)

Science understanding

- Physical sciences y6: Electrical energy can be transferred and transformed in electrical circuits and can be generated from a range of sources (ACSSU097)

Science inquiry skills

- Processing and analysing data and information 5&6: Compare data with predictions and use as evidence in developing explanations (ACSIS218)

Science as a human endeavour

- Use and influence of science 5&6: Scientific knowledge is used to solve problems and inform personal and community decisions (ACSHE083)

Cross curricular outcomes

Visual arts: Years 5 and 6 Content:

- Develop and apply techniques and processes when making their artworks (ACAVAM115)
- Plan the display of artworks to enhance their meaning for an audience (ACAVAM116)

Technology: Years 5 and 6 Content:

- Design and Technologies Knowledge and Understanding : Investigate how electrical energy can control movement, sound or light in a designed product or system (ACTDEK020)
- Design and Technologies Processes and Production Skills: Select appropriate materials, components, tools, equipment and techniques and apply safe procedures to make designed solutions (ACTDEP026)

Warning

- ELECTRONICS GET HOT! Hot enough to burn fingers. Be wary, warn students, and have a first aid plan. Some electronic components are damaged or made imperfectly, and will short out on their own, becoming extremely hot and doing nothing else at times. Be careful. ***Have a wet rag on hand to cool hot fingers*.**
- Power tools are helpful in this project. **Do not** allow students to use the power tools.

Preparation

As always, do not attempt an activity in front of the class unless you have perfected it yourself.

- Mini motors - search: "3 volt mini motors for DIY projects" online. Buy at least one for every student, and 10% more in case of breakages.
- Battery holders - search: "Plastic Battery Storage Case Box Holder For 2 X AA batteries, 3V with wire leads" or similar. One for every student, and 10% more in case of breakages.
- Two AA batteries per student, with 10% more just in case.
- A strong cup with a hole drilled in the bottom wide enough for the motor's wires to fit through. Alternatively, you may use a pool noodle cut to about 10cm long, but it's more expensive.
- Three felt tipped pens. It helps if they're all the same brand, work properly, and have lids.

And to help with your project you'll want to get:

- A drill and drill bit, one that is just a fraction smaller than the diameter of the axle of the motor.
- Something to drill to create the offset weight – it needs to be fairly big to slow down most mini motors. Paddle pop sticks are excellent. You may want to predrill and fit on the entire set of weights. This can be very tricky and difficult, and is best done before fronting students. Put the hole in just off the centre of mass of the weight. I find about 2/5ths of the way to be about right. It needs to fit on the motor and stay on, so it needs to be tight.
- Sticky tape to hold things together. Lots of good quality, clear tape.
- Decorations such as googly eyes and feathers.
- Paper for the Art Bot to draw on. A4 will do, but bigger is better. A wide piece of butchers' paper that the whole class can make art on might really be fun!

Learning Intent (student friendly)

'We are learning to' (WALT). Build an Art Bot and make some art.

Success criteria

- 'What I'm looking for' (WILF). A working Art Bot, and more specifically, a working understanding of how the Art Bot's mechanics and electronics work.

Student learning goals

- Help students make an age appropriate, self-monitored learning goal for this lesson, such as 'make a robot'.

Evidence of learning

- How will you know when the learning goal is achieved? What EVIDENCE do you have that your students have met or exceeded the learning expectations?

Suggestions for other year levels

As always, more material is presented here than can be used by the average class during the average lesson time. However, since the students' questions can and should guide student learning, more material is presented for your convenience. Remember, it is not uncommon for students to only remember those points which answered their personal questions.

Younger:

This activity is inappropriate for most students at this age, at least without an adult walking them through every step of the way.

Middle:

This activity is tricky for the age group, and they will need help.

Teen:

Some students in this age group will really struggle with this activity. Take time to understand what their struggles are, and how to help them to overcome them. The others might run on ahead and wonder what the delay is about – perhaps they can help teach others.

Engage

- Remind students about the previous lesson on Smushy Circuits: that electricity must travel in a circle.

Step 1

⇨ Give students the battery packs and motors to play with. Challenge them to make the motor spin.

Tell them: today we are going to make Art bots!

Remember:

- Robots like exactness and precision. Try to 'think' like a robot and get the instructions spot on!
- Robots don't have any brains – use your own! They can't protect you; they only ever do what they're told. So be careful!

Explore

- ⇨ Ask students why they think the motor spins. Encourage and validate student explanations of this phenomenon. You may like to ask students to write or draw their explanation personally to avoid embarrassment to students unfamiliar with this material. Remember, 'I don't know' is a valid explanation in science – it is the beginning of learning new things!

Explain

The answer is that the motor uses little magnets to push against the electricity in the wires – this is called electromagnetism. As soon as the battery turns on, the magnets push the motor around and around and around.

Of course we can get more complicated than that – ask the students if this explanation is enough for them.

Elaborate

- ⇨ Ask students if they can design new ways to test this explanation, is it really sufficient? Can they think of further or better explanations, and the experiments needed to test them?

Try and see if a magnet sticks to a motor. Does the magnet stick even better, or worse, once the motor is on? (Usually worse, but the steel covering of the motor can shield the motor from your magnet's magnetism, and helps to prevent the magnetism inside the motor from getting out).

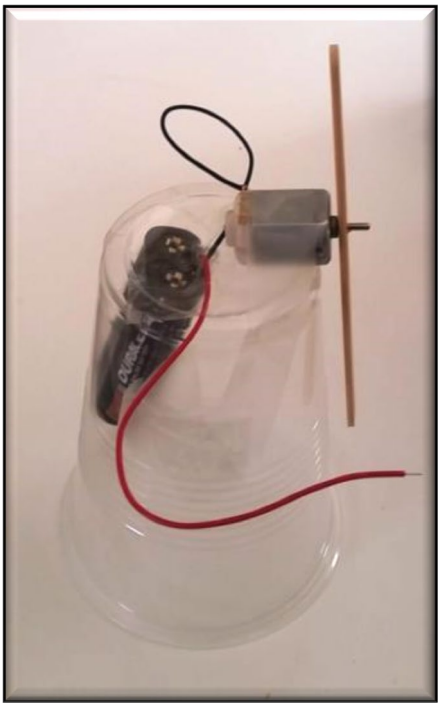
- ⇨ FEEL how warm the motor and wires and batteries are now. Remind students to be careful, and DON'T EVER LEAVE THE MOTOR RUNNING ALONE!!!

One more time:

DON'T LEAVE THE MOTOR RUNNING NON STOP OR THE WIRES WILL GET SO HOT THAT THEY WILL BURN YOU!

Step 1 – Build an offset motor

- ⇨ Place the paddle pop stick onto the axle of the motor.
  This is often more tricky than it sounds.
  - If the hole is too big, the stick will not move with the motor but will just sit there as the axle spins around ineffectively. You need to use a new stick with a smaller hole.
  - Of course, a small hole makes it very difficult to push it on to a small motor. It will take some practice and skill. You might like to make up a device, such as a clamp or wooden pen, to hold the motor upright while you push the stick on. The force needs to run directly down the axle so that nothing breaks. It's a bit tricky!
- ⇨ Of course, once the spinning offset motor gets spinning there's a whole new field of problems.
  - If the motor is left running it will get HOT, really hot. Be careful.



- The sticks spin around quite a bit of force. If you try and stop it with your fingers it will HURT as they smack against you. Try slowing them down using a table top, or even better, remove the wires and let them slow down on their own.

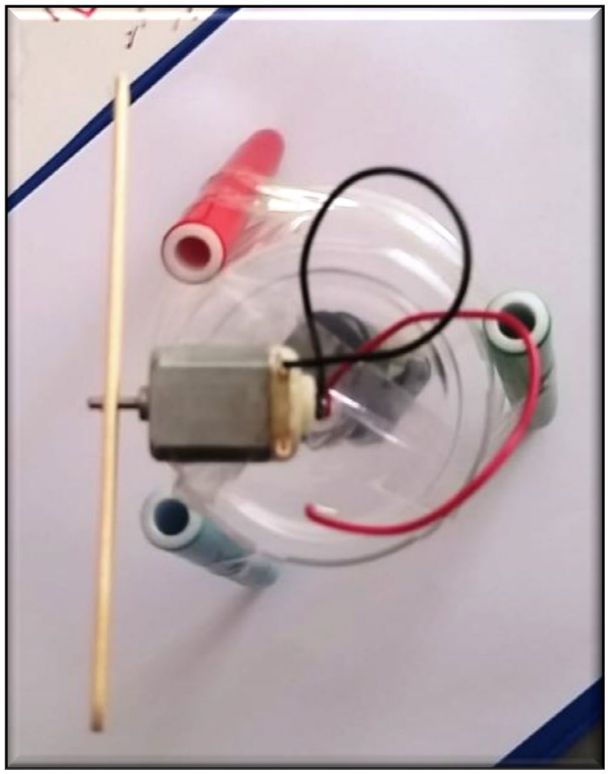
Step 3 – Mount it on the cup.

⇨ Place the battery holder into the cup and thread the wires through the hole. Tape them down carefully. Tape the battery holder to the side or top of the cup.

⇨ Tape the offset motor to the side: MAKE SURE THE OFFSET WEIGHT CAN SPIN FREELY. You'll probably have to put the motor right at the edge of the cup, even having it hang over a bit. We found you can put a small prop under the leading edge of the motor (on the outside) to help it stay at a helpful angle (i.e., not constantly hitting the cup)

- This is about the trickiest part of the project. If you go wrong here, the Art Bot won't work and you might not know why.

⇨ Test that the motor can spin; jiggling about and probably knocking over the cup.



Step 4 – Give it legs.

With the pen lids on, and facing downwards, place at least three pens around at equal distances around the base of the cup. Some advice:

- **Put the first pen exactly opposite the spinner**. Any pens near the spinner will end up hitting it.
- Make sure the pens are the same height. Or else the Art Bot will try to tip over.
- Why not four, or five pens? Because more pens make it heavier, and a heavier bot will dance about just a little less. Maybe that's a good thing? Maybe that's what you need for your Art Bot? But three is the very minimum you'll need that will still keep your dancing Art Bot upright.

Step 5 – Start the art.

REMEMBER: When you need to STOP your bot DON'T just grab the spinner – it hurts! Grab the Art Bot from behind, and carefully remove just one of the battery leads. It'll stop.

So how do we start the art?

⇨ Take off the pen lids.

⇨ Place your Art Bot in the centre of the drawing paper.

⇨ Carefully hold the spinner! Place on the battery leads.

⇨ Release the spinner, and watch the art!

Tips from the Masters

Is your bot not working? All bots everywhere may need troubleshooting! Here are some common problems:

- Spinner: Is the spinner stuck somewhere? Have loose hairs become tangled up on your axle? (Have a grownup use a knife to cut them away.) Is the spinner not 'offset' enough? (Get a new spinner and make sure the hole for the axle is NOT near the centre of the spinner – try ¼ of the way along – but even that's pretty extreme. It can depend greatly on the kind and quality of the motors you have).

- Check your circuit: Have your batteries fallen lose? Is there a wire out somewhere?
- Stability: are your battery and motor on the same side, making your Art Bot fall over in that direction all the time? (Move the pens closer, or add one if it helps). Are your pens too far apart somewhere?
- Weight: Art bots won't dance if they're too heavy – have you put on too many decorations? Maybe you can try to carry your batteries overhead, if you have long enough wires. I know that's what some professional robotic engineers do to solve the problem that robots need power, and power is often HEAVY.

Further studies

⇨ Why not decorate your bot? Maybe some googly eyes for giggly fun!

⇨ Can you find other uses for the offset motor? (Try looking at smart phones…)

⇨ Can you find other examples of robots used to make art? (Is painting a car 'art'?)

⇨ Can you get another object into your circuit, such as a LED, while the Art Bot arts?

Evaluate

⇨ Review with students what they felt they learnt from this lesson. Did they have any questions at the start that they feel were answered?

Success criteria

⇨ Review the Learning Intentions of this lesson with students. Was it met?

At the end of each class, review the learning objective and see how we did. Ask:

- Did you achieve your learning goal?

Assessment

Prior learning:

- Try a simple activity before this one to assess students' abilities to follow stepwise progression of activities. Get to know those who are self-managed, and those who will need greater scaffolding.

Formative:

- Stop at the end of every stage and see if the students can get their motor to spin.

Summative:

- Have students plan and exhibit their Art Bots alongside their Art Bot artworks. Have students explain the flow of electricity in their Art Bot, the effect of the offset motor.
- You may even like to visit some younger year levels and help them experience the Art Bots – WATCH OUT FOR WACKING FINGERS however!!

So what?

There are many ways in which science can be fun. We not only learn some great ideas, we can make some weird art, learn how mobile phone buzzers work, and we can make robots that dance.

Creating science

Science Understanding:

As we learn about electricity in a circuit, we learn that;

- Physical sciences y6: Electrical energy can be transferred and transformed in electrical circuits and can be generated from a range of sources (ACSSU097)

Science inquiry skills

As we figure out how to get an offset motor working, and use it as part of an Art Bot, we;

- Processing and analysing data and information 5&6: Compare data with predictions and use as evidence in developing explanations (ACSIS218)

Science as a human endeavour

As we overcome the technical challenges of the Art Bot through understanding the science surrounding them, and as we learn about the uses of the offset motor, we;

- Use and influence of science 5&6: Scientific knowledge is used to solve problems and inform personal and community decisions (ACSHE083)

Cross curricular outcomes

As we develop, display, and explain our Art Bot art, we are;

Visual arts: Years 5 and 6 Content:

- Develop and apply techniques and processes when making their artworks (ACAVAM115)
- Plan the display of artworks to enhance their meaning for an audience (ACAVAM116)

As we built a successful Art Bot, we;

Technology: Years 5 and 6 Content:

- Design and Technologies Knowledge and Understanding : Investigate how electrical energy can control movement, sound or light in a designed product or system (ACTDEK020)
- Design and Technologies Processes and Production Skills: Select appropriate materials, components, tools, equipment and techniques and apply safe procedures to make designed solutions (ACTDEP026)