6 Lesson Unit

Created by Ryan Evans in conjunction with Mic Lowne
Rangeview Primary School, Mitcham VIC

Overview

Making and performing music with LEGO robotics!

A lesson series designed to allow students to explore the **making** experiences offered by BricQ Motion, **animation** and **coding** possibilities of Spike Essential and allow them to extend all the way into sound sampling and editing. This series encourages students to play, explore and experiment with Lego and coding, all within a goal driven program where all students can achieve success. The series also brings music curriculum into the Digital Technology classroom; a surprisingly synergistic combination.

Creator's note: This lesson series would be more effective once students have had a session or two to look at the kit and have a bit of an awareness of the parts that are in the kit, particularly the lessons that involve some free-building.

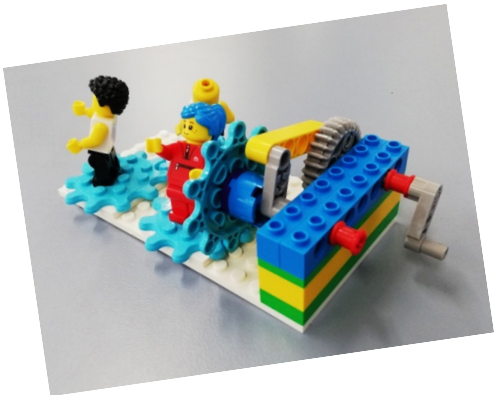
Lesson 1 - Tiny Dancer

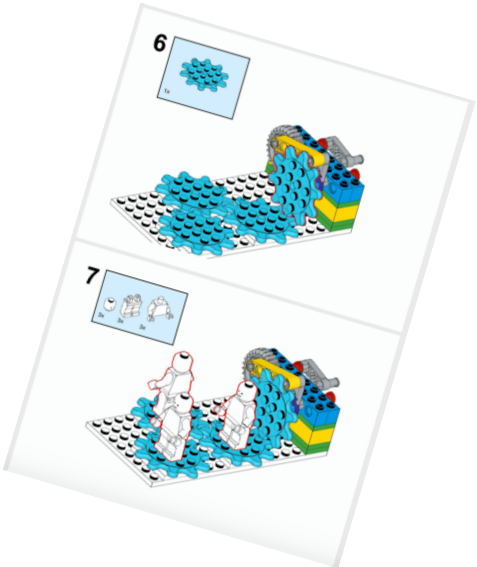
Uses only BricQ Motion Essentials - Students use a series of splat gears to make a moving dance floor. Introduced to *reciprocal motion* to allow for twist motion in splat gears. Students then modify to improve motion.

Summary
Students begin by discussing movements and how that might be replicated in Lego. Introduce splat gears and how they interact on a plate with turntable bases. Consider the different sizes. How might they affect the amount of twist/turn. Students explore by sticking a minifig on different splat gears and turning with a different gear, trying different sizes. Produce/distribute/download instructions for lesson 1, stage 1 and build initial design and test. Stop and discuss how you might replicate a 'twist' rather than just full turns. Discuss how these instructions work in that you don't pull apart the whole build, you just modify. Students use stage 2 instructions to build the crank modification to produce *reciprocal motion*. Discuss how we've converted continuous rotation into a linear motion that in turn is translated back into a circular motion through a much smaller arc rather than a full rotation. Have them look at how it's happening and speculate *why* [the pin on the gear is only rotating in a range of 3 studs, whereas the crank requires 5 studs, causing the liftarm to then only push it a short distance and then draw it back]. Are we happy with the amount of rotation in the twist? How can we increase the amount of motion left and right? [many possible solutions - we'll explore one] Use stage 3 instructions to raise the mechanics and replace the small splat gear. Students test and observe the greater motion. Discuss.

Assessment
Student engagement, ability to follow instructions, ability to work in pairs/teams, discussion responses - particularly those around increasing movement and why the new mechanism causes the gears to go back and forth, creativity around minifig positioning and if they swap out other splat gears.

Curriculum Links
Investigate how forces and the properties of materials affect the behaviour of a designed solution (VCDSTC024)
Investigate the suitability of materials, systems, components, tools and equipment for a range of purposes (VCDSTC027)
Reflect on an investigation, including whether a test was fair or not (VCSIS071)





Lesson 2 - Twist and Shout

Adding Spike Essential to their BricQ Motion build - Students use basic icon programming to animate their splat gear dancers. They run concurrent programming to select music and time their animation to suit.

Summary

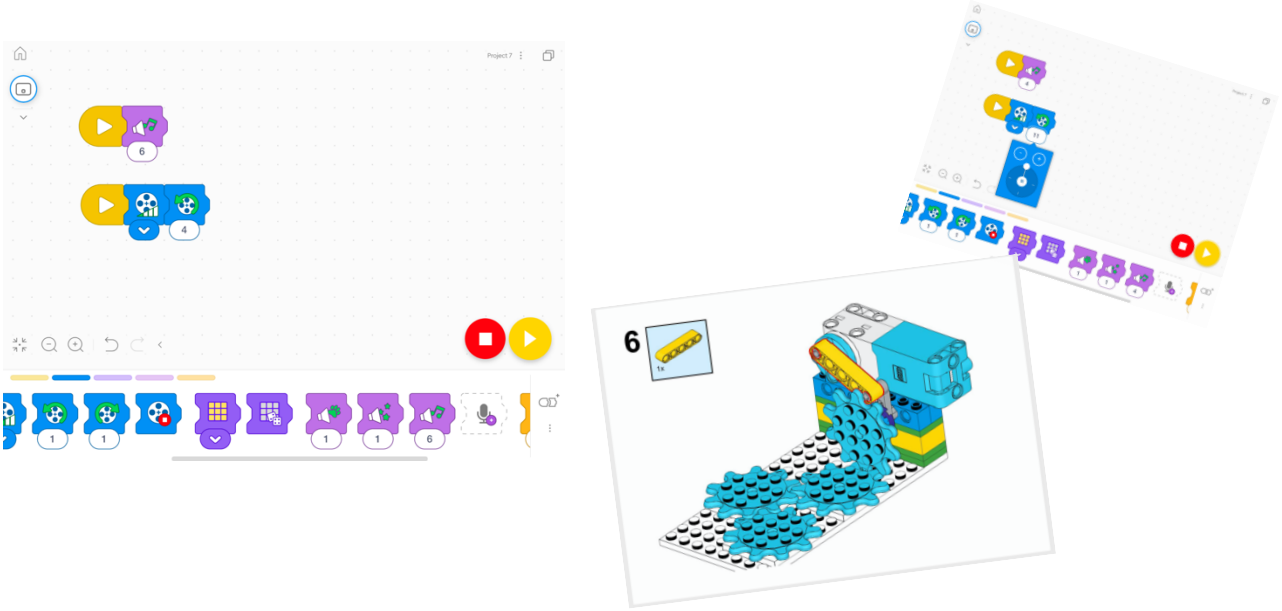
Students begin by reassembling last session's final build. Follow Lesson 2 instructions to add a motor to replace the manual crank/gear. Students then connect their devices to their individual Hubs and run a simple motor run program to rotate the motor and, in turn, cause the minifigures on the splat gears to twist automatically. Students then add a speed adjustment block to see how changes in that affect the performance of the minifigs. Discuss. Students then place a second 'start' button into the program and add the third audio block (speaker and notes) to this. When the 'play' button is pressed, the selected song will commence with the motion, but may not match in both speed and/or length of time. The challenge: to pick a 'song' and then find a speed and appropriate number of rotations so that when the program is started, the minifigs dance along in time with the song and stop dancing when the music stops. Students experiment with a number of different songs/speeds/timings.

Assessment

Student engagement, ability to follow instructions, ability to work in pairs/teams, discussion responses, determination around the accuracy of the number of rotations (ie. 6.25 rotations) that best align with the selected song, appropriate movement/song combination, creativity in minifig placement and positioning. A preparedness to engage with the programming blocks and how they are edited.

Curriculum Links

Use imagination and creativity to explore pitch, rhythm/time and form, dynamics and tempo using voice, movement and instruments (VCAMUE025)
Explore a range of digital systems with peripheral devices for different purposes, and transmit different types of data (VCDTDS019)
Develop simple solutions as visual programs (VCDTCD024)



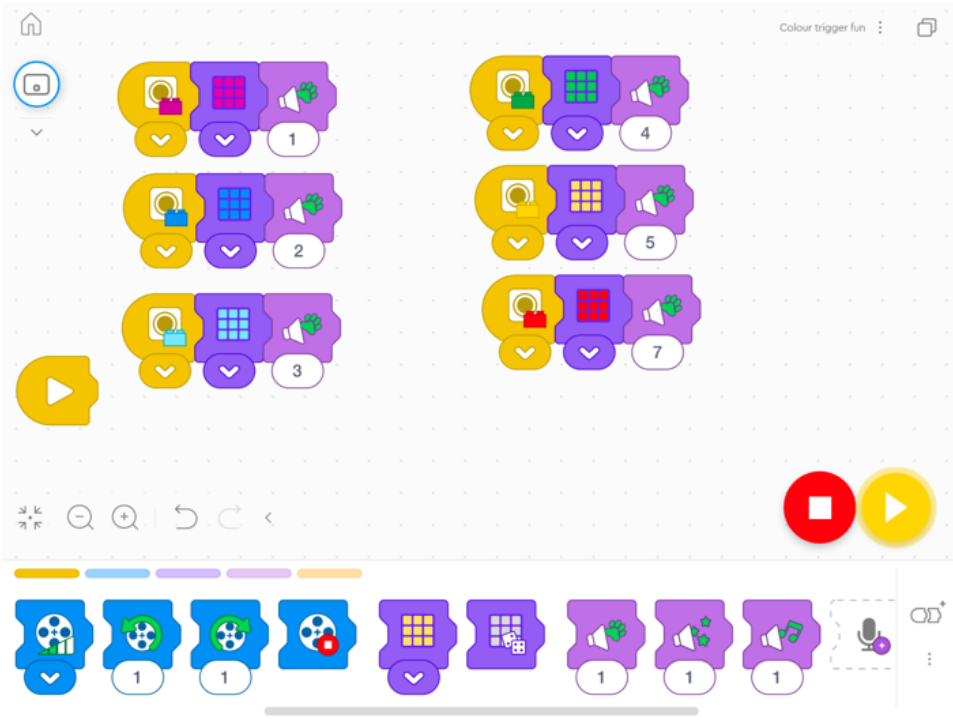
Lesson 3 - The Lion Sleeps Tonight

Introduce using sensor triggers with Spike Prime Essentials, including making music through adding and recording sounds with pitch and volume. Controlling sounds with sensors.

Summary
Students follow instructions to build a magic wand ‘beater’ using the Hub and colour sensor. They also follow instructions to build a colour brick xylophone to act as a trigger. Teacher demonstrates a single colour selection trigger block and one animal sound programming block. Students then go on to create a trigger block for each colour and attach a different animal sound to each trigger. Run program and test the wand on the xylophone to trigger the different sounds. They can then test the sensor with other materials around the room.
Students then attach the light matrix and add one to each program, setting the appropriate colour to each trigger.

Assessment
Student engagement, ability to follow instructions, ability to work in pairs/teams, discussion responses, ability to replicate and modify programming blocks, willingness to explore triggers, ability to add to each program component and accurately modify light matrix to match appropriate trigger.

Curriculum Links
Use imagination and creativity to explore pitch, rhythm/time and form, dynamics and tempo using voice, movement and instruments (VCAMUE025)
Explore a range of digital systems with peripheral devices for different purposes, and transmit different types of data (VCDTDS019)
Develop simple solutions as visual programs (VCDTCD024)



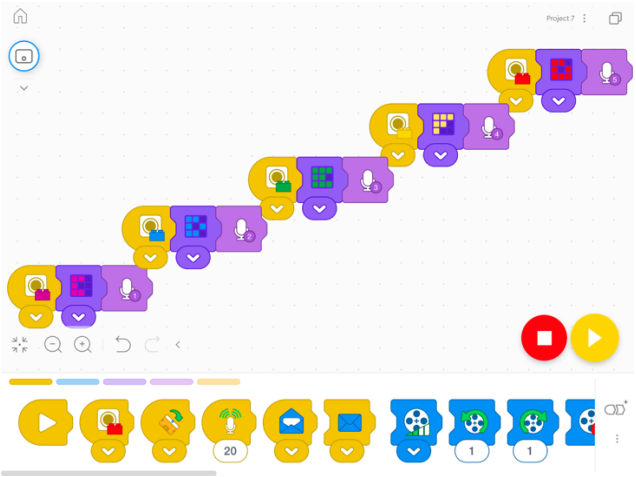
Lesson 4 - Mary Had A Little Lamb *and other cool songs...*

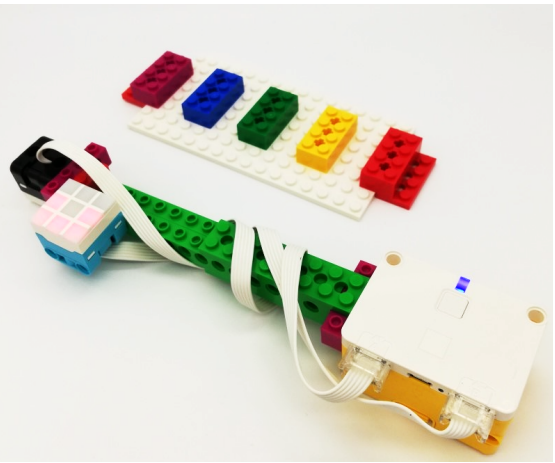
Using the same xylophone and 'beater' as lesson 3, but delve deeper into the programming, recording their own tuned samples they can trigger to create a simple melody. The title isn't as exciting as other songs, but where they take this is only limited by their imagination.

Summary
Teacher to demonstrate the record block and how to edit the waveform to ensure only the recorded sound plays when triggered. Discussion around length of each audio file, student expectations and providing quiet whilst each group record their samples.
Students begin by using a tuned instrument such as a xylophone, a recorder, a guitar or even a keyboard app on a second iPad. Students systematically use the record block to create additional single note audio files, editing them down to a similar length. Depending on their chosen melody, they may need to record more notes and extend the xylophone, adding other colours. Once samples are recorded, they simply insert these into a similar trigger program to the one used in lesson 3 and begin practising their melody. Optional extension - add 'letters' to each note using the light matrix brick.

Assessment
Student engagement, ability to follow instructions, ability to work in pairs/teams, discussion responses, ability to record similar length samples, ability to organise program to trigger samples, creating a recognisable melody.

Curriculum Links
Use imagination and creativity to explore pitch, rhythm/time and form, dynamics and tempo using voice, movement and instruments (VCAMUE025)
Define simple problems, and describe and follow a sequence of steps and decisions involving branching and user input (algorithms) needed to solve them (VCDTCD023)
Plan a sequence of production steps when making designed solutions (VCDSCD032)





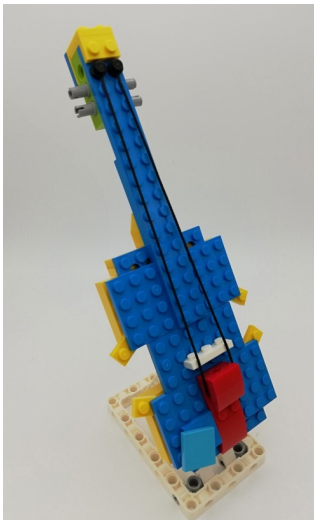
Lesson 5 - Build Me Up Buttercup

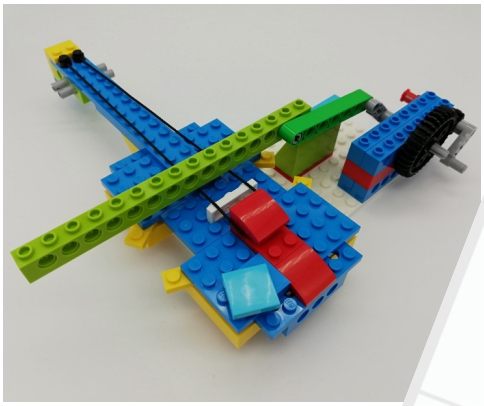
Exploring musical instruments and how to replicate them (in particular their playing action) using Spike Essentials motors and control blocks with BricQ Motion Essentials.

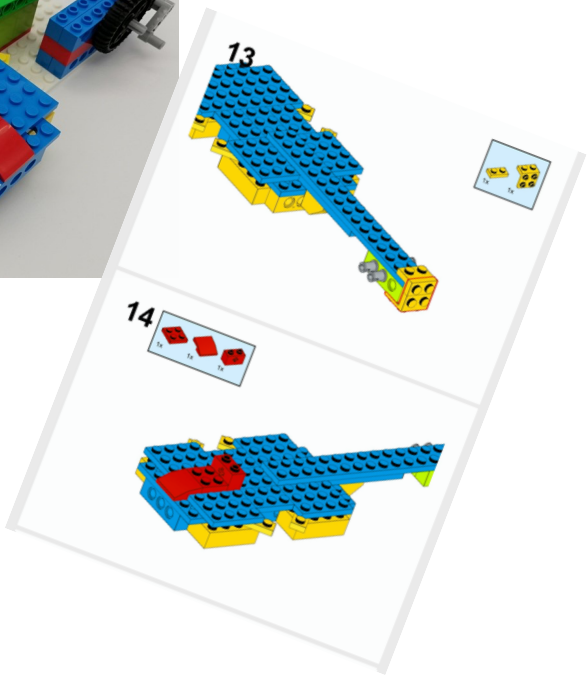
Summary
Students look at Students are given the option of either building a design provided, such as the violin or drum, or free build one, keeping in mind the action they might hope to include. Students can work with other teams to overcome problems or to share ideas. Where students may struggle to build what they have envisioned, suggest modifying one of the existing designs eg. violin becomes a guitar, bow becomes a strumming hand.
Once built, students then connect and program their instrument to be played. Using their programming knowledge from previous lessons, they may also wish to use **in-built** music to accompany their build.

Assessment
Student engagement, ability to follow instructions (if appropriate), ability to work in pairs/teams, discussion responses, ability to design an instrument (or representation of), ability to add motion to the build, appropriateness of animation, inclusion of and appropriateness of music to the chosen instrument.

Curriculum Links
Select and use materials, components, tools and equipment using safe work practices to produce designed solutions (VCDSCD030)
Plan a sequence of production steps when making designed solutions (VCDSCD032)
Investigate a range of problem-solving strategies, including brainstorming, identifying, comparing and selecting options, and developing and testing hypotheses (VCCCTM020)







Lesson 6 - Unchained Melody

Students will use the more advanced coding in the **word blocks** to create a musical performance with their instrument - possibly with other groups to form a 'band'. Instruments or samples from apps such as garage band will be required. *This lesson may be best visited after some time exploring the **word block** programming environment.*

Summary

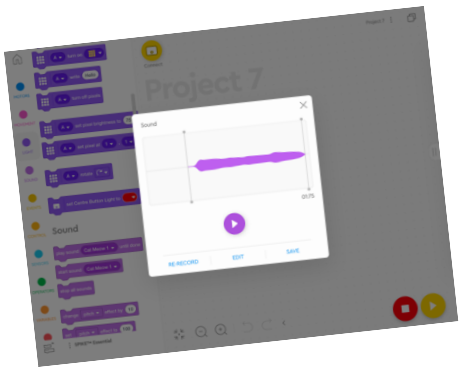
Students will be stepping up to the word block coding to take advantage of greater editing features within. Teacher will demonstrate the basics of the word block coding, citing the similarities with the icon version and highlighting the differences with the in the **sound** section. Explanations provided on what the control features do, but in particular, where to go to record sounds. After a sample sound (perhaps a guitar chord) is recorded, the edit feature will be explored briefly to demonstrate how the file can not only be trimmed accurately, but certain effects can be added. Whilst students will be encouraged to spend some time exploring these, they must remain focussed on the goal - to create a performance for their instrument or band. A demonstration of how to use this saved sample in a sequence, along with some pitch shifting to change the chord/note, to demonstrate the basics of how to write their short performance.
Students will then record notes, chords, drum beats, etc. to use in their performance. They will then create a sequence that *may involve pitch shifting. They will also program movement to accompany this music. If they have chosen to form a band, they will need to work together to ensure timing is kept and that their recordings don't clash!

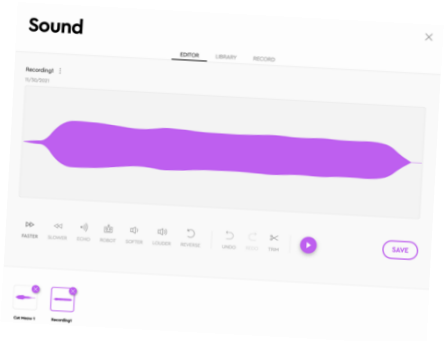
Assessment

Student engagement, ability to work in pairs/teams, discussion responses, ability to transfer knowledge from icon blocks to word blocks, ability to use sound editing features, quality and complexity of sequencing, quality of team performance (if appropriate).

Curriculum Links

Rehearse and perform songs and instrumental music they have learnt and composed, shaping elements of music to communicate ideas to an audience (VCAMUP027)
Use voice and instruments to sing, play and arrange music from different cultures, times and locations, and improvise and compose music in different forms (VCAMUM026)
Define simple problems, and describe and follow a sequence of steps and decisions involving branching and user input (algorithms) needed to solve them (VCDTCD023)





Full Lesson Plan

Making and performing music with LEGO robotics!

Summary

Adding Spike Essential to their BricQ Motion build - Students use basic icon programming to animate their splat gear dancers. They run concurrent programming to select music and time their animation to suit.

Lesson 2 - Twist and Shout

Key Objectives

Students will:

- Be introduced to the programming environment of Spike Essential
- Engage in a practical application of motorisation in conjunction with reciprocal motion to animate a model
- Be introduced to a purposeful use of music within the software, with a focus on rhythm and timing and how the programming environment can be used to effect change on these elements.

Things you will need

For every group of two students:

- LEGO Education Bricq Motion Essentials set
- LEGO Education Spike Essentials hardware
- Device with the LEGO Educaiton SPIKE App installed

Additional resources

- PDF instructions distributed for Lesson 1 and Lesson 2 models

Educational Standards/ Curriculum Links

Use imagination and creativity to explore pitch, rhythm/time and form, dynamics and tempo using voice, movement and instruments (VCAMUE025)

Explore a range of digital systems with peripheral devices for different purposes, and transmit different types of data (VCDTDS019)

Develop simple solutions as visual programs (VCDTCD024)

Prepare

- Ensure all students have access to the PDF instructions for Lesson 1 and 2
- As this is an immersion activity into the use of Spike Essentials, there is no need to pre-teach any concepts
- Ensure batteries are charged and all units' firmware is updated.
- Consider when to distribute sets with respect to classroom management.

Engage

(Whole Class, 5-10 minutes)

- Facilitate a discussion around automation and animation and the role robots play within these tasks. Reflect on last lesson and how they managed to introduce reciprocal motion.
- Begin by having students rebuild the final build from Lesson 1.
- Introduce students to the programming canvas and guide them on how to add a motor block and how to start the program.
- Distribute brick sets to each group.

Explore

(Small Groups, 20 minutes)

- Students begin by following the instructions in Lesson 2 to replace the manual crank with a Spike Essential small motor and connect this to the hub.
- Students then connect their devices to their individual hubs via the Spike App.
- They then recreate the basic motor program to rotate the motor and, in turn, cause the minifigures on the splat gears to twist automatically.
- Pose the question, *how might we change the speed of the motor? How might we speed it up or slow it down?*

Explain

(Whole Class, 5 minutes)

- If students don't find the speed block of their own accord, advise them how and demonstrate how to use.
- Discuss observations and reflections
- Pose questions like, *is this the most efficient way of producing this movement?*

Elaborate

(Whole Class, 15 minutes)

- Students then place a second 'start' button into the program and add the third audio block (speaker and notes) to this.
- When the 'play' button is pressed, the selected song will commence with the motion, but it is highly likely the speed of the dancers will not match the rhythm of the music. Furthermore, it is unlikely the conclusion of the motion and the music will coincide.
- The challenge for each pair is to pick a 'song' from the bank of inbuilt tunes and then find a suitable speed and an appropriate number of rotations so that

when the program is started, the minifigs dance along in time with the song and stop dancing when the music stops.
- Students explore the various editable parameters in the motor blocks to effect change on speed and duration.
- Pose the question, *if 6 is too many, and 5 is not enough, what's something 'in between'?*

Evaluate

(Ongoing Through the Lesson)

- Ask guided questions to encourage your students to articulate their thinking and explain their predictions and observed outcomes of the experiment.

Assessment opportunities

Teacher Observation Checklist

- Assess student engagement in task(s)
- Monitor students' ability to follow instructions and reproduce the code provided on the TV/IWB
- Observe interactions between pairs and or supporting/seeking support within the group.
- Discussion responses (sharing, quality of responses)
- Whether students explore decimals or settle for the nearest whole number.
- Student preparedness to engage and experiment with the programming blocks and how they are edited.

Self-Assessment

- Have each student choose the brick that they feel best represents their performance as an individual
    - Yellow: I was able to animate the model with a simple program
    - Blue: I was able to edit my program to more closely match the speed of my model
    - Green: I was able to match my model's speed and timing perfectly, using decimals to achieve my solution.

Peer Assessment

- In their small groups, have your students discuss their experiences working together.
- Encourage them to use statements like:
    - I liked it when you…
    - I'd like to hear more about how you…

Differentiation

Simplify this lesson by:

- Providing students with the coding blocks required, but without connecting them.
- Support with dialogue, for example *slow songs like this one probably need a slower motor speed. Have you found a way to slow your motor down?*

Increase the difficulty by:

- Experimenting with a number of different songs/speeds/timings.
- Trying out some different splat gear combinations and make conjectures around the relationship between the gear sizes and the amount of movement.

Extensions

- What other dance moves are possible other than twisting? Can this be replicated in Lego?