autismsa

Flinders University

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The LEGO® ROBOTICS Guide:

A guide to facilitating LEGO® Robotics sessions for autistic teens

December 2023

CHILDREN'S RESEARCH FOUNDATION

This guide is an output of a collaborative research project between Flinders University, Autism SA, and Griffith University.

The authors of this Guide are: Louise Williams, Niki Welz, Michael P. Russo, Pammi Raghavendra, David Hobbs, Belinda Lange, Rowena Petticrew, David Trembath and Emma Hinze.

The project: **"Can LEGO® Robotics therapy improve the mental health and social skills of adolescents on the autism spectrum?: A Phase 1 trial,"** was funded by the Channel 7 Children's Research Foundation (https://crf.org.au/).

Twenty-four autistic teens between the ages of 13-16 years from four mainstream schools participated in the project. Each LEGO® Robotics group of three teens was supported by two facilitators from Autism SA, and run at schools during school hours.

This guide consists of information on the LEGO® Robotics therapy program, how to form and facilitate the groups, supporting resources, learnings from the program, and a summary of the research findings.

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This guide has been developed through collaborative research between Flinders University, Autism SA, and Griffith University to assist implementation of the LEGO® Robotics therapy program with the endeavour to improve outcomes for autistic teens.

LEGO® Robotics Therapy Project Research Findings

Can LEGO® Robotics therapy improve the mental health and social skills of adolescents on the autism spectrum?: A Phase 1 trial.

Research Team

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Research Summary

What was the aim?

The aims of this project were to (a) examine the effects of an 8-week LEGO® Robotics therapy program on anxiety, social skills, and school engagement in high-school aged autistic students, and (b) explore the views and perceptions of the program from the autistic students, parents, school staff, and LEGO® Robotics facilitators who were involved.

Why was the project conducted?

LEGO® therapy involves groups of three people working together to build pre-designed LEGO® sets. Each person is assigned a role – the engineer, supplier, and builder – to help organise the work together and create opportunities for learning and participation. Previous research has indicated that LEGO® therapy can help autistic children to develop communication and social skills and reduce aloofness (Narzisi et al., 2021). However, it is not clear if the same types of benefits may also extend to autistic teenagers.

What happened in the project?

We brought together researchers from Flinders and Griffith Universities, along with specialists from Autism SA, to develop the LEGO® Robotics therapy program and implement the project. The LEGO® Robotics program, which is described in this guide, used the principles of LEGO® therapy to build and solve fun challenges using the LEGO® Mindstorms EV3 Robot kit. We then partnered with four mainstream schools to offer the program to students and families in 2021. Twenty-four autistic students (ages 13-16 years), divided into eight groups of three, participated in weekly ~1-hour sessions over a period of 8-weeks. The sessions occurred at school, during school time, and were run by facilitators from Autism SA.

A series of questionnaires were completed by students, parents, and school staff before and after the 8-week program:

- **Social Skills**
  Students, their parents and school staff who knew the students well completed the Social Skills Improvement System-SSiS-SEL (Gresham & Elliot, 2008) rating scales.

- **Anxiety**
  Parents and school staff completed the Autism Anxiety Scale-ASC-ASD (Rodgers et. al, 2016) based on their perception of student's anxiety levels.

- **Motivation and Engagement -MEH-HS**
  Students completed the Motivation and Engagement scale (Liem et. al, 2012).

In addition, participants completed the System Usability Scale (SUS)(Brooke, 1996) after the 8-week sessions which captured information on the utility of the LEGO® Robotics sessions.

What were the outcomes?

Two-thirds of students (n=16) attended 7-8 sessions showing high engagement with the program.

The SUS identified that the program was 'acceptable' from a utility perspective, as the average SUS score from 18 student responses was 66.4 ± 17.6, which is close to the 'acceptable' SUS score of 68.

Although the utility of the program was acceptable, we did not find any clear differences (from a statistical perspective) in students' social skills, anxiety, motivation, and engagement using the above questionnaires. Instead, we saw a lot of variability, which may be due to several factors, including the implementation of the program during the COVID-19 pandemic, with compulsory mask wearing in one school term and the short length of the program. There might have been higher levels of anxiety with all participants in terms of the pandemic and the impact on everyday life including possible school closures.

Feedback from the three groups (students, parents, and school staff) and the facilitators from Autism SA were positive overall and supportive of the LEGO® Robotics therapy program. The feedback covered the benefits of the program, school attendance and engagement, social connections, knowledge, and skills.

The students described the sessions as fun. *"It was fun to do, calming to relieved stress," (Student 3). "It was fun way to use LEGO to solve different kinds of problems and work with other people" (Student 20).* In terms of working in a group, many said that it was *"fine".* Some said that they did not like working in groups, but tolerated it as it was with LEGO®. *"I felt nervous" (Student 15). "I don't like working in groups for anything with anyone. However, it was a bit more bearable since the topic of the work was LEGO" (Student 22.).* They also mentioned that being in the sessions helped with their social skills. *"I improved my social skills by engaging with some people that I might not have had the chance if I didn't do the program" (Student 23).* In terms of the session being run during classes, most were positive that it was during lessons, *"It was a nice break from the classroom" (Student 16). "It helped the stress from school because it gave me a break from school work" (Student 3).*

Parents shared that the program was beneficial for their children in terms of school attendance, opportunities for new friendships, communication, and social skills. *"I know that Student 2 was keen on the sessions. Student 2 struggled with school attendance... and I know that there was some days where the robotics session was what got Student 2 to school, so even just in that respect, it was positive program for (them)" (Parent of Student 2).* School staff corroborated this: *"Student 2's attendance is very poor at the moment, but (they) always made sure (they) came on a Monday because (they) really liked the program, so to the point that Student 2 would come after recess because, like Student 2 would miss care group but come for the LEGO® program".*

Teamwork, communication, and an increase in confidence was also mentioned by parents. *"Student 3 wasn't really the one... to build stuff, but yeah, Student 3 surprised that you know Student 3 did enjoy it and working with other people as well... "Student 3 has sort of found... Student 3 put herself there and Student 3 is talking to a lot more different people so (their) confidence is yeah... more confident".* Student 3's school staff also commented: *"Student 3 is quiet... your typically quiet, reserved, but I have noticed Student 3 engaging with (their) peers more in class not just during class time, but also off campus".*

The School Support Officer of Student 17 and Student 18 highlighted the opportunities for new friendships. *"I noticed that two students, so Student 17 and Student 18, once they started the sessions, they – outside of class because they do have other subject classes together – they actually started sitting together".*

One Senior school staff synthesised the outcomes as follows: *"skill building and transferring and just making themselves more aware of themselves as social participants. Then it's also just having something good for – having something for them that is made for them. That it kind of like hits their interest, hits their needs, it's for them and they get to connect with some other people and broaden their social base within the school, which is important".*

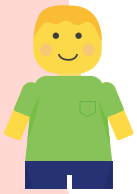
Parents, school staff and the facilitators shared suggestions for future LEGO® Robotics Programs, such as running the sessions for at least two school terms or longer, grouping students with similar levels of LEGO® interest and abilities to work together, and facilitators needing to have expertise and experience in working with autistic students and in managing groups.

Key findings from the research

1. The LEGO® Robotics therapy program can be run in schools
2. The LEGO® Robotics program provided a focus on an activity that allowed for social and communication skills to develop and be practiced in a natural way
3. Students attended school on the day of the program, showing positive motivation and engagement with the program
4. Students found the program to be fun and enjoyable
5. Parents, school staff and facilitators observed an increase in confidence and improvement in social skills
6. Students connected with other students who were not known to them before and started to 'hang out' with these peers
7. Increase in students' team building skills and knowledge in building LEGO® Robotics
8. No statistically significant differences at the group level in relation to their social skills, anxiety and motivation and engagement using standardised measures.

Take home message

A LEGO® Robotics therapy program can be beneficial for some autistic students, but decisions about accessing the program should be individualised based on their interests, needs, and goals.



Recommendations for future programs

1. Consider running the groups for at least two school terms or longer
2. Gather input on the best time at school so that students do not miss other important academic lessons
3. Consider grouping of students with similar levels of LEGO® interest and abilities
4. Encourage students to attend the initial sessions so that they have opportunities to learn the three roles and build a sense of belonging
5. Groups could have four students to cover absenteeism so that there are three students to take on the three roles
6. There must be a specific dedicated room with adequate space and appropriate lighting to run the group
7. Facilitators need to have experience in working with autistic students and in groups
8. Ensure participants sensory needs are met through accommodations, adjustments, and tools.

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LEGO® Robotics Therapy

An Introduction

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1.0 LEGO® Robotics Therapy: An Introduction

1.1 What is LEGO® Therapy?

LEGO® Therapy is an evidence based social skills programme for individuals on the autism spectrum. LEGO® therapy interventions encourage students to work together in groups of three to collaboratively build a predesigned LEGO® creation, following step-by-step visual instructions. These interventions have been used with autistic children as young as five years of age (Lindsay et al., 2017a). Interventions targeting the interests of participants have been shown to improve cognitive and behavioural development (Otero et al., 2015). A key aspect of LEGO® therapy is the three distinct social roles – the engineer, supplier, and builder. Using the LEGO® set instructions, the engineer describes the bricks needed to the supplier and explains to the builder how to assemble the bricks; following the engineer's instructions the supplier selects and supplies the pieces to the builder, and the builder builds the set. A group of three usually work with an adult facilitator and participants adopt one role per session. Effective communication, problem solving, negotiating, turn taking and cooperating are the focus.

Research has shown that school-aged children and adolescents who attended LEGO® Therapy made significant improvement in their social skills (Owens et al., 2008) and anxiety (Lindsay et al., 2017b. Narzisi, et. al., 2021). LeGoff (2004) found that children and young people aged 6-16 years showed significant improvements in social competence because of participating in LEGO® Therapy. Improvements in motivation to initiate social interaction with peers, ability to sustain interaction with peers, and a reduction in behaviours such as aloofness and rigidity were documented.

LEGO® Therapy has been applied to a variety of settings, including clinics, education, and the community.

1.2 What is LEGO® Robotics Therapy?

LEGO® Robotics Therapy is an intervention aimed at developing social and communication skills and increasing wellbeing specifically for autistic teenagers.

LEGO® Robotics Therapy was conceived based on the practice of LEGO® Therapy, developed by Clinical Psychologist Daniel LeGoff. LEGO® Therapy has been primarily used with children under 12 years of age. To meet the interest and needs of autistic teenagers LEGO® Robotics Therapy was considered and implemented.

Similar to traditional LEGO® Therapy, LEGO® Robotics Therapy consists of groups of three participants who are assigned specific roles with clear objectives: Engineer, Supplier, Builder. For this particular project, eight sessions were held weekly for between 45 minutes to an hour over an 8–10-week time period. The difference between traditional LEGO® Therapy and LEGO® Robotics Therapy is the LEGO® used for LEGO® Robotics offers a matched level of challenge for teenagers, incorporating technic LEGO® pieces and the ability to program a controller to move and control the final design.

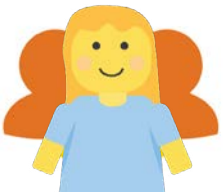
The group is semi structured, with a Facilitator guiding the group's engagement and interactions as opposed to providing instructions. Participants work through the process of building a LEGO® robot and complete challenges while developing social, communication, problem solving and emotional skills.

LEGO® Robotics Therapy can provide predictability because the participants are often familiar with LEGO® as a toy, and can provide natural motivation as LEGO® may be an area of interest. One participant reported that the group was a *"fun way to use LEGO® to solve different kinds of problems and work with people".*

WHAT IS

LEGO® Robotics Therapy?

LEGO© Mindstorms Education EV3 Core Set



3-4 Participants

1 Facilitator

45minutes - 1 hour sessions

Over 8 - 10 weeks

Icons created by Canva

1.3 Why use LEGO® to develop skills?

For this particular project, the LEGO® Mindstorms Education EV3 set was chosen as the core tool for LEGO® Robotics Therapy. The benefits of using LEGO® in this way include:

- That LEGO® may be a natural area of interest for teenagers
- It can offer predictability in the way LEGO® connects and is formed
- Provides a focus on an activity allowing social and communication skills to develop and be practiced in a natural way
- Offers scalability in meeting the various skill levels of participants or groups
- Utilises an individual's strength, instilling confidence and a willingness to take risks
- Engineers an environment for communication and social interaction to occur spontaneously
- Can invoke connection and belongingness in being part of a group
- Having a common goal to foster teamwork.

LEGO® can be an area of interest, meaning that participants can be more engaged from the outset, better able to attend and focus, and better able to learn and use social skills than within general social groups. Research on the value of strengths suggests that knowing and following one's strengths generates optimism, helps to develop self-confidence, generates a sense of vitality and builds resilience (MacConville & Rae, 2012). Participants are able to see the value that they bring to the group. Additionally, for participants that do not have a current interest in LEGO®, engagement in the group can introduce a potential new and enjoyable leisure activity. Parents also reported that the reason why they were interested in having their child participate, was that it gave them the opportunity to try something new and gain a potential new hobby.

While some participants came to the groups not having an interest or experience in LEGO®, we found that many participants were likely to be confident and enjoy making LEGO® models, which enabled them to connect over a common interest with other participants.

Participants reported, "*It was a fun and exciting experience"* and it gave them an opportunity in *"meeting new people and making things and problem solving".*

Participants also shared that *"I don't like working in groups for anything, however, it was a bit more bearable since the topic of the work was LEGO®"* and that *"it was fun and a nice, new challenge".*

We also found that LEGO® as a familiar tool, supported participants to talk to one another and appear more relaxed. As an example, one participant in our session asked another participant how they made friends. They said they used their sense of humour and the other participant said they used social media to find the participants at their school and then arranged to meet them in person at school. One participant went to the Minecraft© group at school and invited another participant to join them.

This increased confidence could lead to the participants taking more risks and accepting feedback from their peers that may have previously been difficult. One participant started the sessions directing the actions of others, including how to use the LEGO®, and by the last session was able to accept others' ideas and was keen to help them.

Every participant is different and the skills they develop while attending LEGO® Robotics sessions, and the extent to which they develop, will vary from person to person. Some of the skills we anticipated LEGO® Robotics to develop included:

- Attention and listening skills
- Turn taking, waiting and sharing
- Expressive and receptive language skills
- Social communication and social competence skills
- Teamwork/collaboration
- Problem solving
- Negotiation and joint problem solving
- Tolerance of participating in group activities
- Fine motor skills, and
- Self-esteem.

LEGO® Robotics Therapy

Participant Roles

Photo by Astrid Schaffner on Unsplash

2.0 LEGO® Robotics Therapy: Participant Roles

2.1 Participant role in LEGO® Robotics Therapy

LEGO® Robotics Therapy involves 3-4 participants who work in a team to build a LEGO® robot model using a LEGO® Mindstorms Education EV3 core set. Once the robot has been built, participants use the LEGO® Mindstorms Education EV3 Expansion Set and a range of other resources to complete various challenges together.

The intervention is aimed at participants between the ages of 13-16 years.

Each participant rotates through the following roles:

- Engineer
- Supplier
- Builder

An optional additional role can be used if you have a fourth participant:

- Supervisor

PARTICIPANT ROLES IN

LEGO® Robotics

Engineer

Builder

Supplier

Supervisor
OPTIONAL

Image 1: Photo by Chris Curry on Unsplash(edited), Image 2: Photo by Marcel Strauß on Unsplash, Image 3: Photo by Marcel Strauß on Unsplash, Image 4: Photo by Qi Li on Unsplash

Engineer

I give instructions to the Supplier and Builder.

1. I read the instructions.
2. I describe the pieces that we need to the Supplier.
3. I explain to the Builder where to put the pieces.
4. I listen to any questions that the Builder has.
5. I check that the model is looking the same as the instructions.

Photo by Chris Curry on Unsplash(edited)

Supplier

I supply the Builder with the right pieces.

1. I listen to the Engineer describe the pieces we need.
2. I choose the right LEGO® pieces.
3. I give the pieces to the Builder.
4. I wait for my next instruction.

Photo by Marcel Strauß on Unsplash,

Builder

I follow the instructions from the Engineer.

To build the model:

1. The Supplier gives me the pieces to use.
2. I listen to the Engineer's instructions.
3. I can ask questions if I'm not sure where to put a piece.
4. I build the model.

Supervisor

I supervise the group to ensure we work together and get the job done!

1. I check that everyone is following the rules.
2. I check that everyone is doing their job.
3. I can help the others if they ask for help.
4. I help with problem solving for the group.

Photo by Qi Li on Unsplash

Engineer

I give instructions to the Supplier and Builder.

1. I read the instructions.
2. I describe the pieces that we need to the Supplier.
3. I explain to the Builder where to put the pieces.
4. I listen to any questions that the Builder has.
5. I check that the model is looking the same as the instructions.

Supplier

I supply the Builder with the right pieces.

1. I listen to the Engineer describe the pieces we need.
2. I choose the right LEGO® pieces.
3. I give the pieces to the Builder.
4. I wait for my next instruction.

Builder

I follow the instructions from the Engineer.

To build the model:

1. The Supplier gives me the pieces to use.
2. I listen to the Engineer's instructions.
3. I can ask questions if I'm not sure where to put a piece.
4. I build the model.

Supervisor

I supervise the group to ensure we work together and get the job done!

1. I check that everyone is following the rules.
2. I check that everyone is doing their job.
3. I can help the others if they ask for help.
4. I help with problem solving for the group.

2. 2 Allocation of roles

Session 1

In the first session participants sit wherever they want when they come into the group. Participants will start the activity with the role allocated in that place and then every 5 minutes, roles are changed by moving clockwise to the station allocated for the next role. The idea is that each participant gets a chance to trial each role.

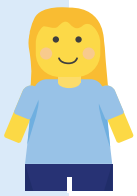
Initially, many participants when in the Builder role wanted to reach out and get pieces instead of waiting for the Supplier, or as the Engineer, wanted to reach over to the builder and show them what to do. As the sessions went on and they became more familiar with the roles, they would wait.

Sessions 2+

In further sessions we rotated roles every 10 minutes until the build was completed. We found some participants preferred a particular role and felt encouraged and confident to join in the group if they could start in their preferred role. We allowed this as it made participants feel calmer and connected. We took this as an opportunity to point out they may prefer a particular role because of the strength they display in that role, i.e. logical thinking or attention to detail. We then encouraged them to rotate through the other roles with the participants after 10 minutes.

Each participant must play their role and only their role which can be very difficult for those who are used to making LEGO® models on their own. They may need reminders about waiting, which is why we have the 'Wait' cue card. Additionally, this is also when the 'Help' cue card can be used. Visual Supports can be found in the Additional Resource section of this guide.

Note:
In some of the groups we allowed participants to stay with the role they liked to help build confidence and feel positive about their contribution to the project. One participant identified that he felt stressed doing the Engineer role and some participants wanted to stay in the role they felt they were "doing a good job" in, so we asked the participants to vote for changing the roles or staying in the same role. We also found that participants were suggesting a participant stay in the role because they were really good at it, which started a discussion about compliments.



2.3 Skills required and developed in each role

Role	Skills developed in each role
Engineer	Able to give an instruction to the Builder about where to place a LEGO® piece (Expressive Language)
	Able to describe exactly which LEGO® piece the Supplier needs. (Expressive Language)
	Able to answer any questions from the Builder (Receptive & Expressive Language)
	Able to see if a LEGO® build is progressing correctly according to the kit instructions (Visual Perception)
Supplier	Able to listen to a description of the LEGO® piece from the Engineer (Receptive Language)
	Able to look at and choose exactly which LEGO® piece to provide to the builder (Visual Perception and Receptive Language)
	Able to ask questions about shape, colour and size in relation to the piece required (Expressive Language)
Builder	Able to understand an instruction from the Engineer that tells them where to place a LEGO® piece (Receptive Language)
	Able to understand exactly which LEGO® piece to use when it is described by the Engineer (Receptive Language)
	Able to ask the Engineer questions about the build (Expressive Language)
	Ability to pick up/place LEGO® pieces to build the kit (Fine motor skills, Visual-Motor Integration skills and Spatial Reasoning)
Supervisor	Able to support the participants with problem solving (Critical Thinking)
	Able to reinforce positive engagement (Expressive Language)
	Able to redirect participants back to role (Expressive Language)

LEGO® Robotics Therapy

Facilitator Role

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3.0 LEGO® Robotics Therapy - Facilitator Role

3.1 Facilitator Role

LEGO® Robotics sessions require at least one facilitator to guide the group.

We found that it was useful to have two facilitators per group. The benefits of having an additional facilitator include:

- Sharing the workload
- Completing feedback and assessment
- Ability for a facilitator to fill in a role if a participant was absent from the group
- Ability to continue to run the groups if one facilitator was absent
- Ability to support individual participants' needs, including self-regulation, while continuing to run the group.

Key characteristics of an effective facilitator:

- Able to coach and guide participants
- Able to use role play to show things like calming strategies or conversations
- Enjoy running groups and using their sense of humour to overcome difficult situations; humour is a strength for many people on the autism spectrum
- Experience in working with autistic teens
- Able to provide positive reinforcement
- Use a strengths-based approach
- Use non-judgemental teaching strategies
- Practice patience and support resilience
- Facilitate group led learning and decision making
- Encourage problem solving and conflict resolution
- Keen observer and supporter
- Facilitate belongingness and a sense of connection.

KEY CHARACTERISTICS OF A

LEGO® Robotics Facilitator

Experience in working with autistic teens

Provide positive reinforcement

Uses role play to demonstrate skills

Strengths-based approach

Facilitate group learning and decision making

Keen observer and supporter

Facilitate belongingness and a sense of connection

Enjoy running groups

Able to coach and guide the group

Uses non-judgemental teaching strategies

Have a sense of humour

Encourage problem solving and conflict resolution

Practice patience and support resilience

Icons created by Canva

The facilitator requires experience with running groups for this age cohort and ideally for autistic individuals, or individuals that are neurodivergent. Additionally, it is beneficial if facilitators or a facilitator is familiar with LEGO® or Mindstorms© sets. It is important to be able to provide positive reinforcement and feedback in a non-judgemental way and provide support when it is needed by participants. Facilitators of a group are there to support participants to learn from each other. The build/challenges are not as important as the skills development.

The facilitator's role is to coach and guide the process in a way that encourages participants to problem solve any conflicts or breakdowns in communication that arise themselves. This is a chance for participants to interact with others in a structured situation with adult support to encourage positive interaction and develop skills. The facilitator emphasises what participants can do, not what they can't do.

The facilitator doesn't assist too early but instead waits, watches and allows the participants to use their skills to calm themselves in conflict situations and listen to others, compromise, and consider how they can respond. Facilitators support participants to be able to practice resilience and try to overcome their frustrations in the challenges when their ideas don't work, or the pieces they need are not available.

When the group is building or completing challenges, circle the group listening and observing the interactions, asking if anyone needs help from their peers rather than immediately providing it themself. However, some participants will need support to give them confidence. One participant said she was "not sure if I want to come back" and required a lot of support but by the seventh session she was able to do the challenge without adult support and we saw a definite improvement in her self-esteem and independence.

The build and the challenges need to be developmentally appropriate so that the focus is on skill development in the areas of social, communication and problem solving, as opposed to the technical skills required to complete the build or the challenges. One participant reported that the group offered *"a sense of accomplishment".*

LEGO® Robotics sessions were developed for autistic teens between the ages of 13-16 without an intellectual disability, but it is important to allow for the individual needs of the various members of the group to be catered for i.e. more time to complete a challenge, being able to stand back and watch the other participants before they start their own challenge, or extra tasks for those who are quicker, such as only using 10 pieces to complete the challenge. We also had a participant who had difficulty seeing the colours of the pieces, so we made a visual guide to support him to be successful.

To develop a sense of belonginess in the group it is key that the facilitator points out the helpful and kind things participants are doing and encourage the team members to also do this. The "belongingness hypothesis" states that people have a basic psychological need to feel closely connected to others, and that caring, affectionate bonds from close relationships are a major part of human behaviour. We found that once the participants got to know each other they were happy to help each other either to find or make a piece, or to assist with their challenge solution. The participants responded well to belongingness strategies i.e., "we missed you", "we are glad you are here". When a participant joined the group after a session or was late to a session, it was often more difficult to feel that sense of belongingness. One participant included another participant in the challenge even though previously they didn't want to interact with them. This demonstrated that the group felt more connected as they progressed through the program.

Practices to support the implementation of LEGO® Robotics Therapy

- Display visual schedules
- Use timers for change of roles
- Use visual cues
- Display roles and group expectations
- Set up the room the same way each time so it is predictable
- Give instructions and allow for processing time
- Observe and note different learning and building styles
- Model and demonstrate the skills needed
- Focus on and provide positive reinforcement and feedback
- Make it fun
- Provide a safe environment
- Encourage all ideas when doing challenges
- Emphasis on what they can do not on what they can't do
- Guide the participants through the build while encouraging skill development.

3.2 Assessment and feedback

Participant Assessment Sheet (Page 28-30)

As the facilitator, it is important to collect formal feedback that can be used to evaluate outcomes for the group's participants. This can be achieved through observing each participant during sessions to identify skills or practices that are and are not being used. At the end of each session the Assessment Sheet can be used to record the skills participants are demonstrating and the extent to which the skills are being used.

Participant Observation Assessment Sheet (Page 31)

The Observation Assessment Sheet can be used to record additional data regarding skills development and progress. One participant didn't know how to accept a compliment, so the facilitator asked how he felt when he got one. He responded positively and then later gave a participant a compliment. We also found that participants started to compliment themselves; *"I've got a good brain",* and *"I am good at this".* This feedback can be recorded on the Observation Assessment Sheet.

We also found we could use the Observation Assessment Sheet to identify skills that weren't being used by the participants and bring discussions and activities into future sessions to either develop these skills or to provide the opportunity for the participant to demonstrate these skills.

LEGO® Robotics Therapy: Participant Assessment Sheet

Participant information

Participant's name: _____

Please indicate each week:

D - Developing	**P** - Partially met	**C** - Critera met	**N/A** - Not Applicable

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
Social communication								
1. Asking and answering questions								
2. Listening to directions								
3. Active listening/ joint attention								
4. Respecting others point of view & suggestions								
5. Expressing ideas effectively								
6. Providing positive feedback/complimenting								
Social interaction								
7. Turn taking/waiting								
8. Sharing								
9. Asking for help								
10. Bonding with peers								
11. Accepting criticism/feedback from others								
Collaboration								
12. Division of labour								
13. Joint accomplishment								
14. Assertiveness (not aggressive)								
15. Resolving conflict								
16. Resilience								
17. Belongingness								

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
Self awareness and motor skills								
18. Self-control								
19. Fine motor skills								
20. Following routines								
21. Following rules								
Participant LEGO® Therapy: Participant Check Out scale								

LEGO® Robotics Therapy: Meanings

Active listening/joint attention
They look at who is talking, stop what they are doing, turn their body towards the speaker, take turns in talking/responding to others.

Respecting others point of view
They listen to others' ideas even if they don't agree with them, they acknowledge the ideas of others and try to include those ideas so that everybody is heard.

Expressing ideas effectively
They explain ideas to others so that they can understand what is required.

Providing positive feedback/complimenting
They give useful and friendly feedback, encouragement, or compliments to their peers.

Asking for help
Asking their peers in the group or the facilitator.

Bonding with peers
They establish a relationship or link with someone based on shared feelings, interests, or experiences i.e., they encourage their peers to share in the things they are doing.

Accepting criticism/feedback from others
They can accept feedback in a calm manner and possibly change the challenge to reflect that feedback.

Division of labour
They understand that everyone has a role and do not try to take over the other person's role. They decide to do a challenge together and work out who does what job.

Joint accomplishment
They come up with new ideas or solutions for the group to try, as a group they celebrate the accomplishment of e.g., the robot build being completed.

Assertiveness (not aggressive)
Being assertive shows they respect themselves because they are willing to stand up for their interests and express their thoughts and feelings. It also demonstrates that they are aware of others' rights and willing to work on resolving conflicts.

Resolving conflict
They listen to others opinion even if they disagree, suggest ways to resolve the disagreements, change their views to solve a conflict and maybe just say sorry.

Resilience
They have the capacity to recover quickly from difficulties.

Belongingness
Being somewhere they want to be and feeling that others want them in the group. The need to belong is the need to give and receive attention to and from others. They feel like they have a role in the group and have shared goals.

Self-control
The ability to control themselves, including emotions, feelings, actions and desires, especially in difficult situations.

LEGO® Robotics Therapy: Participant Observation Assessment Sheet

Participant information

Participant's name: _____

Week 1	
Week 2	
Week 3	
Week 4	
Week 5	
Week 6	
Week 7	
Week 8	

Calming item/strategy used:

Informal data collection

In addition to the formal assessment and feedback process, the facilitators' role included engaging with participants to seek feedback on their experiences. This was done informally throughout the session and is particularly important towards the end of each session. This allows for adjustments to be made to the planning, implementation and dynamics of the group to maximise outcomes for each participant.

Questions to informally ask the participants after each building session include:

- What role did you like the most?
- When you felt a bit anxious, what strategies helped you feel calm today?
- Do you feel proud of yourself?
- What do you think your strengths were in this session?
- What made you a good Engineer/Builder/Supplier/Supervisor?
- What did you find challenging in this session?
- What can you do next time to do the role differently?
- Did you enjoy working together to complete the build?

Participant 'Check Out' Form

We also used a participant 'Check out' form that was completed by each participant at the end of each session as a tool to support gathering information directly from participants. Alternatively, the facilitator scribed for participants to support accessibility. This provided an indication of how they were feeling about being in the group and their level of participation/need for help, etc. It was deliberately very simple so that the participants were more likely to use it.

The comments section was not required to be used all the time. Participants were advised that they could use it to identify if there was something in particular they liked, if there were sensory items they liked to use during the session, or if they wanted us to know of something bothering them.

LEGO® Robotics Therapy: Participant Check Out

Participant information

Participant's name: _____

Week: _____

Level	Today I.....	Check in
5	Joined in and really enjoyed it.	
4	Joined in and liked doing most of it.	
3	Joined in sometimes and it was OK.	
2	I tried to join in, but I would like more help next time.	
1	I did not join in and need support to join in.	
Comment:		

Amended from- Buron, K.D. & Curtis, M. 2021. The Incredible 5-Point Scale. 5 Point Scale Publishing. Saint Paul, MN. http://www.5pointscale.com.

LEGO® Robotics Therapy

Getting Started

Photo by FORTYTWO on Unsplash

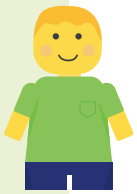
4.0 Getting Started

4.1 Establishing a group environment

To ensure that the LEGO® Robotics sessions are as successful as possible for all participants, environmental considerations and adjustments need to be made, such as:

- Will all sessions be in a permanent or temporary room?
- Will the size of the room fit a group of 3 or 4?
- Is there a separate room for the parents/carers to meet if outside of school hours?
- Consider if you want to leave challenges/builds that are made on display in the room
- Is there space for a calm area?
- What is the best time to get the group of participants together?
  E.g.: try and avoid participants missing their favourite subject if run during school hours.
- Limit distractions like phones, computers, competing noise and conversations so the environment is as sensory reduced as possible.
- Applying individual adjustments such as reduced lighting, alternative seating, use of sensory or communication supports.

Helpful Tip:
If groups are run out of school hours it can be beneficial to have a separate room for the parents/carers. Having the parents/carers together can provide them with the chance to develop their own support network and share stories and experiences with each other. This can also help parents/carers to feel more connected to the program.



4.2 Participant selection

LEGO® Robotics sessions require three participants. An additional participant can be included if required, but a group cannot run with less than three participants consistently. If you have more than one facilitator, one facilitator can fill in one of the roles so that the session can go ahead.

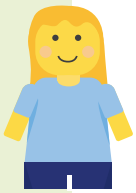
LEGO® Robotics was developed for autistic teens. The eligibility criteria for the research project was a participant with a formal autism diagnosis, who was in a mainstream school. However, we recognise that LEGO® Robotics could be beneficial to a wide range of participants, particularly those who have difficulties in communication and social interaction or are at risk of mental health concerns such as anxiety or depression, but may not have autism.

To ensure that the LEGO® Robotics sessions are as effective as possible for all participants, careful consideration should be made when selecting participants for the group.

Consideration to participant selection should include:

- Does the participant have an interest in LEGO® or robotics?
- Chronological and developmental age differences
- Gender
- Are the participants evenly skilled in the use of LEGO®?
- Functional skills and individual needs
- Receptive and expressive language skills
- Potential for consistent attendance
- Behaviours of concern
- Number of facilitators
- The possibility of friendships developing between participants beyond the group
- Will you have a group of 3 or 4 and include the supervisor role?

Note:
Grouping by developmental age, skills and interests is far more important than grouping by chronological age but it is recommended that the participants be no more than two years apart.



To support the participant selection process, we have developed a Participant Selection Criteria Form. This can be a useful tool to support the participant selection process.

Participant selection criteria form

Participant information

Participant's name: _____

Year/Class: *(if applicable)* _____ **Age:** _____

Gender pronouns: she/her/hers he/him/his they/them/theirs or other: _____

Section 1

1. Is the participant likely to attend at least 7 out of the 8 LEGO® Robotics Group sessions?	**Yes** Proceed to section 2	**No** The participant may be better suited to 1:1 therapy

Section 2

Please circle the most reflective number for each topic below.

1 - Very little	**2** - Little	**3** - Okay	**4** - Greatly	**5** - Significantly

2. Does the participant have an interest in LEGO® or robotics?	1	2	3	4	5
3. Is the participant able to listen to and follow verbal instructions?	1	2	3	4	5
4. Is the participant able to describe a picture using words?	1	2	3	4	5
5. Does the participant show interest in, and have the skills needed to work in a group?	1	2	3	4	5
6. Does the participant have the fine motor skills to be able to put two pieces of LEGO® together and pull them apart?	1	2	3	4	5
7. Does the participant have the confidence to engage with new people and new activities?	1	2	3	4	5

Participant Criteria:
If the participant has 5 out of 7 responses in the 2,3 or 4 columns, they may be suitable for LEGO® Robotic group. Proceed to Section 3. If not, they may be better suited to 1:1 therapy.

Section 3

Circle the number that best represents the participant's level of behaviour of concerns.

1. Does the participant engage in behaviours of concern*?

1 - None	**2** - Rarely	**3** - Occasionally	**4** - Often	**5** - Consistently

**Behaviours of concern can be identified as any of the following: throwing, threatening, punching, slamming, screaming directed at others or self-injurious behaviour.*

A response to this question that placed the participant at a 1, 2 or 3 would indicate that they may be suited to LEGO® Robotics Therapy. A response in 4 or 5 may mean that the participant is better suited to 1:1 therapy.

Participant criteria for LEGO® Robotics

If the participant meets all the criteria outlined in Sections 1, 2 and 3, they should be considered for LEGO® Robotics Therapy with consideration to their individual needs and goals, and other potential participants.

4.3 Parent/carer Involvement

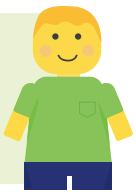
Like most interventions, we hypothesised that LEGO® Robotics is most effective with parent involvement.

To ensure that parents and carers are aware and supportive of the sessions, it is advised to involve the parent in the early stages of planning for the implementation of LEGO® Robotics.

Some practices we used to assist parent and carer awareness and support included:

- Running information sessions for parent/carers on what LEGO® Robotics was and the benefits and expectations for participants prior to the sessions commencement. This was done through a pre-recorded video, accessible to parents/carers
- Sending out a welcome letter for parents/participants before sessions started with the facilitators contact details
- Providing a schedule of what would be involved in the sessions
- Sending out an explanation of the roles
- During the build and challenges, we asked the participants to take photos or videos to show their parents what they had been doing. If they didn't want to do this themselves we would, with their permission, take photos and videos and email them to the parents.

Note:
To prevent participants from being distracted the use of phones was restricted to taking photos or videos of the build.



Welcome letter for parents/carers and participants (example)

Hello [insert participant name],

Welcome to the LEGO® Robotics program!

Participants in the group will be attending 8 x 45 minutes weekly sessions as part of the LEGO® Robotics project. There will be 3 participants in each group and 2 facilitators to support the group.

Over the eight weeks, participants will work in the group to build a robot and find solutions to challenges set by the facilitators using LEGO® Mindstorms Education EV3 robotics equipment and software.

During the sessions participants will be rotated through different roles: Builder, Engineer, Supplier, or Supervisor, to complete the build. Each participant will get time to do each role over the eight weeks.

In the first session the participants will learn the roles of the building process and will get to know their group members with support from the facilitator.

In sessions 2 and 3, participants will work with the group to build a robot.

In subsequent sessions, participants will work together as a team to solve challenges that have been set by the facilitator.

We have provided an explanation of the roles of LEGO® Robotics and a schedule so you and your child are more aware of what we will be doing in the sessions.

The sessions will take place from the [insert start date] until [insert end date]

They will be held on:
Day: [insert day of the week]
Time: [insert start and finish time]
Room: [insert room]

It is strongly encouraged that you discuss your child's participation with them and share this information.

Please contact [insert facilitators contact name and details] if you have any questions about your child's participation.

Yours sincerely,

4.4 Equipment

The equipment needed to run the group should be purchased and organised well in advance to give the facilitator time to familiarise themselves with the set and the set up to run LEGO® Robotics sessions.

The equipment and supports needed to implement the sessions include:

1 x LEGO® Mindstorms Education EV3 Core Set.

The equipment and supports needed to implement the sessions include:

1 x LEGO® Mindstorms Education EV3 Core Set Build Instructions – *placed in a Lever Arch file A4 ring board folder.*

1 x LEGO® Piece Organiser Tray (Core Set) – *assembled with visuals and numbers*

1 x Tray LEGO® Pieces Visual – *used to identify the LEGO® pieces located in the LEGO® Piece Organiser Tray*

1 x LEGO® Piece Box – *to store larger LEGO® pieces*

1 x Box LEGO® Pieces Visual – *used to identify the pieces in the LEGO® Piece Box*

1 x LEGO® Scale

1 x LEGO® Mindstorms Education EV3 Expansion Set – *for the challenges*

1 x LEGO® Element Survey 45544

- Role Descriptions – *laminated*
- Additional Resources and Activities – *as outlined in 5.0 Additional Resources and Activities Section*
- Coding for the Robot for each of the three challenges – *done before the challenge session*

Additional Equipment for Challenges:

- Additional equipment is required for each challenge. Refer to the Session Instructional Sheet for information regarding what equipment is needed for each challenge.

LEGO® Mindstorms Education EV3 Core Set and Expansion Set

LEGO® Robotics uses the LEGO® Mindstorms Education EV3 core set (Figure 1). This is needed to build the robot by the group.

Figure 1
The LEGO® Mindstorms Education EV3 Core Set

In addition, the LEGO® Mindstorms education EV3 expansion set (Figure 2) is needed to complete the challenges.

Figure 2
The LEGO® Mindstorms Education EV3 Expansion Set.

Both of these can be purchased online or at any good LEGO® store.

Each group requires the core set for the robot build and the expansion set for the challenges. You cannot run multiple groups using the same core sets at the same time. Once a group has finished, you can dismantle the robot and use again for future groups.

The rough cost for the LEGO® Mindstorms Education EV3 Core Set is AUD$800 and the LEGO® Mindstorms Education EV3 Expansion Set is around AUD$300.

While other sets may be used, the instructions on building and coding the sets provided in this guide are based on the LEGO® Mindstorms Education EV3 core set and the expansion set.

To begin with, LEGO® Robotics sessions require participants to work together to build a robot using the LEGO® Mindstorms Education EV3 Core Set.

This requires the group to use the:

- LEGO® Robotics Sessions Robot Building Instructions (Core Set).

The build instructions are included in the LEGO® Mindstorms Education EV3 Core Set. It is important to print the instructions before the session.

The building instructions are used by the Engineer. To ensure that the Builder and Supplier do not see the build instructions, we found that it was best to put the instructions into a Lever arch file A4 ring (Figure 3).

Figure 3
LEGO® Mindstorm Education EV3 Build Instructions (Core Set) placed in a Lever Arch file A4 ring board folder.

Note:
We tried many different folders and found that this was the best folder to prevent the Supplier and Builder from seeing the instructions.

LEGO® Piece Organiser Tray (Core Set) assembled with visuals and numbers:
During the robot build session, the Supplier is required to give the required pieces to build the robot to the Builder based on the Engineer's instructions. To support quick finding of the right pieces, we assembled a LEGO® Piece Organiser Tray (Figure 4). The tray is then given to the Supplier during each session.

Step 1

We placed the stickers provided in the LEGO® Mindstorms Education EV3 core set on each compartment of the LEGO® Piece Organiser Tray. We attached the stickers to one side of the compartment within the tray as a visual reminder and a way for the pieces to be found easily by the Supplier and described by the Engineer. This is not needed for the Expansion set.

However, this was still frustrating and time consuming for the Engineer to find each piece from the robot build instructions and describe it to the Supplier. Therefore, we also added number stickers to the compartments in the LEGO® Piece Organiser Tray for quicker and easier identification.

Figure 4
Stickers of the LEGO® pieces attached to one side of the compartments of the tray.

Step 2

Number the LEGO® Piece Organiser Tray compartments (Figure 5): rotate the LEGO® Piece Organiser Tray and add numbers on each compartment of the tray from 1 to 13.

Figure 5
Numbers are added to the other side of the compartments of the LEGO® Piece Organiser Tray.

Step 3

Write the same numbers on the Tray LEGO® Pieces Visual card provided in the LEGO® Mindstorms Education EV3 Core Set to match the LEGO® Piece Organiser Tray (Figure 6). This assists the Engineer to describe the correct piece.

The Engineer describes the piece required from the robot build instructions and what number section it would be in, and gives this information to the Supplier in a smoother and less frustrating way.

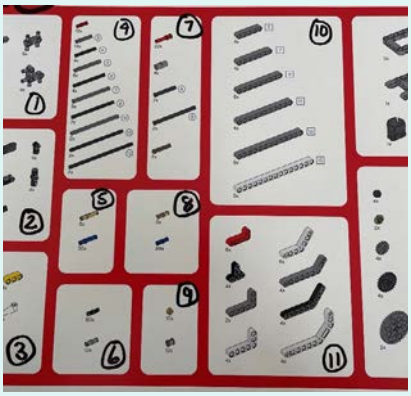


Figure 6
The LEGO® Pieces Visual card numbered to match the LEGO® Piece Organiser Tray.

Step 4

Add the LEGO® pieces from the Core Set to the correct compartments of the LEGO® Piece Organiser Tray (Figure 7). Make sure that pieces from the expansion kit are not added.

Figure 7
The assembled LEGO® Piece Organiser Tray.

LEGO® Piece Box

The box that the LEGO® Mindstorms Education EV3 core set is supplied in (Figure 8) is used to store all the LEGO® pieces not included in the LEGO® Piece Organiser Tray (Core Set). These are the larger pieces such as the wheels.

Figure 8
The LEGO® Piece Box.

Box LEGO® Pieces Visual

The Box LEGO® Pieces Visual card outlines the LEGO® pieces found in the LEGO® Piece Box (Figure 9). The Engineer will use the visual card to identify where the pieces are located to complete the robot build instructions.

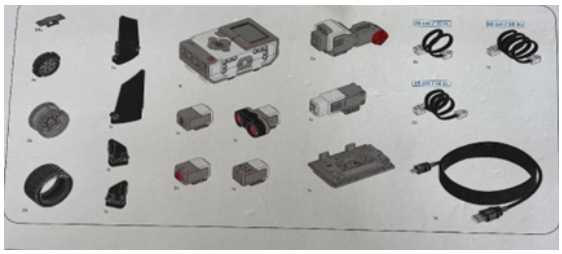


Figure 9
The Box LEGO® Pieces Visual.

Box LEGO® Pieces Visual

The LEGO® Element Survey 45544 lists the names for the LEGO® pieces in the core set and is not included in the core set (Figure 10). This needs to be printed prior to commencement of the group:

- LEGO® Element Survey 45544

The LEGO® Element Survey 45544 is needed so the Engineer can describe the pieces.

Often participants would make up their own names for pieces and this worked as well. We had some very funny names and descriptions of pieces, but the Supplier always seemed to know what was required.

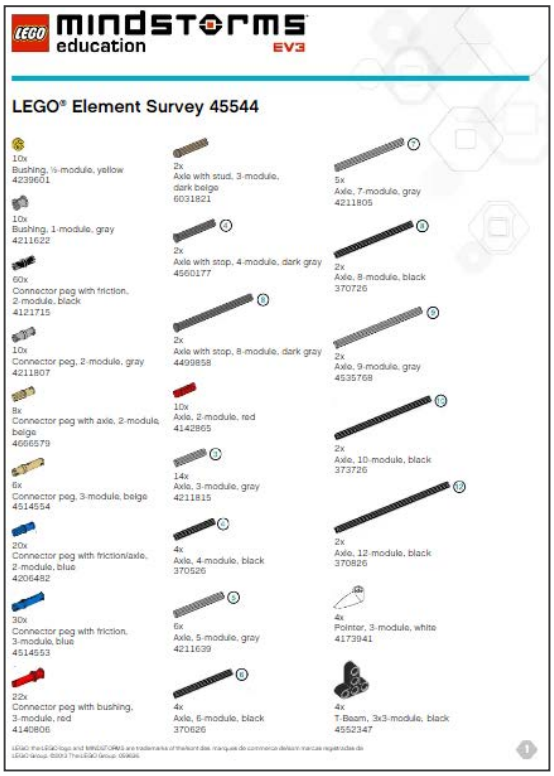


Figure 10
The LEGO® Element Survey 45544.

LEGO® Scale

The LEGO® Mindstorms Education EV3 core set includes a visual of a LEGO® Scale (Figure 11).

We printed several copies of this as it was useful for both the Engineer and the Supplier to help them to describe and select the correct LEGO® piece.

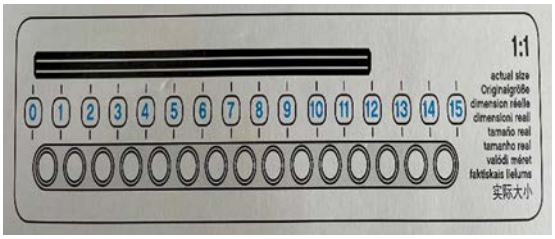


Figure 11
The LEGO® Scale.

Role Descriptions

To prompt participants and remind them of their roles, we printed out the different Role Descriptors (from pages 16-20), laminated these, and displayed them at the different stations (Figure 12). This supported participants to ensure that they only fulfilled those roles and responsibilities.

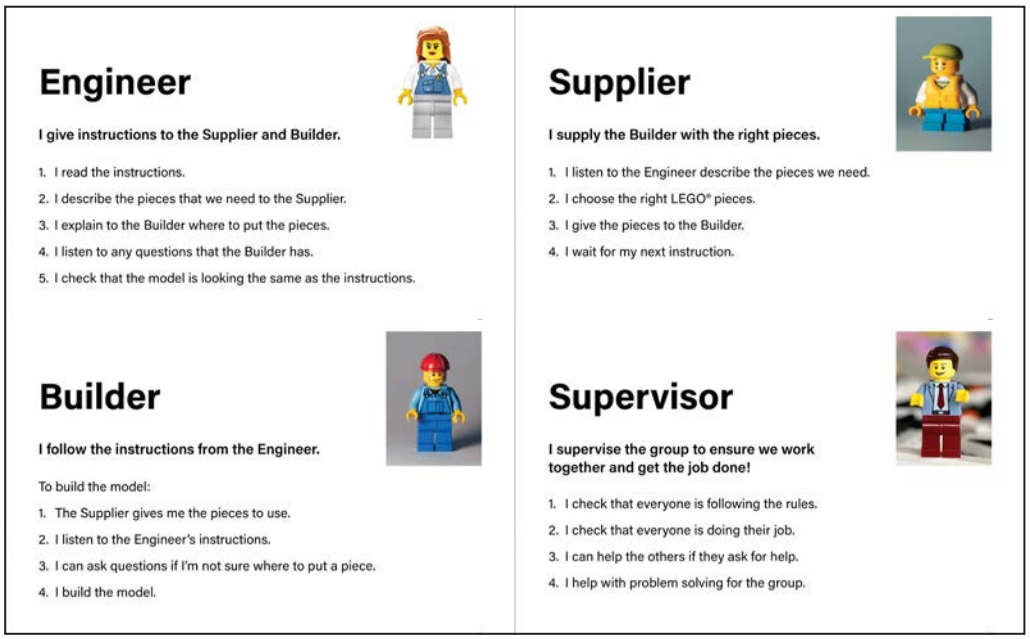


Image 1: Photo by Chris Curry on Unsplash(edited), Image 2: Photo by Marcel Strauß on Unsplash, Image 3: Photo by Marcel Strauß on Unsplash, Image 4: Photo by Qi Li on Unsplash

Figure 12
The LEGO® Robotics participants role descriptions.

Set up supports and coding the robot

Supports

In addition, we printed out additional Visual Cues and all additional resources to support the implementation of the group (Figure 13). It is recommended to print these out and have them at hand when running the Groups. The additional resources can be found in the Additional Resource and Activities section of this guide.

Additional resources to support activities such as ice breaker activities should be sourced and made prior to the commencement of the group. Items such as minifigures should be purchased and resources such as conversation cards should be created before commencing the group. Refer to the Additional Resources section of this Guide.

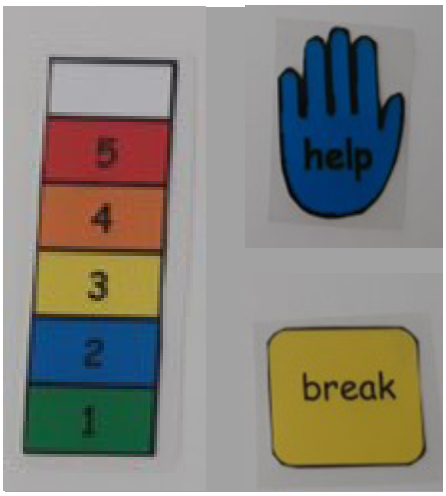


Figure 13
Examples of extra resources used.

Roles Equipment Checklists

To support setting up for the sessions, we developed checklists for each role, which included the equipment, resources, and role descriptions for the four different roles.

Equipment Checklist: Engineer

- ☐ Role description (Engineer)
- ☐ Break Card
- ☐ Help Card
- ☐ 'How do you feel' – Check in Scale
- ☐ LEGO® Mindstorms Education EV3 Core Set Build Instructions in a Lever Arch file A4 ring board folder
- ☐ LEGO® Scale
- ☐ LEGO® Elementary Survey 45544
- ☐ Tray LEGO® Pieces Visual
- ☐ Box LEGO® Pieces Visual.

Equipment Checklist: Supplier

- ☐ Role description (Supplier)
- ☐ Break Card
- ☐ Help Card
- ☐ 'How do you feel' – Check in Scale
- ☐ LEGO® Scale
- ☐ LEGO® Piece Organiser Tray
- ☐ LEGO® Pieces Box.

Equipment Checklist: Builder

- ☐ Role description (Builder)
- ☐ Break Card
- ☐ Help Card
- ☐ 'How do you feel'– Check in Scale
- ☐ Any build from last session that is not complete.

Equipment Checklist: Supervisor

- ☐ Role description (Supervisor)
- ☐ Break Card
- ☐ Help Card
- ☐ 'How do you feel' – Check in Scale.

4.5 Coding the Robot Instructions

Once the robot is built during the sessions, it needs to be coded before it can be used to complete the challenges.

To limit distractions like phones and screens we decided to code the robot before we started the challenge sessions.

Downloading LEGO® programs to the robot

Please note, these instructions are for computers that have a standard USB port or ports that can be converted to standard USB ports. In short, the supplied USB cable can be plugged into the computer.

Installing LEGO® EV3 Classroom software

First you will need to download the LEGO® EV3 Classroom software from the LEGO® website. Make sure to download the correct version for your computer operating system.

1. Click/copy the link below to take you to the LEGO® website.
   - Link: https://education.lego.com/en-us/downloads/mindstorms-ev3/software

2. Using the drop-down menu (Figure 14) select the version appropriate to your computer.

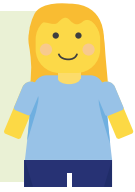
Figure 14
The 'Download' prompt for the LEGO® EV3 Classroom software

3. Press download.
4. Once downloaded, open the installation file and follow the instructions.

Opening the program files

Opening the program files for the challenges can be done in two ways as outlined below.

Note:
In both cases make sure you have the files in an easy to locate folder and that they are not in a compressed/zip file.



Before commencing you should have three program files:

1. CHAL_1
2. CHAL_2
3. CHAL_3

Opening the file from directory

1. Navigate to the location the program files are saved
   - If the program file has a blank icon next to it, proceed to the next section

2. Double click each program so that they open in LEGO® EV3 Classroom
   If they do not open in the right software, then proeceede to the next section.

Opening the Program Files from LEGO® EV3 Classroom

1. Open the LEGO® EV3 Classroom software.
   - Programming icon (shown below)

2. Press 'File,' located in the top left of the software, and in the drop-down menu. Then press 'Open.'

3. Navigate to one of the program files and double click it.

4. Repeat for the remaining program files.

Downloading the program files to the robot

For the program files to be installed on the robot you will need to make sure the robot has some charge, you have the supplied USB cable (it should be in the robot box) and have the programs opened in the software.

1. Turn the robot on by pressing the centre button.

2. Connect the robot to your computer using the USB cable
   - You will know the robot is connected when the robot status indicator in the top left of the software has changed to green (shown below).

Robot not connected

Robot connected

3. Once the robot is connected the play and download button in the bottom right of the software will become clear (previously greyed out or opaque – shown below).

Robot not connected

Robot connected

4. You have two options for downloading the programs:
   - **Option 1: Download (down facing arrow) Button:**
     This will download the program file to the robot for later use. Instructions for running each program can be found in the Challenge instructions.

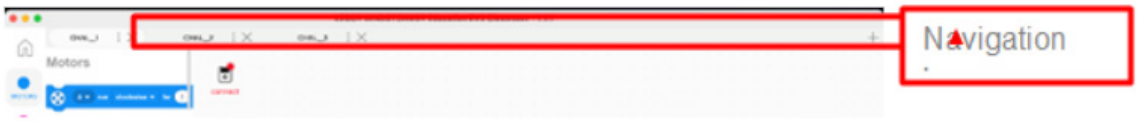
- Option 2: Play Button
  The play button will download and instantly run the program. This can be useful but will mean the robot will move immediately. If you are surprised that the robot is moving without any reason, it is likely that this button has been pressed by accident.

5. Press the Download Button to send the program to the robot

Changing between programs within the LEGO® software

The method of downloading a program, above sections, will work for any of the program files. The first program to download will vary depending on the order you opened the program files. Use the method below to switch between opened program files within LEGO® EV3 Classroom.

1. Locate the navigation bar at the top of the software. It will look similar to the image below:



2. You will be able to see the names of each challenge program file. If you can't see all of them, it means they have not been opened.

3. When you click on each of the programs you will notice the icons in the centre of the software change – there may be a slight delay from click to icon changes. These are the program icons and tells the robot how to move.

4. The selected program will be the one that is downloaded to the robot when you press the Download button.

If things don't work, try some of the following:

- Turn the robot off, leave it for a minute and then turn it back on
- Try a different USB cable. There should be multiple cables available between the kits. If not, some printers or rechargeable headphones use the same cable
- Check the robot has enough charge. Sometimes the robot may turn off when the program is downloading as there is not enough charge to complete the download. You can either charge the robot and come back later or plug the charger in while downloading programs
- Restart the software. Sometimes it can glitch, in particular if you have restarted your computer after installing the software or restarted it a long time since the computer has been restarted
- Restart your computer.

Note:
If you choose to use a different kit then you will have to make changes to the coding.

LEGO® Robotics Therapy

Additional Resources and Activities

Photo by Markus Spiske on Unsplash

5.0 LEGO® Robotics Therapy: Additional Resources and Activities

5.1 Resources to support LEGO® Robotics Groups

In addition to the LEGO® Mindstorms Education EV3 core set and expansion sets, there are a range of resources and activity materials recommended to support the implementation of the group.

These resources have been used by experienced Autism SA practitioners for many years and have been shown to be useful in supporting the needs of autistic individuals.

Facilitators should be experienced in working with a range of evidence informed practices to support an individual's understanding and engagement. Facilitators should take time to familiarise themselves with the resources we have provided to support the implementation of the group to ensure the program is as effective as possible.

Some of the resources should be used on an ongoing basis to support the implementation of an effective group while others may be used as opportunities arise.

While implementing the LEGO® Robotics sessions, we found that many naturalistic learning opportunities presented and having a range of support resources on hand allowed practitioners to develop understanding and skills as opportunities arose. Depending on the group dynamics, some resources may be needed more than others.

Some of the resources can either be displayed on the wall or placed on the table in A4 or A5 size, depending on the participant's input or need for privacy.

These include:

- Check in Scale – How do you feel?
- Visual cues – wait, help, break
- Rules
- Check out
- The Rules of Compromise
- Conversation Starters
- Calming Items
- The Catastrophe Scale
- Volume Scale
- Think it or Say it – Filter
- Challenge Visuals.

We started with A3 visuals to put up on the wall, however, we felt the privacy aspect for the participants meant that we also made A4 size posters and A5 visuals that could be placed on the desk. You can decide according to the group you have.

Check-in Scale

Check-in Scale – How do you feel? from 'The Incredible 5-point scale' program.

We found the participants were coming in to the first session quite anxious about what we were doing, so we made a check- in visual for them to show us how they were feeling with LEGO® faces. The incredible 5-point scale can be used for emotional regulation and by using this visual the participant can (without words) identify how they are feeling and what they might need.

We used the Check-in scale so that each participant could let us know how they were feeling at the beginning of each session. We developed various scales so that participants could choose what one they wanted to use. Some participants would then use this time to discuss what had happened before the group session, i.e.: bullying, a test that was happening next, or that they had just had a long assembly.

They could then immediately access the calming items in the calm area so they were OK to go ahead with the LEGO® Robotics session. Some participants found this hard to do so we used their interests such as cats and dogs to identify the dog/cat for each level and then they were better able to identify their own level. Many other participants had already used this program previously.

When running the sessions, we had both the big version of the scale on the wall as well as the smaller versions on the table for each participant. The smaller version was used by some participants to show us how they were feeling during the session.

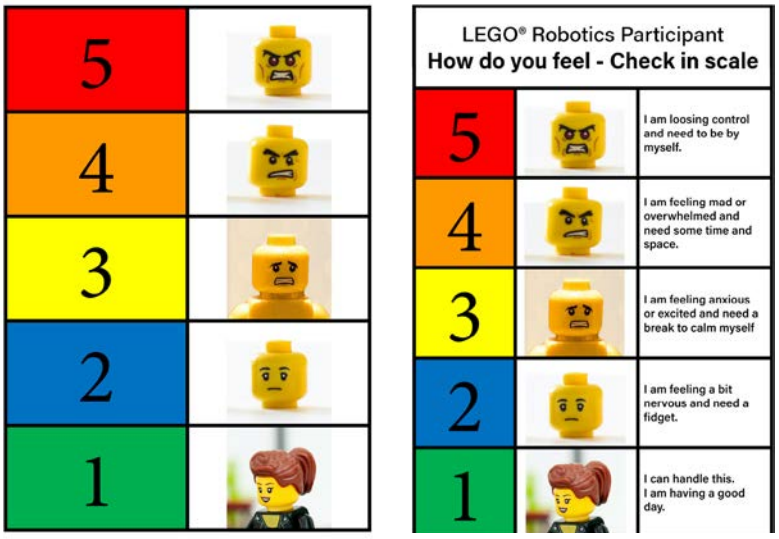


Figure 15
Participant and wall hung LEGO® Faces check-in scale.

Image 1: Photo by Nik on Unsplash, Image 2: Photo by Nik on Unsplash, Image 3: Photo by Jason Leung on Unsplash, Image 4: Edited photo by Nik on Unsplash, Image 5: Photo by Matt Hudson on Unsplash.

Scales amended from: Buron, K.D. & Curtis, M. 2021. The Incredible 5-Point Scale. 5 Point Scale Publishing. Saint Paul, MN. http://www.5pointscale.com.

Participant Check-in cards

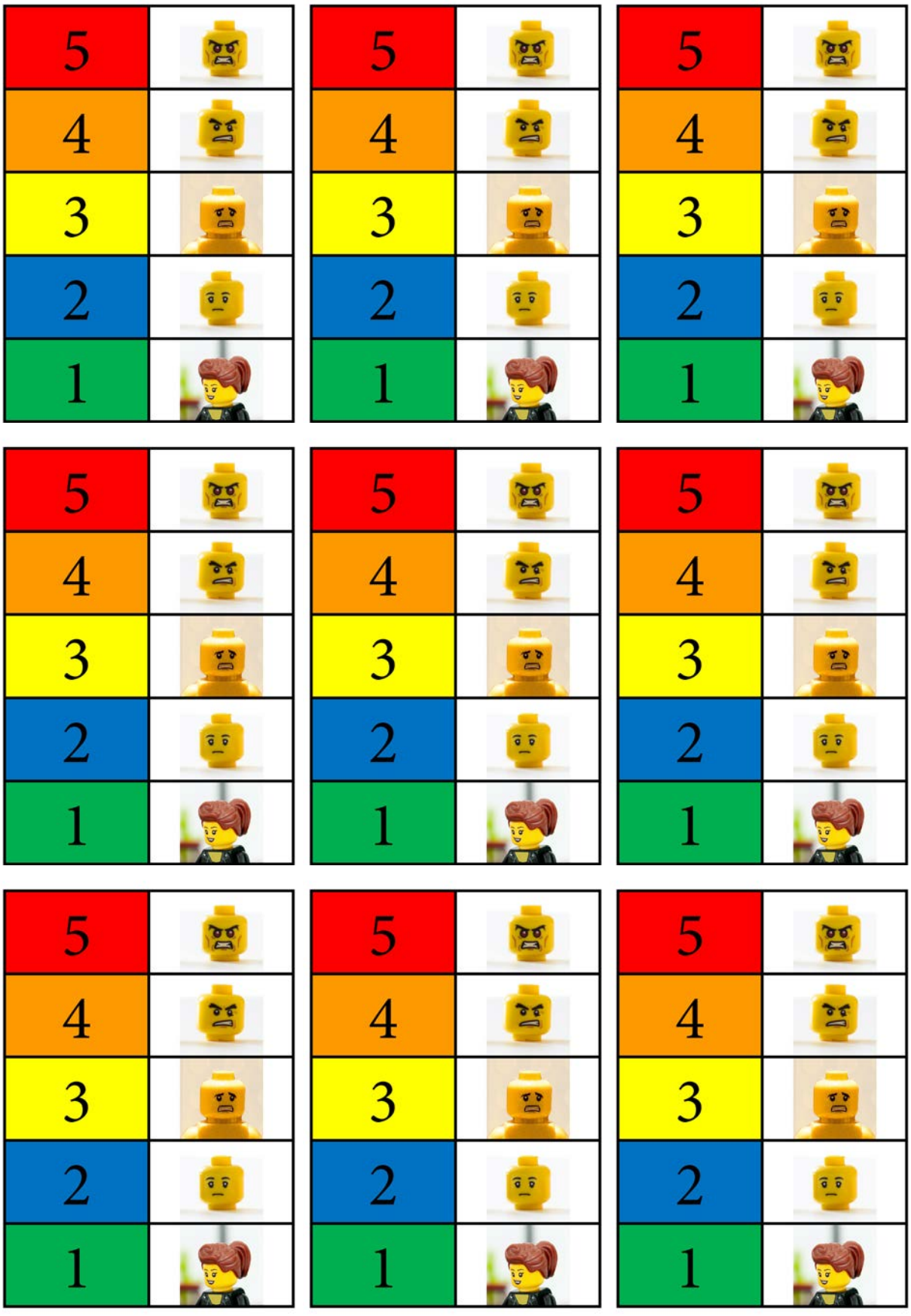


Image 1: Photo by Nik on Unsplash, Image 2: Photo by Nik on Unsplash, Image 3: Photo by Jason Leung on Unsplash, Image 4: Edited photo by Nik on Unsplash, Image 5: Photo by Matt Hudson on Unsplash.
Scales amended from: Buron, K.D. & Curtis, M. 2021. The Incredible 5-Point Scale. 5 Point Scale Publishing. Saint Paul, MN. http://www.5pointscale.com.

Poster - Participants Check in Scale

LEGO® Robotics Participant
How do you feel - Check in scale

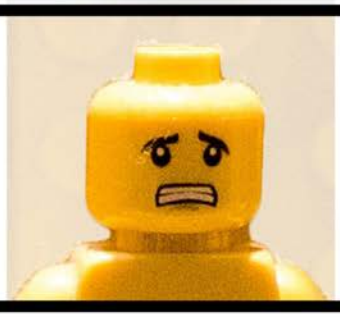
5		I am loosing control and need to be by myself.
4		I am feeling mad or overwhelmed and need some time and space.
3		I am feeling anxious or excited and need a break to calm myself
2		I am feeling a bit nervous and need a fidget.
1		I can handle this. I am having a good day.

Image 1: Photo by Nik on Unsplash, Image 2: Photo by Nik on Unsplash, Image 3: Photo by Jason Leung on Unsplash, Image 4: Edited photo by Nik on Unsplash, Image 5: Photo by Matt Hudson on Unsplash.
Scales amended from: Buron, K.D. & Curtis, M. 2021. The Incredible 5-Point Scale. 5 Point Scale Publishing. Saint Paul, MN. http://www.5pointscale.com.

Visual cues

Visual cues are widely used when supporting people on the autism spectrum as they can be used to support both receptive and expressive language.

Wait cards

These are kept by the facilitator. Sometimes it can become difficult to share the building of the robot and to stick to the different roles. For example, while in the 'Builder' role a participant would sometimes reach out and grab the LEGO® piece instead of waiting for the Supplier to give it to them. The Engineer sometimes pointed to the piece required instead of only using their words or to show the Builder their plan to move them on. The wait cue card is given to the participant who is finding it hard to wait and will be a prompt to allow others to take their time without interference.

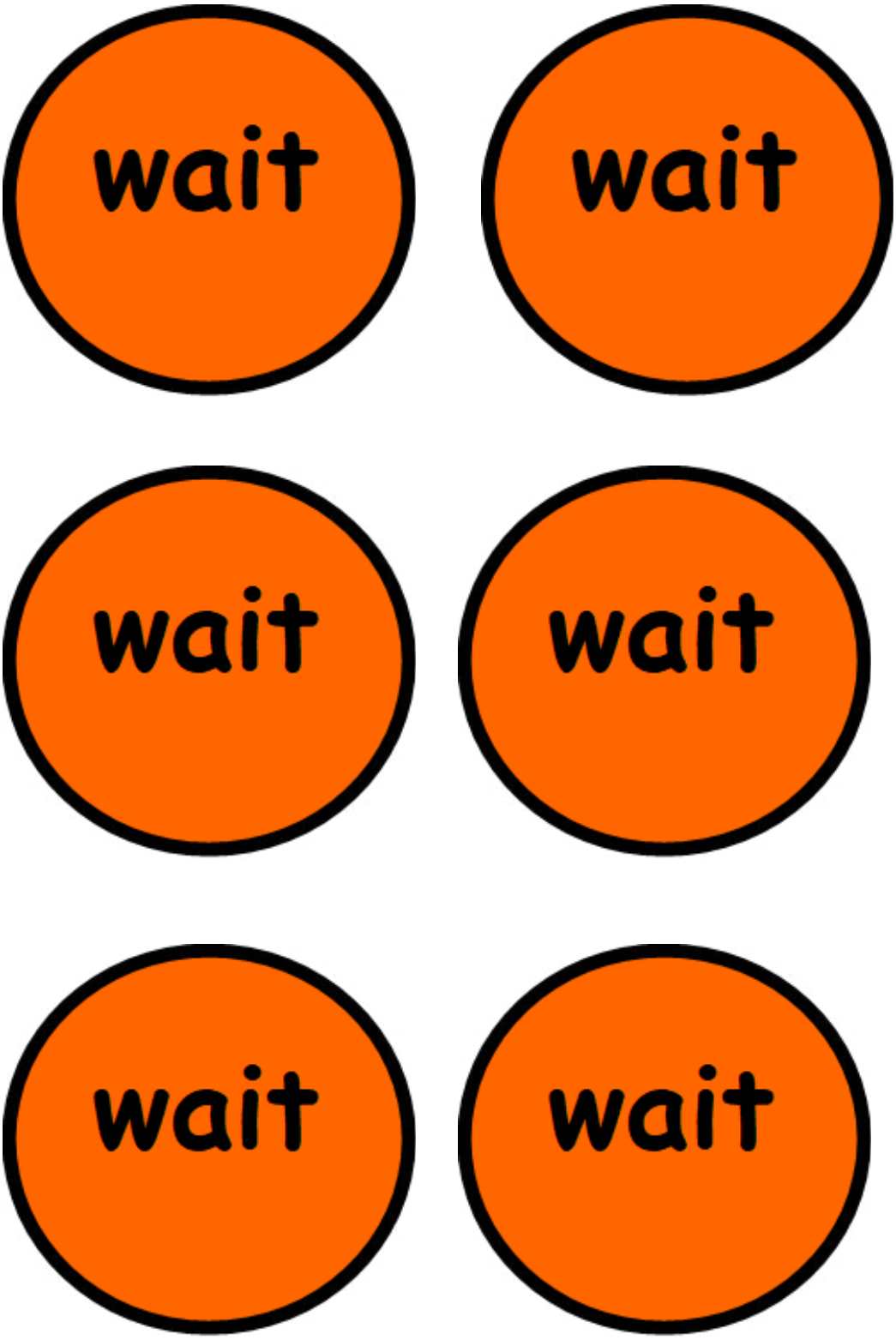
Help cards

These were placed on the table for each participant. If a participant was unsure of an instruction or task, they could point to the card if they did not feel comfortable to ask for help. Help was then provided.

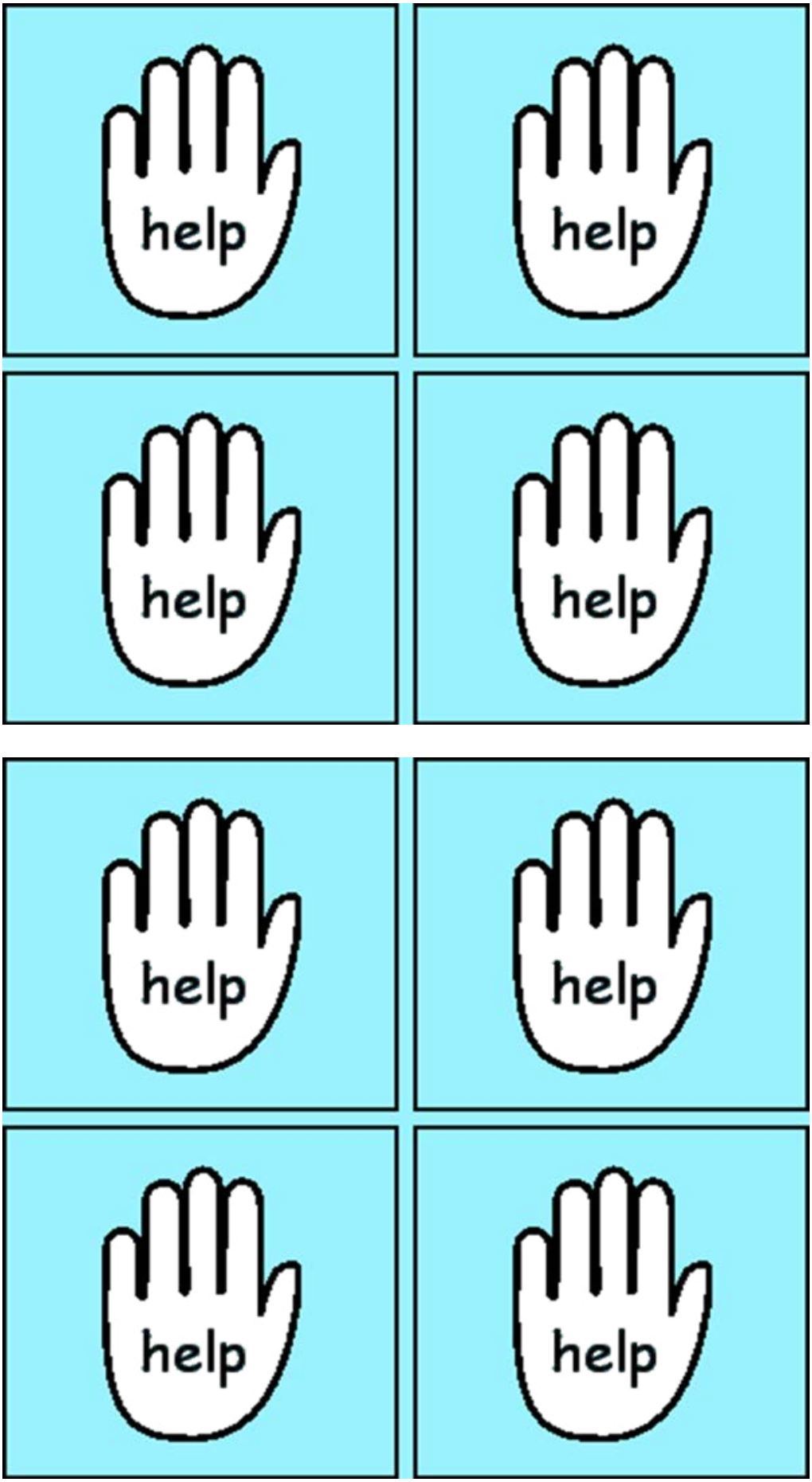
Break cards

These were placed on the table for each participant to remind them that they could have a break whenever they needed it. If the participant pointed to, or handed the card to the facilitator, they could then move to the calming area, or take time out where they were, e.g.: no demands or questions placed on them.

Wait cards



Help cards



Break cards

break	break
break	break
break	break
break	break
break	break

Rules

Clearly defined and agreed upon rules or expected behaviours allow participants to know the expectations during the sessions. This can reduce anxiety and support participants to feel calm, as they know the expected behaviours of others. Rules and expectations are more meaningful if the participants develop and agree on them rather than rules being imposed upon them.

To support the development of rules and expectations, we used the Social Behaviours Mapping Chart from Garcia Winner, M. (2007). Social Behaviour Mapping, San Jose. Think Social Publishing Inc.

Facilitators can use the Social Behaviour Mapping Chart to identify the rules in the first session or can just use plain paper. This can be done as a brainstorming activity. Ask the participant/s to come up with a list of expected behaviours they think are important to have during the sessions; unexpected behaviours are also highlighted in this process.

After collecting all the rules the participant/s come up with, they should be able to be categorised into four/five different groups e.g. participating in the activities, looking at and listening to each other, taking turns, waiting, respecting each other and property.

It is important that the rules are all written in a positive way; we need to show what **to do** not what not **to do**.

When you refer to the expected behaviours during session time you are then reminding them of their own rules.

Rules of LEGO® Robotics Sessions

If the facilitator and/or group prefers, the Rules of LEGO® Robotics Sessions can be used or discussed and rules chosen by the group.

It is important to explain each rule to the participants:

Have fun and use your manners
Making it fun for everyone in the group, having fun with the challenges and remembering to wait, share and take turns.

Listen to others
Listen to their ideas even if they are different to yours.

Ask for help
Asking other participants or the facilitators.

For example, during the sessions we ran one participant took a piece of their own challenge solution and gave it to another participant who needed it. There were differences in the confidence level of the participants to try new things without help, but by the final session they were helping others.

Some participants started off not wanting or asking for help but as trust built in the group they accepted and asked for help. Many participants needed to be reminded they could ask for help.

One participant was very controlling in the beginning, but by the last session asked the other participants if they wanted to do a challenge together. He didn't mind that another participant took over and gave him a secondary role.

Be safe
It means keeping voice volume to an inside voice and thinking about tone and the words we are using so that others feel safe. Being safe with the use of the LEGO®.

Work together
Looking at and listening to each other.

Respect others
Their point of view, the things they have made, and being aware of the difficulties they may be having.

LEGO® Robotic Rules

Have fun and use your manners	
Listen to others	
Ask for help	
Be safe	
Work together	
Respect others	

Image 1: Photo by Markus Spiske on Unsplash, Image 2: Photo by Ravi Palwe on Unsplash, Image 3: Photo by Marcel Strauß on Unsplash, Image 4: Photo by Ben Griffiths on Unsplash, Image 5: Photo by Michael Bader on Unsplash

The Rules of Compromise

Being in a group requires participants to draw and develop many social, communication and conflict resolution skills in addition to skills around self-management. It is inevitable when working with groups that conflict will arise in some form or another.

To support participants to identify and work through conflict, we used The Three Rules of Compromise from Mataya, K & Owens, P (2013) Successful Problem-Solving for High Functioning students with autism spectrum disorders. AAPC Publishing.

The visual tool was used, as this provides a way for the participants to be able to work out any conflict/disagreements in a structured way. Participants have three choices in the way they will deal with conflict, i.e.: (i) majority rules, (ii) first-then, and (iii) brainstorming.

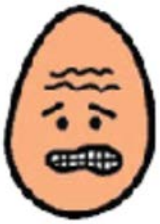
Each of these goes onto a table followed by an additional two columns. In the next column participants work to define what each of these mean e.g. majority vote means that the conflict is settled by taking a vote. The majority prevails. In the last column an example of what this looks like is included.

By doing this with participants as a group, supports understanding and ownership.

Catastrophe scale

Scales can be an effective way to increase understanding about an abstract concept. We often use Buron, K.D. & Curtis, M. 2021. The Incredible 5-Point Scale. 5 Point Scale Publishing. Saint Paul, MN. http://www.5pointscale.com. We used a catastrophe scale to visually demonstrate how big or small a problem may be in context. An example of this is when a participant had a big reaction when they couldn't find the piece they wanted. Another participant had a big reaction when their solution to the challenge didn't work. In both these instances we used the scale to work through the size of the problem comparatively to other potential problems.

Catastrophe scale

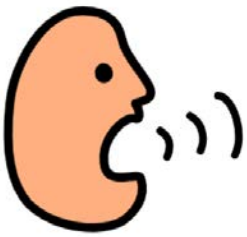
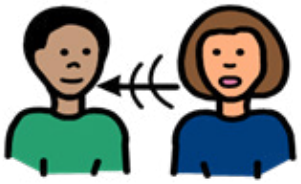
My Catastrophe Scale		
5		End of the world!! Really scary!
4		Dangerous Scary
3		Unsafe A bit dangerous
2		A bit worrying Uncomfortable
1		Safe

Buron, K.D. & Curtis, M. 2021. The Incredible 5-Point Scale. 5 Point Scale Publishing. Saint Paul, MN. http://www.5pointscale.com.
PCS and Boardmaker are trademarks of Tobii Dynavox LLC. All rights reserved. Used with permission.

Volume scale

We found that some participants had challenges in using the expected volume in the group. We found that the volume scale (from The Incredible 5-point scale) was useful to support them to understand the different volume levels and the context in which each volume was expected. In one instance, one of the participants was aware that their voice was very loud, but they were unaware of what to do about it. The participants asked the facilitator for assistance and the scale was used to support the participant's understanding and volume use.

Volume scale

My Volume Scale		
5		Yelling
4		Loud talking (inside voice)
3		Talking (inside Voice)
2		Whispering
1		No talk

Filter – Think it or say it

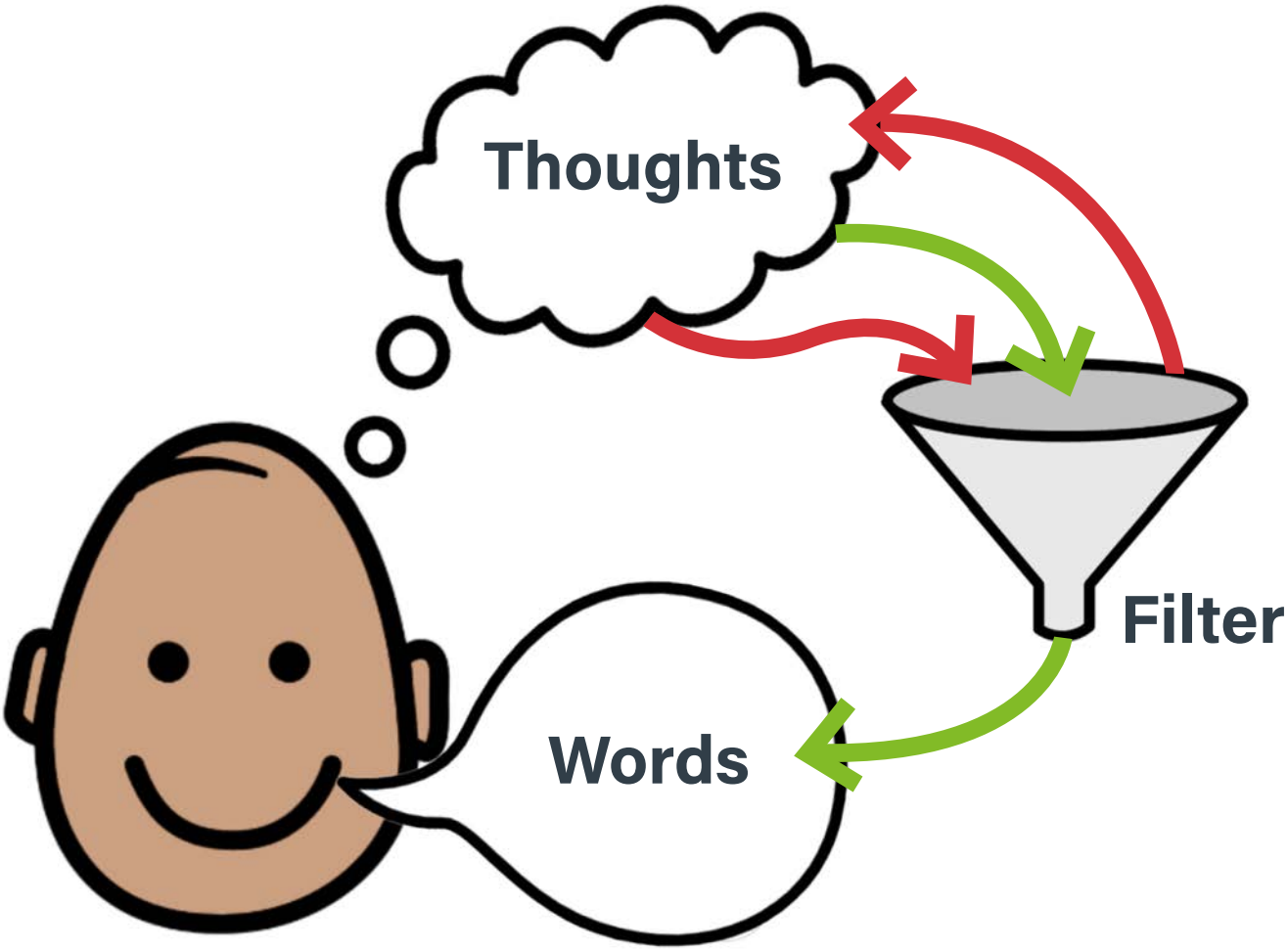
For some people on the autism spectrum, it can be challenging to understand how words can impact other's feelings – theory of mind. During the sessions, there were several instances where we found that participants had difficulty with theory of mind, and this impacted their ability to make connections with others. We used the Filter – Think it or say it to support participants' understanding of this.

One participant would say things like 'you should start again' when doing the challenges. After discussing the filter, they said that they were now thinking about whether what they would say would hurt someone's feelings.

One participant was able to tell another participant that their comments were inappropriate with confidence and in a nice way and the other participant accepted it.

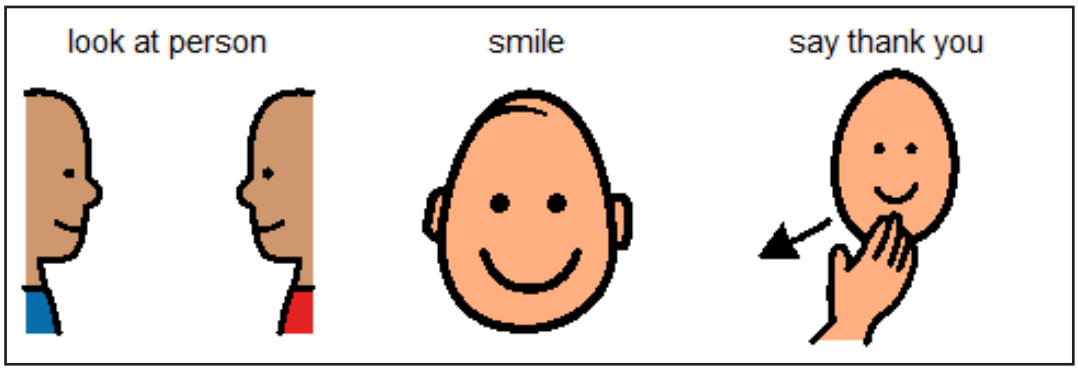
One participant felt that *"All my words hurt and I don't say anything good".* We were able to develop their fluency in using the Filter process to take the time to determine the consequences of what they were thinking of saying before they said it.

Think it or say it



Giving/Accepting a compliment

Compliments (i.e. look at them / smile / say thank you) make people feel good about themselves. If a person feels good around someone, they are more likely to spend more time with them. To develop this understanding in participants, we often used a visual support.



Giving/Accepting a compliment

To assist the participants to seek assistance from each other and cope with the challenges, we made a range of posters.

Before we started a challenge, we referred to the posters to remind participants of these expectations to set the participants up for success.

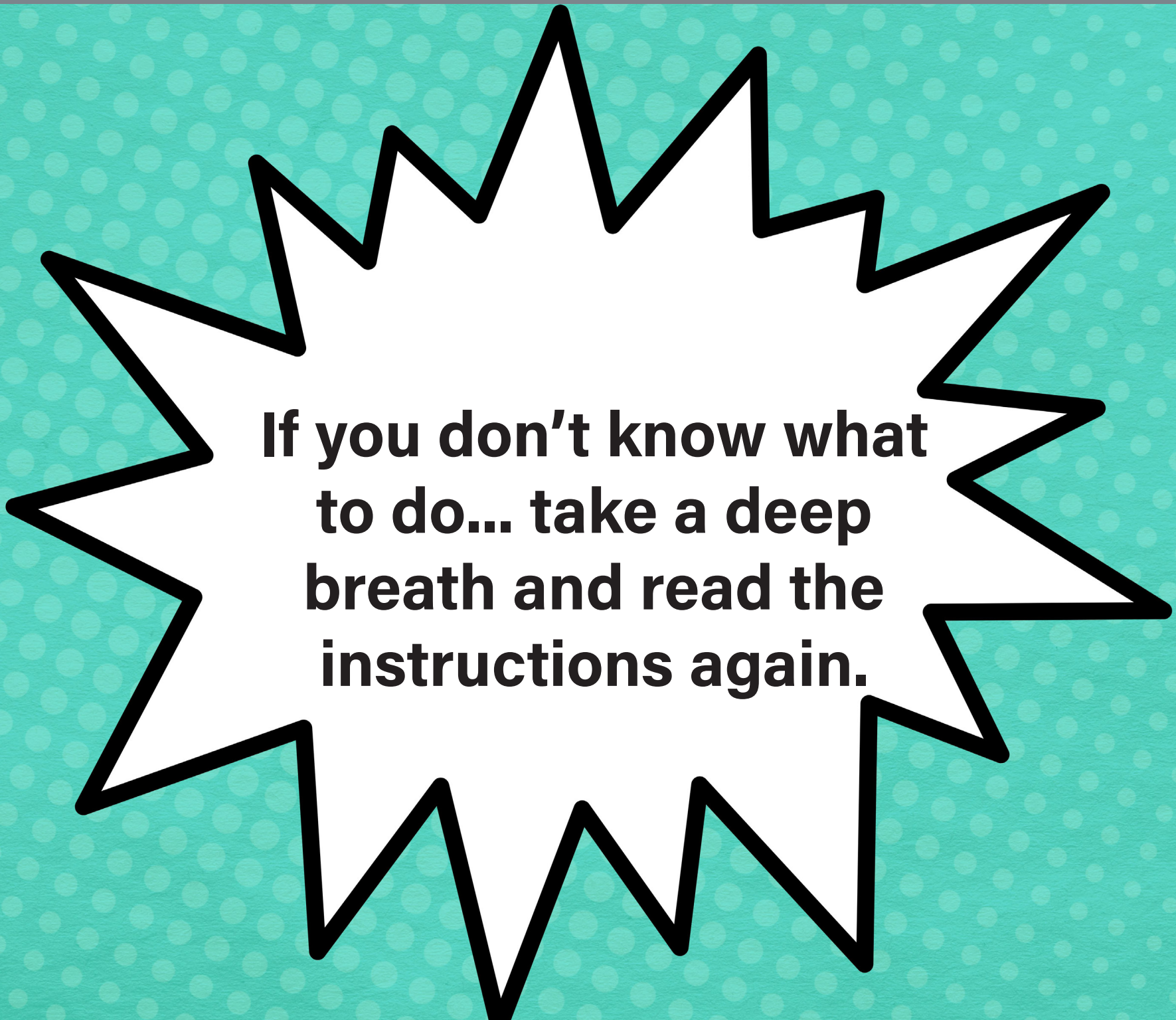
When using the challenge visuals, we explained to participants:

- If you don't know what to do... ask someone in the group!
- If you are not sure if that piece exists... ask someone in the group!
- If you don't know what to do... take a deep breath and read the instructions again.
- If you are not sure about your design... ask someone in the group.
- Have some time to think about it and look at what others are doing.

If you do not know what to do...
ask someone in the group!

If you are not sure if that piece exists...

ask someone in the group!


If you don’t know what to do... take a deep breath and read the instructions again.

5.2 Activities to support LEGO® Robotics Groups

In addition to a range of resources, there are some activities that should be incorporated into the group to support the implementation.

These include icebreaker activities to support participants getting to know each other and the facilitator quickly, activities to increase conversations and the use of calming items and break places to support regulation.

Icebreaker Activities

Most participants will not know each other or the facilitators. As LEGO® Robotics sessions may only run for a short period of time, the facilitators can speed up the friendship and communication skills development by incorporating icebreaker activities prior to commencing sessions, or as required, during sessions.

Make a ME minifigure

We purchased 12 LEGO® minifigures and took them apart and sorted them into separate containers with legs, bodies, faces, hats or hair and accessories.

Participants then made a LEGO® minifigure of themselves and share something about themselves with the group. Once the participants became more aware of their strengths and interests, they can use the LEGO® minifigures to make themselves into a superhero.

The minifigures are very diverse and have a range of easy-to-read emotions. We found that they were a great way to promote social communication and interaction between the participants. We had two groups who were very focussed when building and doing the challenges and didn't interact much with each other, but when we used the minifigures there was so much interaction it was amazing.

LEGO® Icebreakers

Build your name with the LEGO©

Using a base plate, participants sit alongside each other and work to write out their names, nicknames or full names, using LEGO®.

Free Build

Set a two-minute build to get the participants using LEGO® pieces that are in the kits.

Emotion Build

Set a timed challenge to build something that they like or that makes them feel happy.

Share Builds

Bring photos of what the participants have made at home to share with the others.

Conversation Starters

To support participants getting to know each other we used the 'Conversation Starters' particularly in the introduction session, at the beginning of the sessions and while they were doing the challenges. The cards have topics to develop awareness for themselves and others of their strengths/talents/interests/dislikes.

We had two groups who had to wear masks due to COVID-19 and were very quiet, resulting in limited social interaction. However, when we used the conversation starter around what pets they had the participants shared photos of their pets, talked about the things they did each week, and were then more open to talking about other things like the teachers who understood them better and the strategies each one used to overcome difficulties.

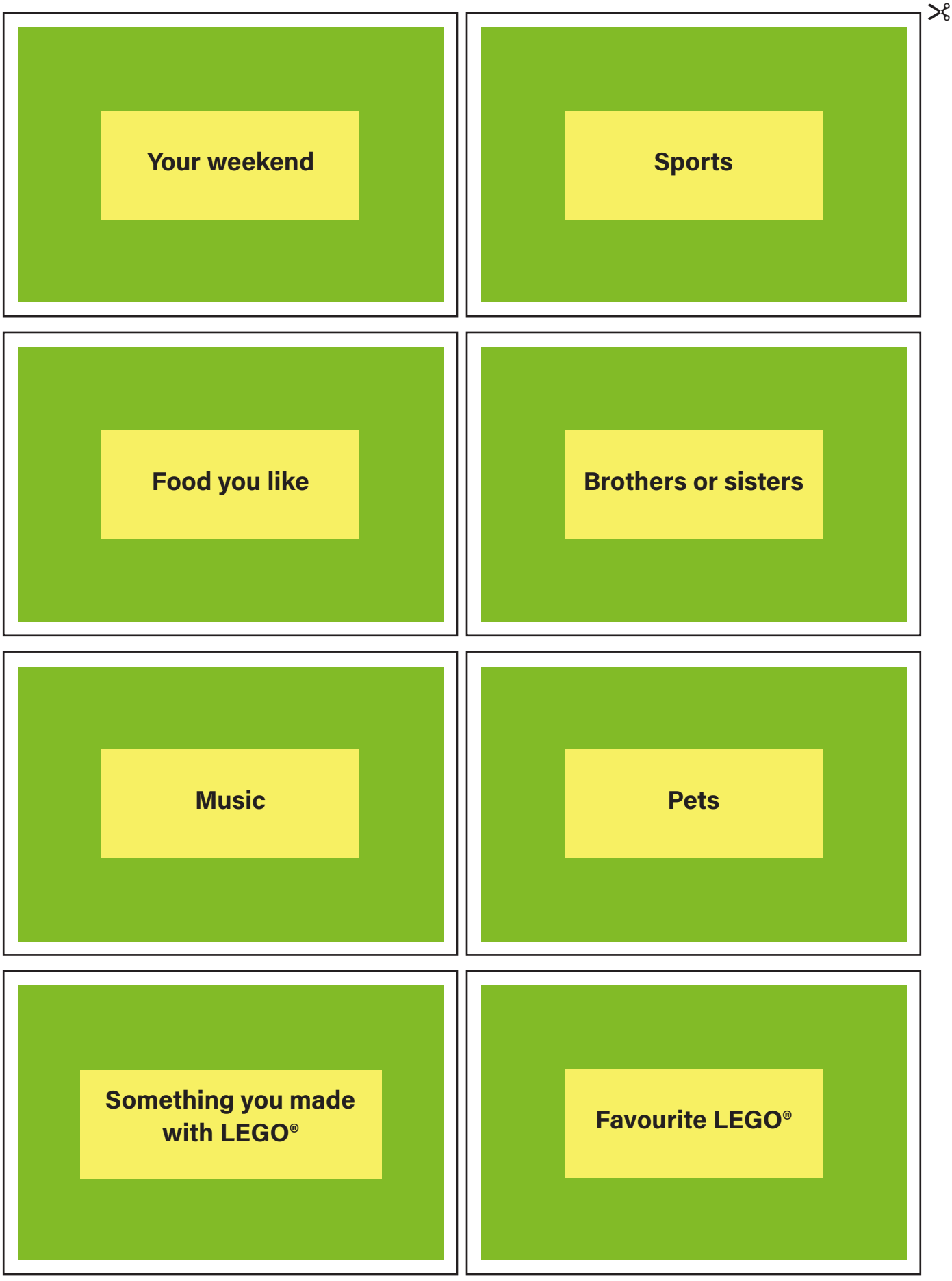
We had a few groups who were so involved in the challenges that they had very little interaction so it then became important to think of a topic that would interest all of them. Some groups had similar interests in games or TV programs like Dr. Who. It was very beneficial to find something that they had in common as this sparked conversation.

Two participants talked about their passions being writing. However, they both had a lot of difficulty putting their ideas down on paper which could become frustrating for them. This also impacted on them being able to do their work at school. The facilitator talked about thinking in pictures and the whole group started talking about strategies to overcome this so that they could be more successful.

Before each session participants can choose a card from the Conversation Starters in the additional visuals section to answer and share with the group.

Conversation Starters - sheet 1

Conversation Starters - sheet 2



Calming items for "getting ready"

Differences with social interaction, communication, resistance to change and processing sensory information can contribute to a person feeling overwhelmed and becoming dis-regulated. For many participants on the autism spectrum, self-regulation can be difficult.

To ensure participants are as successful as possible in LEGO® Robotics sessions, sensory items for calming or getting ready were used to assist the participants to regulate before starting the session and during the sessions to remain regulated. This means they were able to focus and attend throughout the session. The items could be something to look at, listen to, touch and do. We found that many participants enjoyed the fidgets so we made sure that age appropriate items were available. The break card is a reminder for them to use these items.

We found that many of the participants already had some form of calming items they used at school or at home but they did not necessarily share this information with their teachers. We took note of what was used so that we could share this information and the calming items we provided were well used and appreciated.

It was also evident that some participants particularly benefited from using the calming items. One group came to us after assembly and we needed to spend more time using the calming items. We could then recommend to the school staff that this group used the calming items after assembly before they went to their next class. We also found that some participants were being bullied or feeling anxious. We were able to work with them in groups to find calming items that supported them to regulate.

We used chewing gum for this age group with the rule that they put it in the bin when they left the room. One participant said, "high schools are dumb for not letting me chew gum because I feel a lot calmer". They also said that the robotics sessions were very calming so I pointed out that all the things we had in place in the session, could also be used in other settings.

Breaks

It can be the facilitator who identifies a break is needed or the participants can take a break whenever they feel they need it. They don't have to earn a break. Some participants identified that they initially came to group because they needed a break from the classroom.

Figure 17
Some of the calming items we made available to participants to support regulation during the sessions.

LEGO® Robotics Therapy

Sessions

Photo by David Mendoza on Unsplash

6.0 LEGO® Robotics Therapy - Sessions

6.1 Introduction and Build sessions

Instruction sheet - Introduction session

It is important that the first session involves all the participants if possible. In this first session they learn what the group is about, they meet each other and start to learn a bit about each other. They also learn how to support each other's areas of difficulty. Belongingness and trust in the facilitators was evident very early with the participants we worked with, and we found this right across the groups. This was surprising because this has taken longer in other types of group activity. We felt that the therapy approach and using something that was already an area of interest or even a passion was a reason for this. Additionally, running the program in one school meant that participants took the connection formed in sessions, into the school environment.

Hygiene

Food should not be eaten when building with LEGO® as the pieces can be very difficult to clean. Use of hand sanitiser was put in place as we dealt with COVID-19 times, however it is just good practice so that the pieces remained as clean as possible. LEGO® pieces need to be washed

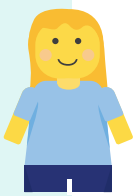
Preparation Checklist

- ☐ Printed Participant schedule
- ☐ Using the roles Equipment Checklist, ensure that each station has the equipment required
- ☐ All Additional Resources and Activities should be on hand.

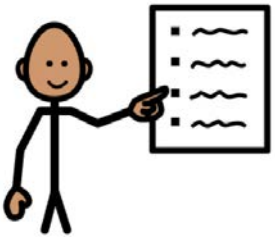
Running the session

1. As participants enter, they can sit at any station.
2. Each participant introduces themselves and tells the others about something they have made with LEGO® or the LEGO® kits they like the most.
3. Getting ready – wash hands and trial calming items. Facilitate a discussion around calming items: what they use, what they like and don't like, when they could use them and what the benefits are.
4. Do an Icebreaker activity as outlined in Additional Resources and Activities
5. Introduce and explain the Check in Scale – How do you feel? From the Additional Resources and Activity section and ask each participant what number they are and direct them to the calming area if required.
6. As a group, facilitate a discussion about the rules of LEGO® Robotics. Create a visual for these rules.
7. Introduce the schedule for participants and run through this for the session.
8. Explain the roles of LEGO® Robotics, i.e.: Builder, Engineer, Supplier or Supervisor.
9. Explain how to use the wait/help/break cards.
10. Show what the robot will look like when completed so they know the expectation.
11. Each participant will take on the role of the station that they are sitting at.
12. Begin building the robot.
13. Every 5 minutes, participants change roles by moving clockwise. The idea is that each participant gets a chance to trial each role in the first introduction session.
14. Each participant can take a photo of what they have built to show their parents. If they don't have a phone the facilitators take the photo and send it to the parent/carer.
15. At the end of the session, each participant completes the Participant Check Out form.
16. As a group, pack up.

Note:
We found that during the build we would have either 5 or 10 minute sessions before changing roles. Sometimes the time would be up before a step was completed, so we voted on whether they should finish the step before we moved on or immediately moved on.



Introduction session

1	Hello	
2	Getting ready	
3	Icebreaker activity	
4	Rules and schedule	
5	Roles and visual cues like wait/help/break	
6	Build the model	
7	Pack up and check out	 

After the session

1. Place the robot in a separate container so it is not damaged.
2. The participants return all the left-over LEGO® pieces to the correct places in the tray or box.
3. Collect all of the *Participant Check Out* sheet and record the feedback on the *Participant Assessment Sheet.*
4. Facilitators complete the Participant Assessment Sheet and Observation Assessment Sheet.
5. Facilitators prepare for the next session.

Instruction sheet: Robot build session

After participants have had time to meet each other and become familiar with the roles within the group, the focus can be on building the robot. It can take another two sessions to complete the robot build depending on the skill of the participants.

Facilitators should use their skills to support and guide participants to complete the build while focusing on supporting skill development in the areas of communication, emotional regulation, conflict management, and friendship building skills.

Included are two Schedules – 'Robot Build' Schedule and 'Robot Build and Challenge' Schedule. The 'Robot Build and Challenge' Schedule may be needed near the end of the build as the group may finish the build and need to progress to starting a challenge within one session.

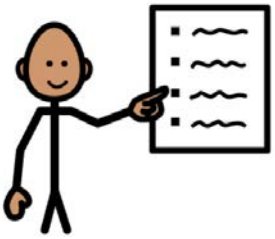
Preparation Checklist

- ☐ Printed Participant schedule.
- ☐ Using the roles Equipment Checklist, ensure that each station has the equipment required.
- ☐ All Additional Resources and Activities should be on hand.
- ☐ Additional Challenge 1 materials if it is likely that the group will finish the build in a session.

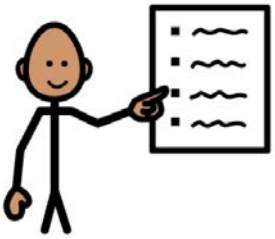
Running the session

1. Hello – support participants to greet each other and the facilitator as they enter the room. Allow time for participants to use small talk to build relationships with one another.
2. Getting ready – wash hands and use the calming items.
3. Rules – outline the rules agreed upon in the introduction session.
4. Roles – allow participants to choose roles to start reminding them that they will rotate through the session.
5. Every 10 minutes, rotate participants clockwise to through roles. As they rotate into a new role, get them to refer to their Role Description for the roles and responsibilities.
6. Facilitate the build of the robot while focusing on developing focused skills.
7. If participants finish the robot build in the session, move onto Challenge 1 Instruction Sheet.
8. Each participant can take a photo of what they have built to show their parents. If they don't have a phone the facilitators take the photo and send it to the parent/carer.
9. At the end of the session, each participant completes the Participant Check Out form.
10. As a group, pack up.

Robot building session

1	Hello	
2	Getting ready	
3	Icebreaker activity	
4	Rules and schedule	
5	Roles and visual cues like wait/help/break	
6	Build the model	
7	Pack up and check out	 

Robot building session and Challenge session

1	Hello	
2	Getting ready	
3	Icebreaker activity	
4	Rules and schedule	
5	Roles and visual cues like wait/help/break	
6	Build the model and begin the challange	
7	Pack up and check out	

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After the session

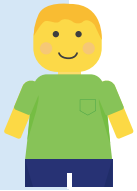
1. Place the robot in a separate container so it is not damaged.
2. The participants return all the left-over LEGO® pieces to the correct places in the tray or box.
3. Collect all of the Participant Check Out sheet and record the feedback on the Participant Assessment Sheet.
4. Facilitators complete the Participant Assessment Sheet and Observation Assessment Sheet.
5. Prepare for the next session.

6.2 Facilitator Challenge Information

Facilitator Challenge Information

Challenges use the robot that the group worked together to build. The group is provided with a challenge Mission Card outlining the problem that they need to work together to solve.

Note:
They **cannot** modify the robot they have built. They must **only add** to the robot.
This is for all the challenges.



Challenge tips

It is important to note that different groups will progress through the Challenges faster than others. Within groups, the participants will have a range of skills and some may finish earlier than others. Encourage them to support others to finish. In the Instruction Sheets, we have provided some extension activity ideas so that the group can be extended in the Challenges if required. Additionally, if facilitators want the group to run for an extended period of time, the extension ideas can be added to the program to increase the number of sessions in the program.

Challenge Observations

Initially we were going to ask the participants to design their solution and then vote on which was the most likely to succeed. This would then be made using the roles. However, we found that for some groups this was not successful, so we reverted to each participant making their own and trialling it with group support.

If participants are reluctant to do the Challenges or not sure of what to do we:

- Showed videos of other participant's solutions.
- Encouraged them to sit back and watch what the others were doing.
- Looked at the interesting pieces, i.e.: colours or shapes that they may want to use.
- Helped the participant begin the challenge and get their ideas together and then they could do it independently.

Robot Checklist and Button Layout

The coding for the Challenges can be done well in advance. Then, before each Challenge, facilitators can use the instructions below to select the coding for the relevant Challenge.

- Make sure the EV3 (Brick) is in the right orientation.
  - Numbered ports (1-4) should be at the back of the robot;
  - Lettered ports (A-D) should be at the front – closest to the wheels.

- Looking at the front of the robot:
  - The left motor should be plugged into Port C;
  - The right motor should be plugged into Port B.

- Make sure there are no loose parts.

Button Layout

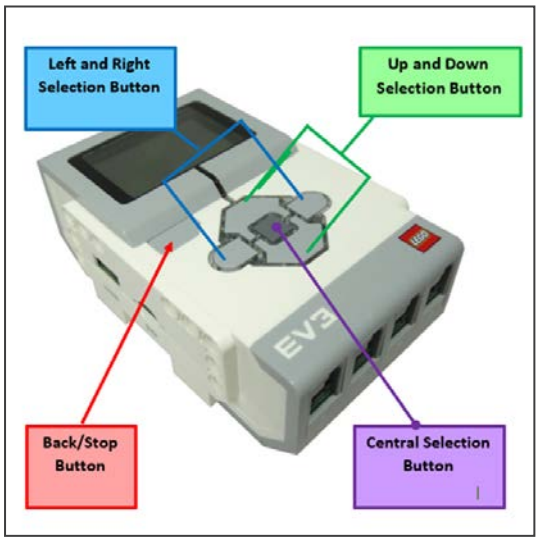


Figure 18
The LEGO Mindstorms EV3 programming and control module.

Facilitator information

The aim of the Challenges should be on guiding communication, interaction and team work. Less focus should be on being successful at the Challenges.

During Challenges, there is an increased need for effective communication, sharing of ideas, collaboration, compromising, problem solving, and turn taking. This can be challenging for some participants and the facilitator needs to carefully observe participants and to provide guidance in areas that participants may find challenging.

Photo by Vlad Hilitanu on Unsplash

Figure 19
Picture representing teamwork

Instruction sheet - Challenge 1 - ‘Axe’ the tree

Challenge 1 - ‘Axe’ the tree

Mission Card

- A tree, located next to a major road, is only just staying upright.
- A robot has been deployed to cut the tree down, but it doesn’t have an axe.
- **Your job** is to design and build an axe that will push the tree over when the robot spins.
- You will need to watch how the robot moves first before starting your design.

Good luck!

Graphic by Canva

Preparation Checklist

- ☐ Make sure you have coded the robot as per instructions in the Equipment/Coding the Robot information.
- ☐ Watch Challenge 1 – Video
- ☐ Print Challenge 1 – Mat. The Challenge mat must be printed in A3 size so that the coding for the robot for each Challenge works effectively.
- ☐ Print the Challenge 1 – Default Solution Build Instructions.
- ☐ Print out a Mission Card for each participant.
- ☐ Make sure the robot is charged. Charge for an hour, minimum, before the session.
- ☐ Stick challenge mat to a table. The mat should not move when a small amount of force is applied.
- ☐ Confirm you have a can that can suitably acts as the 'tree.'
- ☐ Place the can in the 'Tree (can)' area. To make sure the can falls over, place a small LEGO® beam under one side of the can.
- ☐ Just before the participants arrive, turn the robot on. This means you are not waiting for the EV3 to boot up while the participants are watching. Press and hold the selection button until the robot screen lights up to turn the robot on.

Figure 20
Example of the Challenge 1 mat printed on A3 paper and stuck to the table.

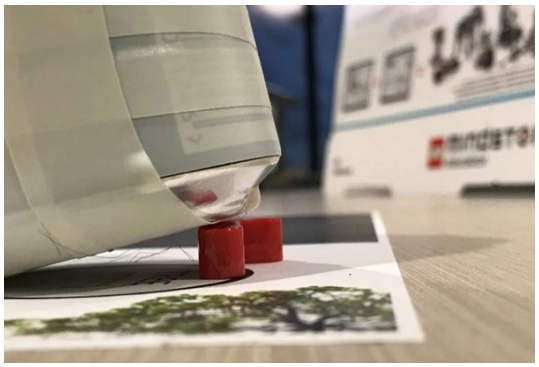
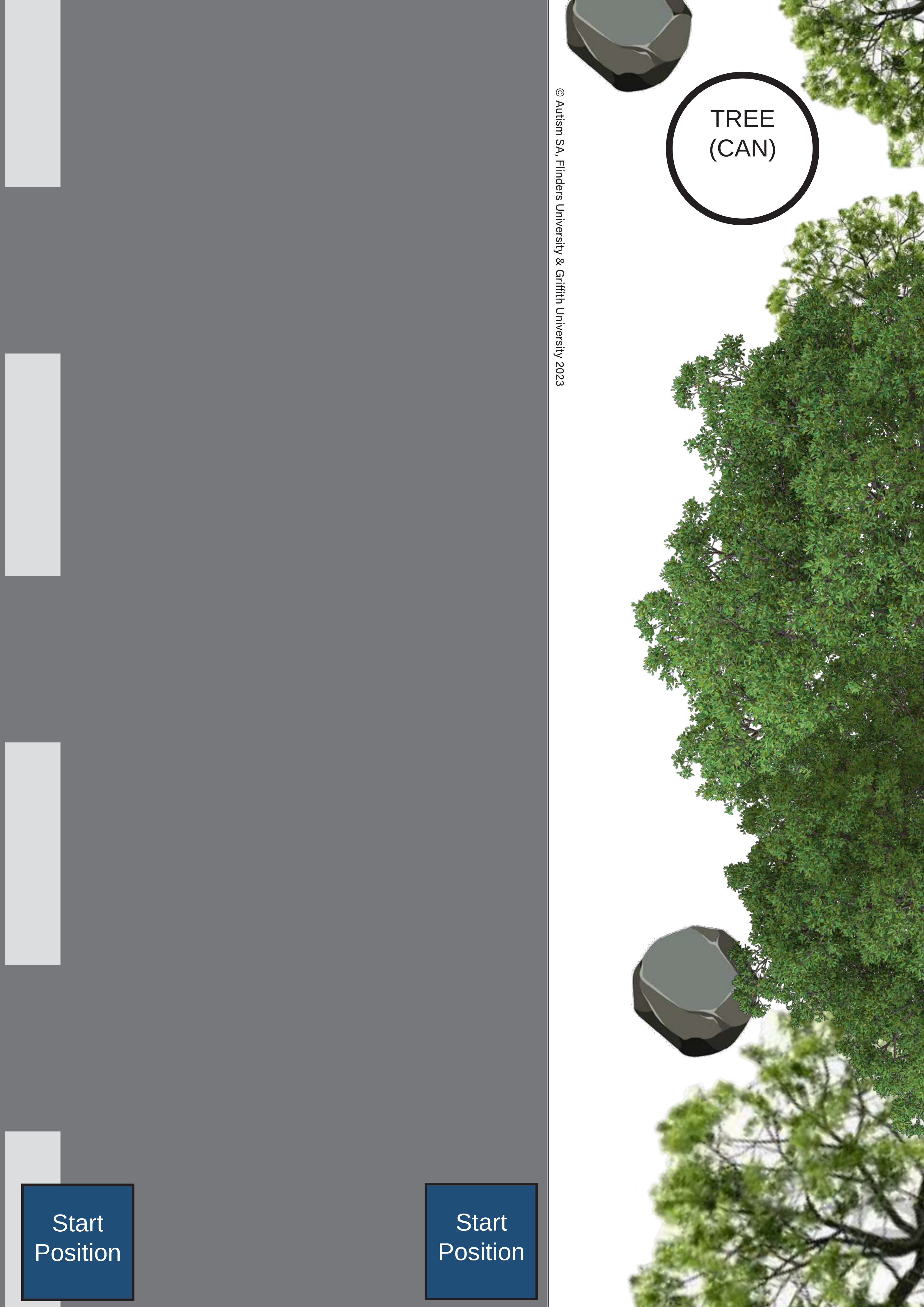
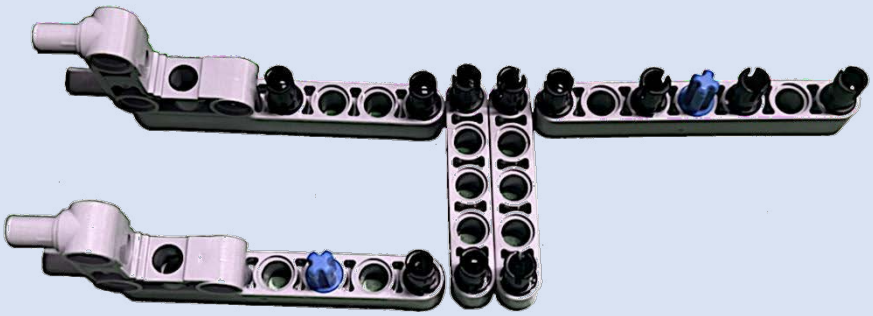


Figure 21
Photo of the can (tree) placed on the Challenge 1 – mat, with red props underneath so it can fall over.

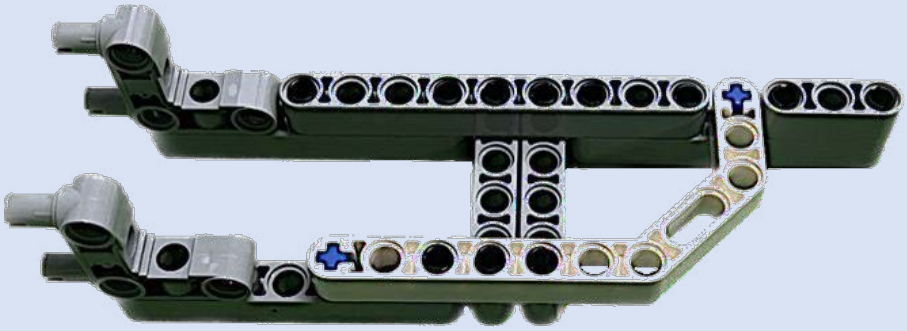


Challenge 1 Default Build Instructions

1 Side View



2 Side View



3 Side View

Running the session

It is more important to support participants to communicate, interact and work effectively as a team member than how to be successful at the Challenges.

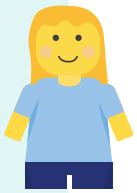
1. As a facilitator, before you start any of the Challenges, tell the participants to:
   a. Take your time to think about it and look at what others are doing.
   b. Read the Mission Card and watch the motion of the robot.
   c. Ask any questions you might have about the Challenge.
   d. Look at the pieces in the LEGO® Mindstorms Education EV3 Expansion set.
   e. Experiment with the pieces you are planning on using.
   f. Participants have 10 minutes to trial their ideas.

Note:
They **cannot** modify the robot they have built. They must **only add** to the robot.
This is for all the challenges.

2. Hand each participant a Mission Card.
3. Ensure the participants understand the following details;
   a. A robot is being used to chop down a dangerous tree that could cause damage.
   b. The robot is starting at the beginning of the stretch of road on the mat.
   c. The robot will drive until it is in line with the tree.
   d. The robot will rotate to cut down the tree.
   e. The robot will then drive away.
4. Now run the robot, without the solution, to show the participants the motions you have described;
   a. Place the robot so that one wheel is in each blue 'Start Position' box on the mat.
   b. The front screen will display several programs; if programs are not visible press the left selection button until 'chal_1', 'chal_2' and 'chal_3' are visible.
   c. Using the four central arrow keys (refer to "Base Robot Checklist and Button Layout") scroll down until 'Chal_1' is highlighted.
   d. Press the central selection button to select the program to run the program.
   e. The robot will carry out the program.
   f. If you need to stop the robot, press the stop button located on the top left. It is a stand-alone button (refer to brick layout sheet in "Base Robot Checklist and Button Layout", if needed).

5. Once the robot has run the program, allow the participants to ask questions, assess the robot and re-run the code if needed.
6. We found that most participants already had an idea in their heads and wanted to begin building immediately. We didn't have a robot for each participant so they would have to work co-operatively by sharing and waiting so that everyone had a chance to trial their design solution on the actual robot.
7. Participants build their solution or work together as a group to build a solution.
8. Be mindful that during Challenges there is an increased need for effective communication, sharing of ideas, collaboration, compromising, problem solving, and turn- taking that as a facilitator you may need to support.
9. If participants are struggling with a solution, they can use the "Default solution build instructions', look at the photos or watch the video supplied, watch other participants solutions, or as the facilitator you can provide support.
10. Trial it. Once made, the participants could do two trials using the robot. We encouraged the other participants to watch the trials of everyone so that they could then give ideas about how to improve/alter the design solution to be more successful. Also, this was a chance for the groups to celebrate any successful trials together.

Challenge tips
The participants will have a range of skills and some may finish earlier than others. Encourage them to support others to finish. We have also provided some extension ideas to the Challenge.



Extension ideas

a. After the participants have made their own model in response to the Challenge and trialled it, they can think of an extra Challenge they can do with the particular movement/coding of the robot. They can work it out together using the Rules of Compromise in the additional resources section or make it individually.

b. We found that some participants did the Challenge with a small number of pieces and some built very complex solutions with a lot of pieces, so we challenged them to do it again with either more or less pieces.

c. Roll a die twice and that is how many pieces the participants can use to build a new model for the Challenge.

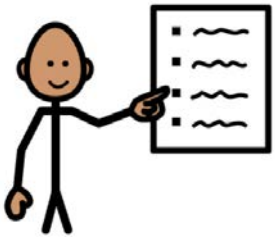
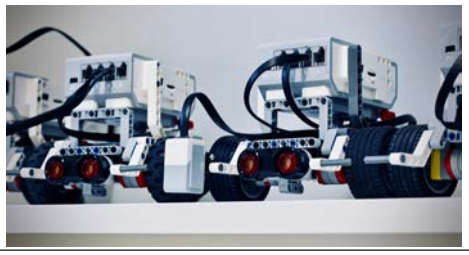
d. Set the number of pieces that the participants can use to build a model for the Challenge.

e. Participants work together to make a model for the Challenge using the least number of pieces possible.

f. Do the Challenge using all the coloured pieces in the set only.

11. Each participant can take a photo of what they have built to show their parents. If they don't have a phone the facilitators take the photo and send it to the parent/carer.
12. At the end of the session, each participant completes a Participant Check Out form.
13. As a group, pack up.

Challenge 1 Participant schedule

1	Hello	
2	Getting ready	
3	Rules	
4	Roles	
5	Challenge	
6	Pack up and check out	

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Draft solutions

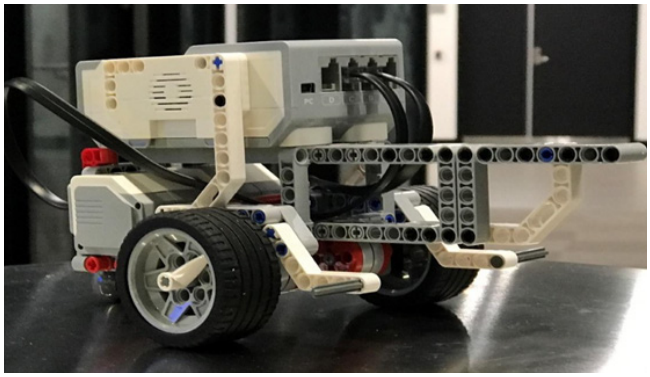
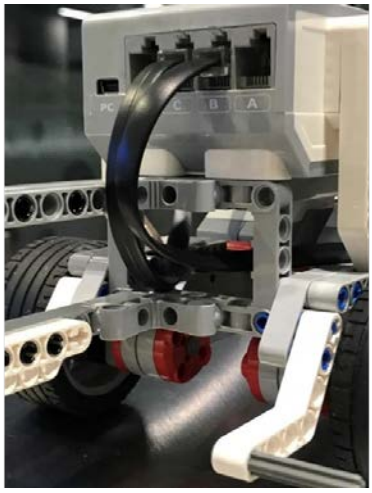


Figure 22
Challenge 1 Default Solution



We used this default solution as a group after the participants had a chance to build their own solution to Challenge 1 using the Challenge 1 – Default Solution Build Instructions.

We thought it was a great way to pull the group together as they would be building using the roles of LEGO® therapy again.

Figure 23
Example photos of participants solutions to Challenge 1.

After the session

1. Make sure all LEGO® pieces are accounted for; remember to collect the LEGO® used to prop the can.
2. Collect the can.
3. Check challenge mat for damage.
4. If participants are part way through a build, place current progress in the LEGO® box or in an alternate bag.
5. Turn the robot off by clicking the back button until a popup window with a tick and cross appear. Press the right selection key to highlight the tick marker. Press the central button – this will turn the robot off.
6. Facilitators complete Participant Assessment Sheet and Participant Observation Assessment Sheet.
7. Ensure all the Participant Check Out sheets results are recorded on the Participant Assessment Sheet.
8. Prepare for the next session.

Instruction sheet - Challenge 2 - Hold the container

Challenge 2 – Hold The Container

Mission Card

- A large vessel has been used to hold some extremely heavy and dangerous chemicals.
- A robot has been deployed to move the vessel. However, the robot drives a little crazy.
- **Your job** is to build a holder that keeps the vessel attached to the robot and off the ground.
- Make sure the instructor can still press the buttons.

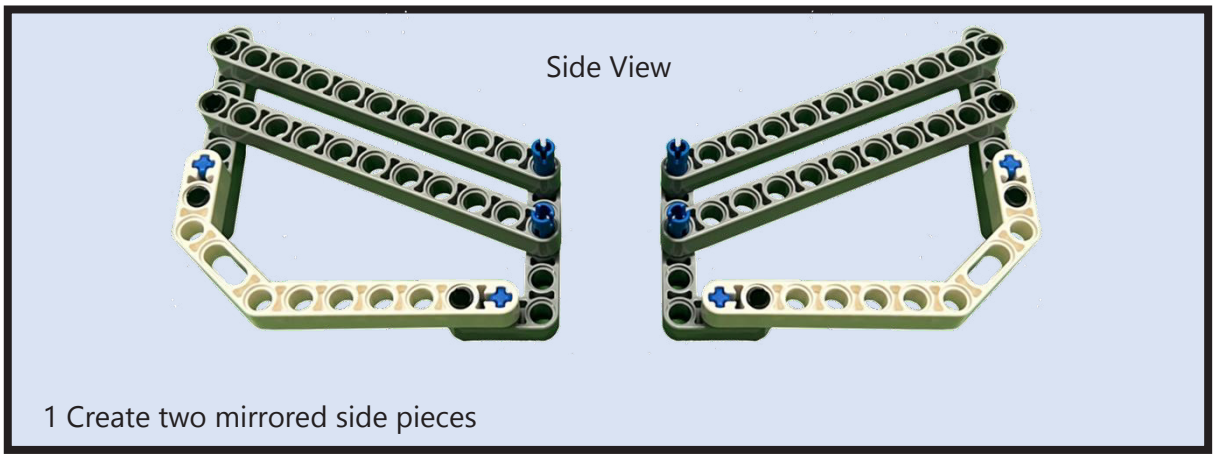
Good luck!

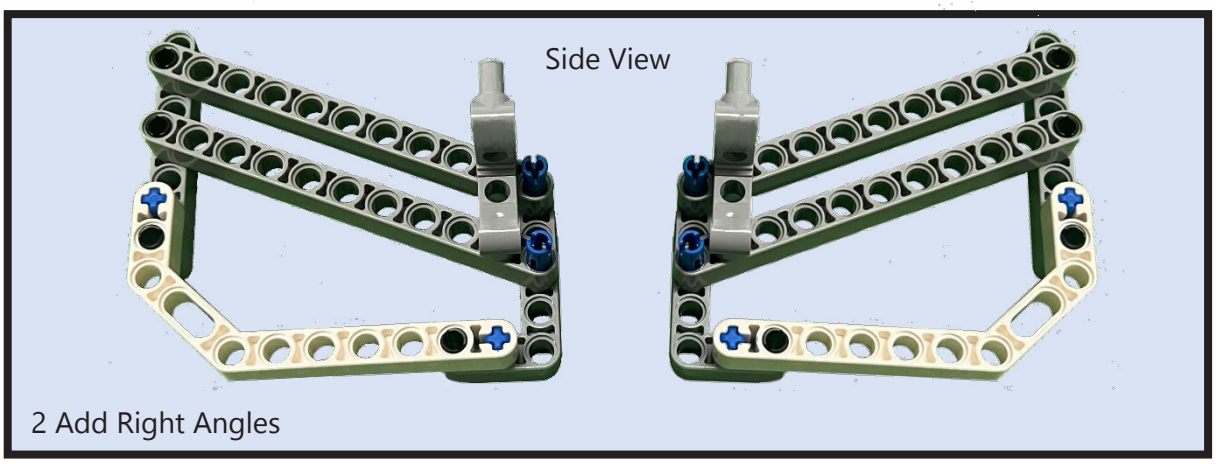
Graphic by Canva

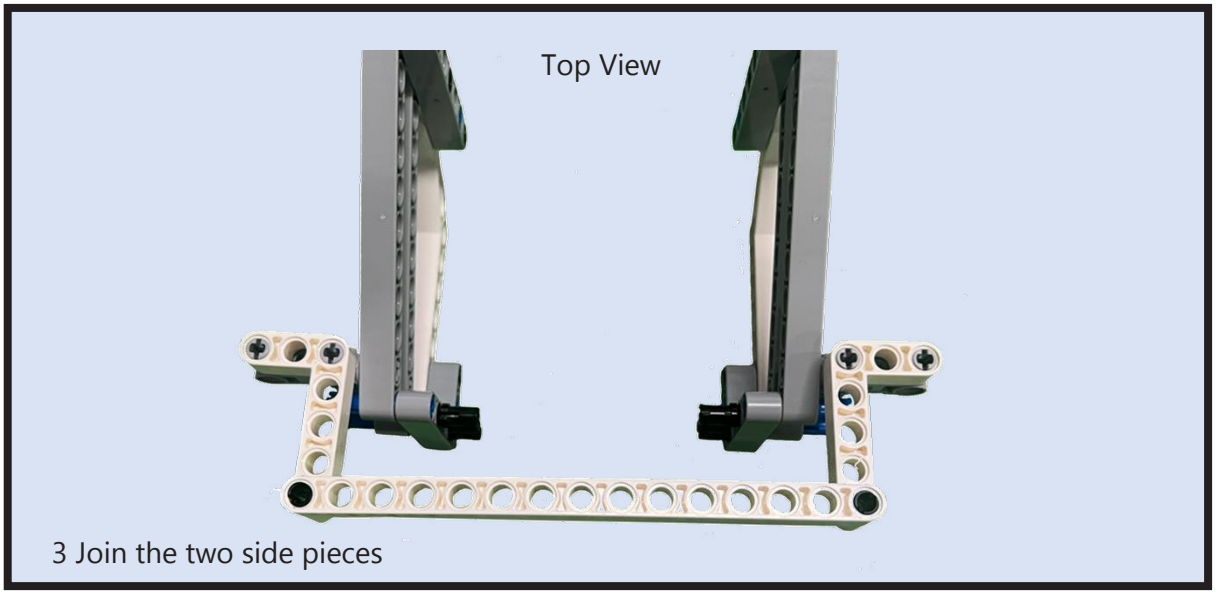
Preparation Checklist

- ☐ Make sure you have coded the robot as per instructions in the Equipment/Coding the robot information.
- ☐ Watch the Challenge 2a video.
- ☐ Watch the Challenge 2b video.
- ☐ Print out the Mission Cards for each participant.
- ☐ Have a softball or a ball of similar shape and weight to a soft ball.
- ☐ Make sure the robot is charged. Charge for an hour, minimum, before the session.
- ☐ Just before the participants arrive, turn the robot on. This is so you are not waiting for the EV3 to boot up while the participants are watching. Press and hold the selection button until the robot screen lights up, to turn the robot on.

Challenge 2 Default Build Instructions







Running the session

It is more important to support participants to communicate, interact and work effectively as a team member than how to be successful at the Challenges.

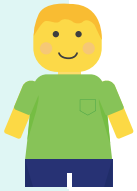
1. As a facilitator, before you start any of the Challenges, tell the participants to:
   a. Take your time to think about it and look at what others are doing.
   b. Read the Mission Card and watch the motion of the robot.
   c. Ask any questions you might have about the Challenge.
   d. Look at the pieces in the LEGO® Mindstorms Education EV3 Expansion set.
   e. Experiment with the pieces.
   f. Participants have 10 minutes to trial their ideas.

Note:
They **cannot** modify the robot they have built. They must **only add** to the robot.
This is for all the challenges.

2. Hand each participant a Mission Card.
3. Ensure the participants understand the following details;
   a. A robot has been deployed to transfer a container of heavy and dangerous chemicals.
   b. The robot drives a little crazy.
   c. The robot cannot fall over or drop the ball or the Challenge has failed.
   d. The student's solution cannot cover the buttons on the EV3 brick.
4. Now run the robot, without the solution, to show the participants the motions you have described;
   a. Place the robot anywhere on the ground or tabletop; if a on a tabletop, make sure it doesn't drive off the edge.
   b. The front screen will display several programs; if programs are not visible press the left selection button until 'chal_1', 'chal_2' and 'chal_3' are visible.
   c. Using the four central selection buttons (refer to brick layout sheet in "Base Robot Checklist and Button Layout", if needed) scroll down until 'Chal_2' is highlighted.
   d. Press the central button to select the program so the program will run.
   e. The robot will carry out the program.
   f. If you need to stop the robot, press the stop button located on the top left. It is a stand-alone button (refer to "Base Robot Checklist and Button Layout", if needed).

5. Once the robot has run the program, allow the participants to ask questions, assess the robot and re-run the code if needed.
6. We found that most participants already had an idea in their heads and wanted to begin building immediately. We didn't have a robot for each participant so they would have to work co-operatively by sharing and waiting so that everyone had a chance to trial their design solution on the actual robot.
7. Participants build their solution or work together as a group.
8. Be mindful that during Challenges there is an increased need for effective communication, sharing of ideas, collaboration, compromising, problem solving, and turn- taking that as a facilitator you may need to support.
9. If participants are struggling with a solution, they can use the "Default solution build instructions", look at the photos or watch the video supplied, watch other participants solutions, or as the facilitator you can provide support.
10. Trial it. Once made, the participants could do two trials using the robot. We encouraged the other participants to watch the trials of everyone so they could give ideas about how to improve/alter the design solution to be more successful. Also, this was a chance for the groups to celebrate any successful trials together.

Challenge tips
The participants will have a range of skills and some may finish earlier than others. Encourage them to support others to finish. We have also provided some extension ideas to the Challenge.



Extension ideas

a. After the participants have made their own model in response to the Challenge and trialled it, they can think of an extra Challenge they can do with the particular movement/coding of the robot. They can work it out together using the Rules of Compromise in the additional resources section or make it individually.

b. We found that some participants did the Challenge with a small number of pieces and some built very complex solutions with a lot of pieces, so we challenged them to do it again with either more or less pieces.

c. Roll a die twice and that is how many pieces the participants can use to build a new model for the Challenge.

d. Set the number of pieces that the participants can use to build a model for the Challenge.

e. Participants work together to make a model for the Challenge using the least number of pieces possible.

f. Do the Challenge using all the coloured pieces in the set.

11. Each participant can take a photo of what they have built to show their parents. If they don't have a phone the facilitators take the photo and send it to the parent/carer.
12. At the end of the session, each participant completes a Participant Check Out form.
13. As a group, pack up.

Draft solutions

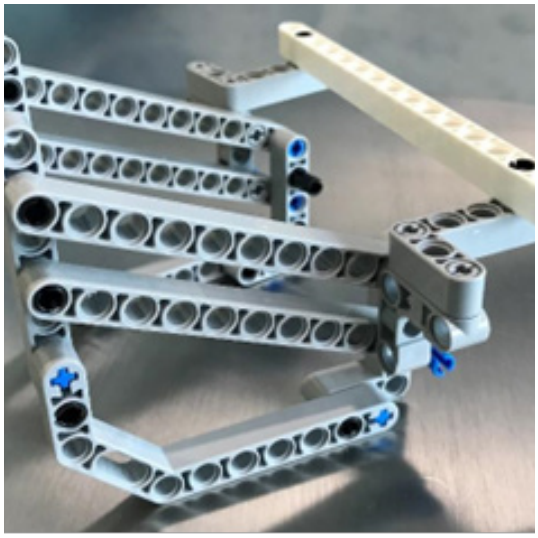


Figure 24
Picture of default solution and the default solution mounted to the robot.

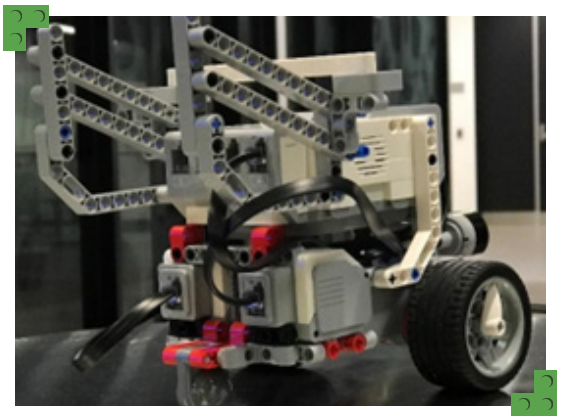
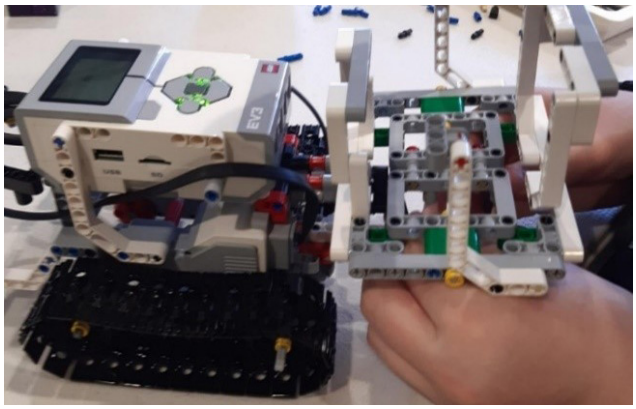


Figure 25
Picture of mounting points for the default solution.



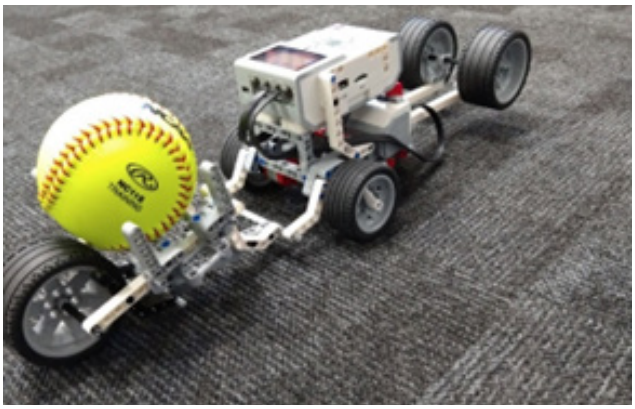
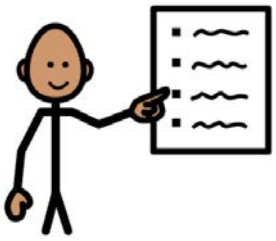
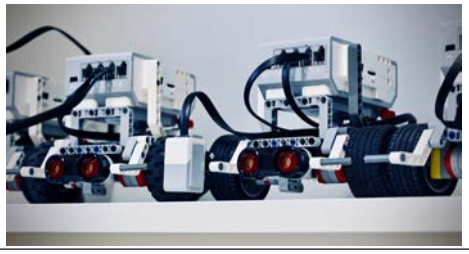


Figure 26
Example photos of participant solutions to Challenge 2.

After the session

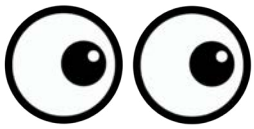
1. Make sure all LEGO® pieces are accounted for.
2. Collect the ball.
3. If participants are part way through a build, place current progress in the LEGO® box or in an alternate bag.
4. Turn the robot off by clicking the back button until a popup window with a tick and cross appear. Press the right selection key to highlight the tick marker. Press the central button, this will turn the robot off.
5. Facilitators complete *Participant Assessment Sheet* and *Participant Observation Assessment sheet.*
6. Ensure all the P*articipant Check Out sheets* results are recorded on the Participant Assessment Sheet.
7. Prepare for the next session.

Challenge 2: Participant schedule

1	Hello	
2	Getting ready	
3	Rules	
4	Roles	
5	Challenge	
6	Pack up and check out	

Instruction sheet - Challenge 3 - My eyes!

Challenge 3 – My eyes!



Mission Card

- Someone has noticed a 'can-car' has broken down in the middle of the road.
- Unfortunately, it is very dark and windy tonight and other cars are not seeing the broken-down vehicle.
- The wind has also caused a tree to fall over and a bin to be blown onto the road.
- A robot that can move the bin, drive around the tree and push the car off the road has deployed.
- **Your job** is to design a small bumper that will stop the bin, tree and can-car contacting the robot's eye.

Good luck!

Graphic by Canva

Preparation Checklist

- ☐ Make sure you have coded the robot as per the instructions in Equipment/Coding the robot information.
- ☐ Print out a Mission Card for each participant.
- ☐ Watch the Challenge 3 video.
- ☐ Construct the 'Fallen Tree Holder' holder using the Challenge 3 – Fallen Tree Holder Build Instructions.
- ☐ You will need to attach the ultrasonic sensor to the front of the robot.
  - First, plug the connector into the sensor.
  - Then thread the connector through the robot and out of one of the sides.
  - You can then attach the sensor to the robot. A right-angle piece with clips is used to connect the sensor to the robot (bottom image).
  - Finally, plug the sensors into port 4 of the robot. This is located on the opposite side of where the 'eyes' are attached.

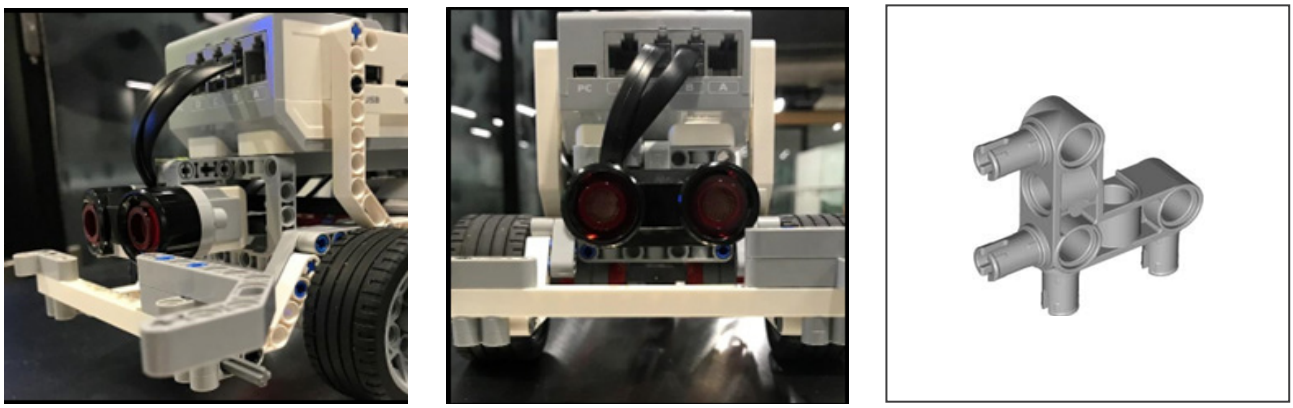
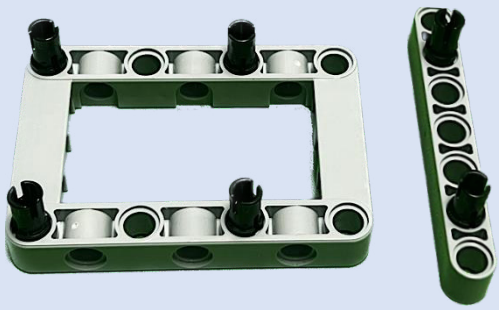


Figure 27
Instructions on attaching the ultrasonic sensor to the front of the robot.

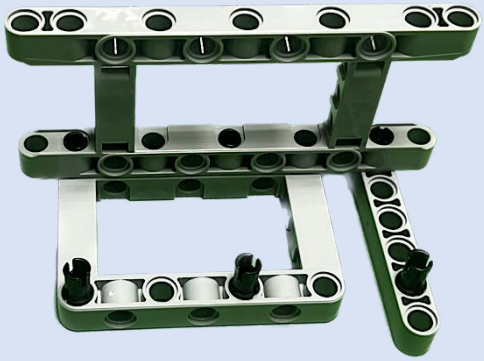
- Print out the Challenge 3 – mat. The Challenge mat must be printed as **A3 size** so that the coding for the robot for each Challenge works effectively.
- Stick the Challenge mat to a table. The mat should not move when a small amount of force is applied. The mats are placed in number order so they are in a normal orientation if the instructor is standing at the beginning of the course (starting position).

Challenge 3 Fallen Tree Holder Build Instructions



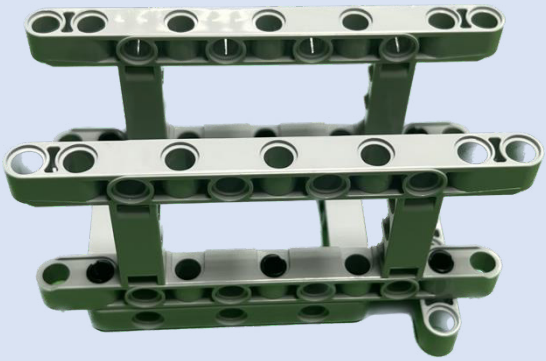
1

FRONT



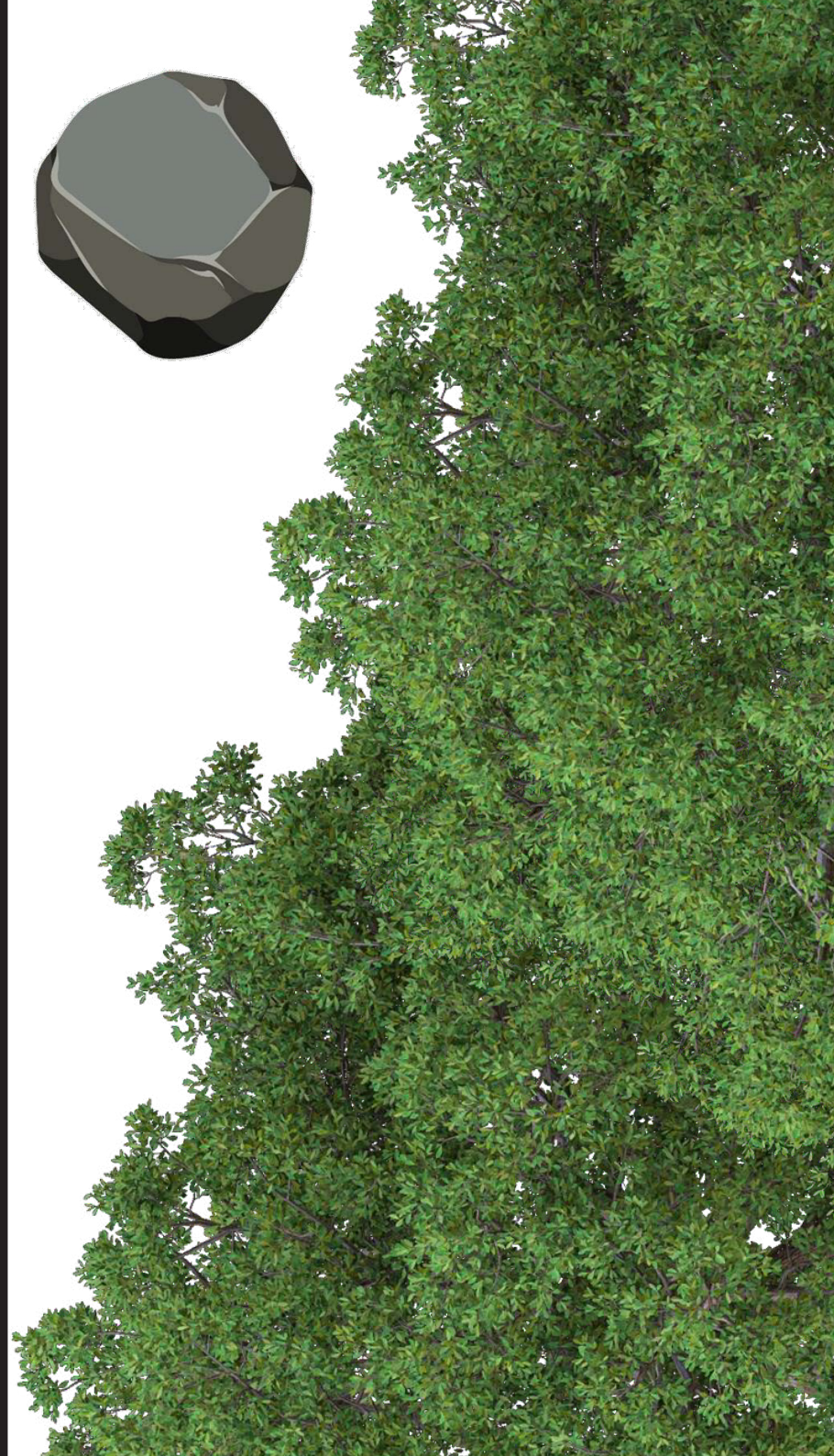
2

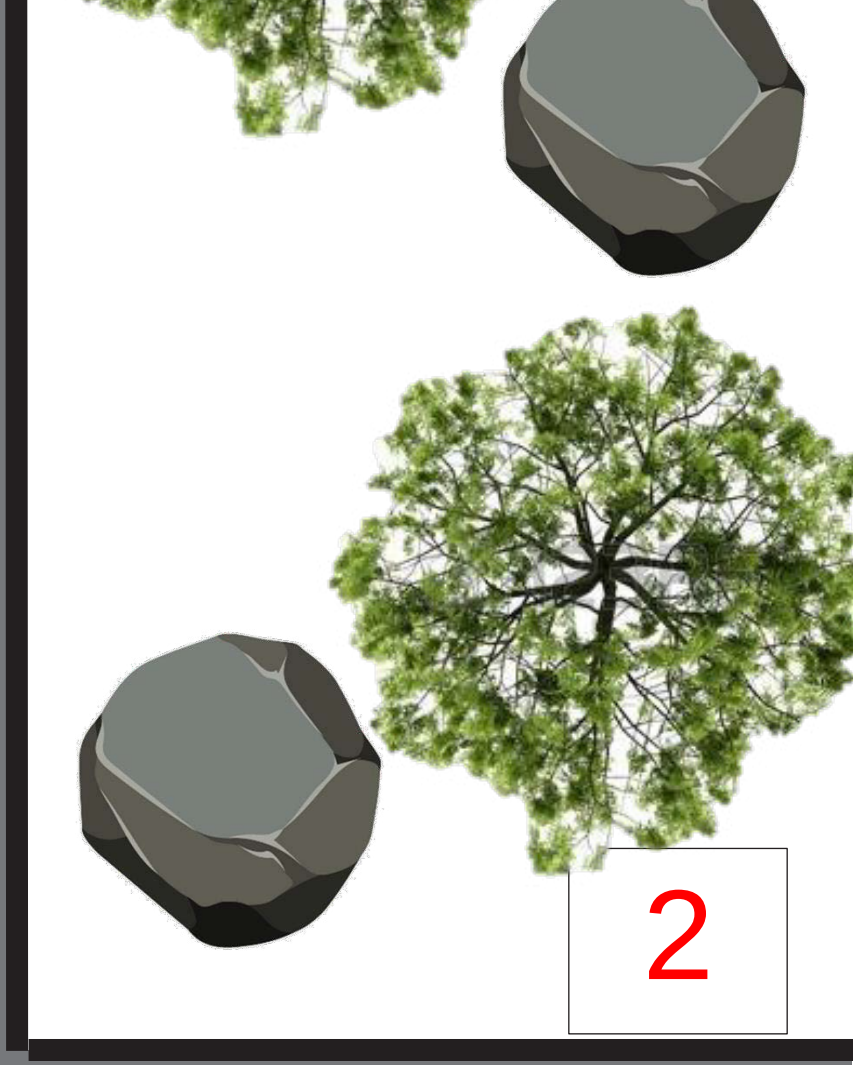
FRONT



3

FRONT





Fallen Tree

3

Figure 28
The Challenge 3 mat layout.

- Ensure you have three cans or can substitutes available.
- Place the cans:
  - Over the 'Move Bin' area;
  - On top of the Fallen Tree Holder in the 'Fallen tree' area; and
  - Anywhere along the road in section 4.

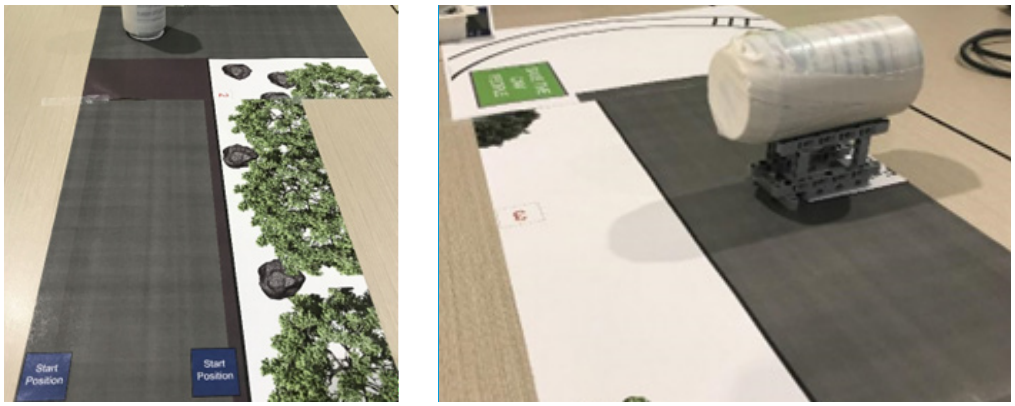


Figure 29
Image of where to position the can for Challenge 3.

- Make sure the robot is charged. Charge for an hour, minimum, before the session.
- Just before the participants arrive, turn the robot on. This means you are not waiting for the EV3 to boot up while the participants are watching. Press and hold the selection button until the robot screen lights up to turn the robot on.

Running the session

It is more important to support participants to communicate, interact and work effectively as a team member than how to be successful at the Challenges.

1. As a facilitator, before you start any of the Challenges, tell the participants to:
   a. Take your time to think about it and look at what others are doing.
   b. Read the Mission Card and watch the motion of the robot.
   c. Ask any questions you might have about the Challenge.
   d. Look at the pieces in the LEGO® Mindstorms Education EV3 Expansion set.
   e. Experiment with the pieces.
   f. Participants have 10 minutes to trial their ideas.

Note:
They **cannot** modify the robot they have built. They must **only add** to the robot.
This is for all the challenges.

2. Hand each participant a Mission Card.
3. Ensure the participants understand the following details;
   a. A robot has been deployed to save a stranded 'can-car.' It's a dark and windy night, meaning people are not seeing the stranded car and a crash is likely to occur.
   b. The wind has blown obstacles onto the road, the robot will need to:
      i. Move the bin; and
      ii. Drive around the fallen tree.
   c. The robot will move the 'can-car' off the road.
   d. The robot has 'eyes' but these need protection, so the bin, tree or 'can-car' don't contact them.
   e. They will need to design a small bumper to protect the eyes. Remind the participants that the eyes need to be protected but not covered or the robot won't be able to perform the challenge; it will continue straight, or it won't see the other items on the Challenge mat.
4. Now run the robot, without the solution, to show the participants the motions you have described.
   a. Place the robot on the mat so that one wheel is in each blue 'Start Position' box.
   b. The front screen will display several programs; If programs are not visible press the left selection button until 'chal_1', 'chal_2' and 'chal_3' are visible.

c. Using the four central arrow (refer to brick layout sheet in "Base Robot Checklist and Button Layout", if needed), scroll down until 'Chal_3' is highlighted.

d. Press the central selection button to select the program so that it will run.

e. The robot will carry out the program.

f. If you need to stop the robot, press the stop button located on the top left. It is a stand-alone button (refer to brick layout sheet "Base Robot Checklist and Button Layout", if needed).

5. Once the robot has run the program, allow the participants to ask questions, assess the robot and rerun the code if needed.

6. We found that most participants already had an idea in their heads and wanted to begin building immediately. We didn't have a robot for each participant so they would have to work co-operatively by sharing and waiting so that everyone had a chance to trial their design solution on the actual robot.

7. Participants build their solution or work together as a group.

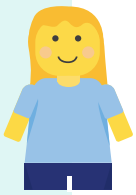
8. Be mindful that during Challenges there is an increased need for effective communication, sharing of ideas, collaboration, compromising, problem solving, turn-taking that as a facilitator you may need to support.

9. Participants will realise when they get to the end of the track, the robot will likely miss the can, **this is intentional.** They will need to go back and add some additional pieces to their bumper to make it wider.

10. If participants are struggling with a solution, they can use the "Default solution build instructions", look at the photos or watch the video supplied, watch other participants solutions or as the facilitator you can provide support.

11. Trial it. Once made, the participants could do two trials using the robot. We encouraged the other participants to watch the trials of everyone so they could then give ideas about how to improve/ alter the design solution to be more successful. Also, this was a chance for the groups to celebrate any successful trials together.

Challenge tips
The participants will have a range of skills and some may finish earlier than others. Encourage them to support others to finish. We have also provided some extension ideas to the Challenge.



Extension ideas

a. After the participants have made their own model in response to the Challenge and trialled it, they can think of an extra Challenge they can do with the particular movement/coding of the robot. They can work it out together using the Rules of Compromise in the additional resources section or make it individually.

b. We found that some participants did the Challenge with a small number of pieces and some built very complex solutions with a lot of pieces, so we challenged them to do it again with either more or less pieces.

c. Roll a die twice and that is how many pieces the participants can use to build a new model for the Challenge.

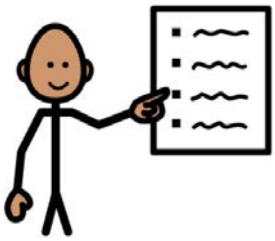
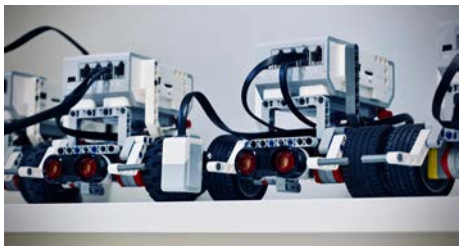
d. Set the number of pieces that the participants can use to build a model for the Challenge.

e. Participants work together to make a model for the Challenge using the least number of pieces possible.

f. Do the Challenge using all the coloured pieces in the set only.

12. Each participant can take a photo of what they have built to show their parents. If they don't have a phone the facilitators take the photo and send it to the parent/carer.
13. At the end of the session, each participant completes a Participant Check Out form.
14. As a group, pack up.

Participant Schedule: Challenge 3 - My eyes

1	Hello	
2	Getting ready	
3	Icebreaker activity	
4	Rules and schedule	
5	Roles	
6	Challenge	
7	Pack up and check out	

Default solutions: Challenge session 3

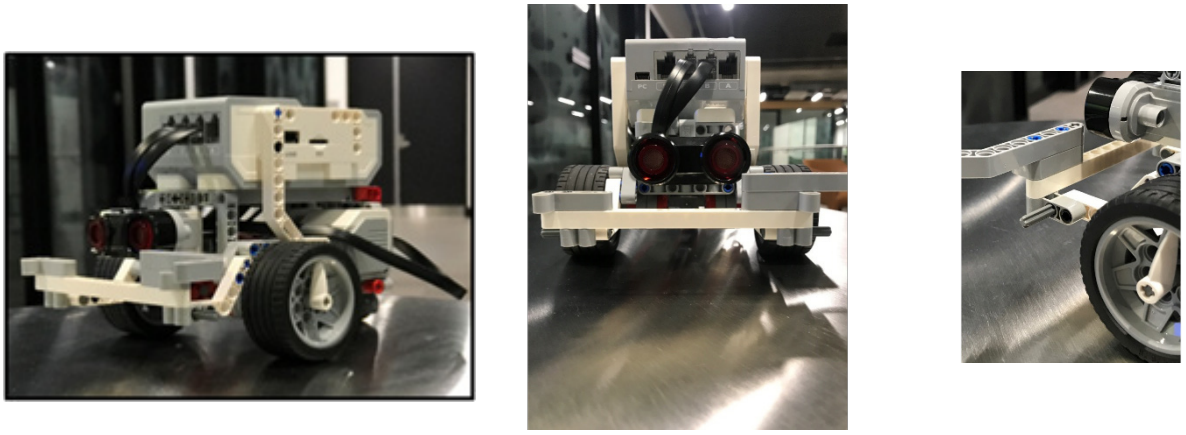


Figure 30
Example photos of participant solutions to Challenge 3.

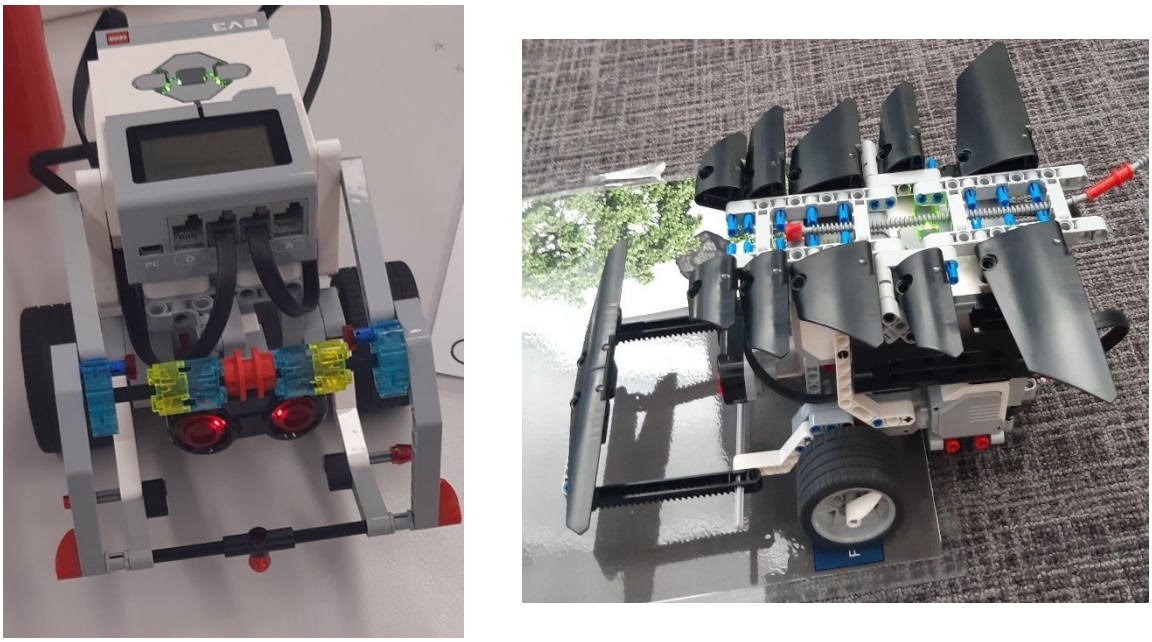
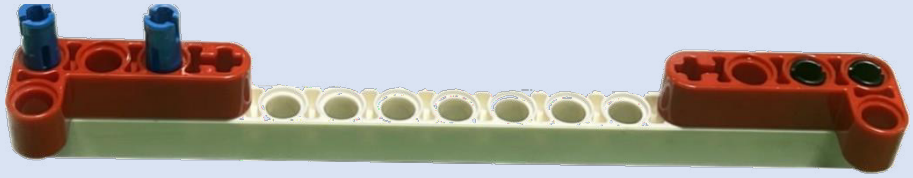


Figure 31
Example photos of participant solutions to Challenge 3.

Challenge 3 Default Build Instructions

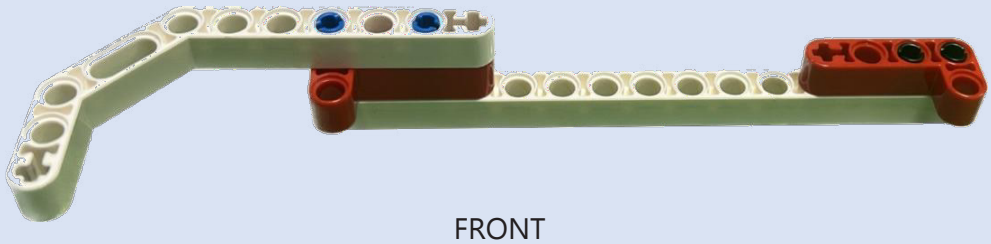
FRONT

1



2

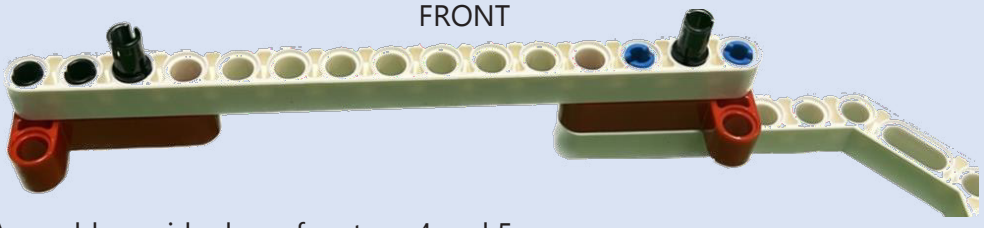
FRONT



3

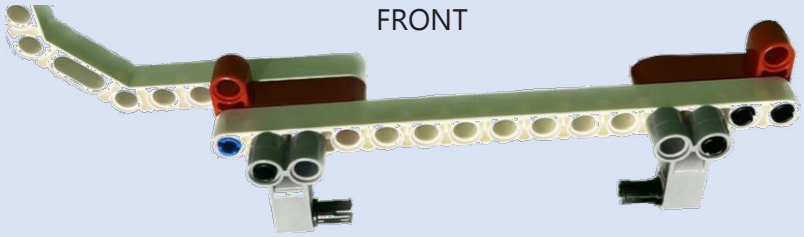
FRONT

FRONT



4: Turn Assembly upside down for steps 4 and 5

FRONT



5

After the session

1. Make sure all LEGO® pieces are accounted for.
2. Collect the call.
3. Check the Challenge Mat for damage.
4. If participants are part way through a build, place current progress in the LEGO® box or in an alternate bag.
5. Turn the robot off by clicking the back button until a popup window with a tick and cross appear. Press the right selection key to highlight the tick marker. Press the central button, this will turn the robot off.
6. Facilitators complete *Participant Assessment Sheet* and *Participant Observation Assessment sheet.*
7. Ensure all the P*articipant Check Out sheets* results are recorded on the Participant Assessment Sheet.
8. Prepare for the next session.

Instruction sheet - Challenge 4 - Extension

Preparation Checklist

- ☐ Use the Challenge 2 movement/coding and instructions.
- ☐ Make sure the robot is charged. Charge for an hour, minimum, before the session.
- ☐ Just before the participants arrive, turn the robot on. This is so you are not waiting for the EV3 to boot up while the participants are watching. Press and hold the selection button until the robot screen lights up, to turn the robot on.

Running the session

You can continue to use the coded Challenge movements to run more sessions.

1. Use the Challenge 2 movement/coding and instructions to build a solution to the Challenge which now has added complexity such as:
   a. Throw some paddle pop sticks on the area that the robot will drive along.
   b. Periodically bump the robot.
   c. Use a heavier ball.
   d. Complete the Challenge on an inclined surface.
   e. If the Challenge is on carpet, you can put small bits of VELCRO® (hook piece) on the wheel to create friction. This will cause some random activity to occur.
2. Participants can choose to make a different solution to any of the 3 Challenges and movements/coding.
3. Add something to the robot that won't fall off when it does the Challenge 2 movement/coding (see photo below).

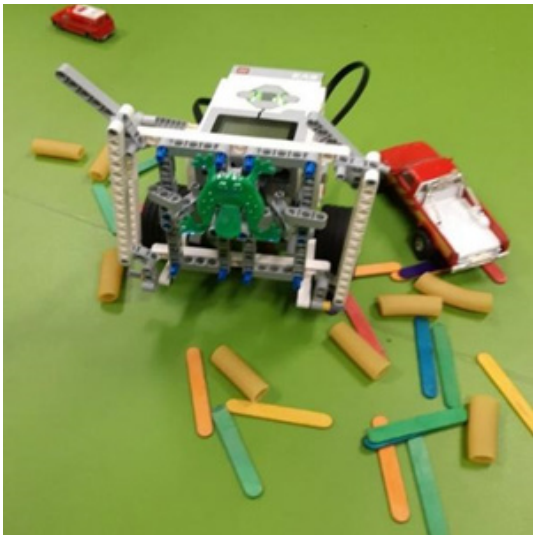
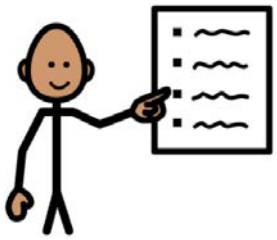
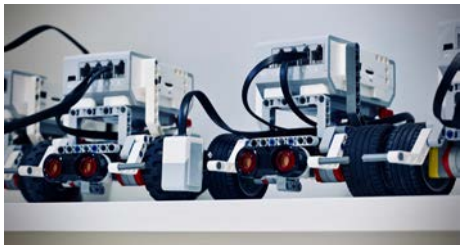


Figure 32
Example of the extension activity of adding something to the robot that won't fall off when it does the Challenge 2 movement.

4. Participants build their solution or work together as a group.
5. Be mindful that during Challenges there is an increased need for effective communication, sharing of ideas, collaboration, compromising, problem solving, turn-taking that as a facilitator you may need to support.
6. For Challenge 3, participants will realise when they get to the end of the track, the robot will likely miss the can, this is intentional. They will need to go back and add some additional pieces to their bumper to make it wider.
7. Trial it. Once made, the participants could do two trials using the robot. We encouraged the other participants to watch the trials of everyone so that they could then give ideas about how to improve/alter the design solution to be more successful. Also, this was a chance for the groups to celebrate any successful trials together.
8. Each participant can take a photo of what they have built to show their parents. If they don't have a phone the facilitators take the photo and send it to the parent/carer.
9. At the end of the session, each participant completes a Participant Check Out form.
10. As a group, pack up.

Participant Schedule: Challenge 4

1	Hello	
2	Getting ready	
3	Icebreaker activity	
4	Rules and schedule	
5	Roles	
6	Challenge	
7	Pack up and check out	

After the session

1. Make sure all LEGO® pieces are accounted for.
2. Check the challenge mats for damage.
3. If participants are part way through a build, place current progress in the LEGO® box or in an alternate bag.
4. Turn the robot off by clicking the back button until a popup window with a tick and cross appear. Press the right selection key to highlight the tick marker. Press the central button, this will turn the robot off.
5. Facilitators complete *Participant Assessment Sheet* and *Participant Observation Assessment sheet.*
6. Ensure all the P*articipant Check Out sheets* results are recorded on the Participant Assessment Sheet.
7. Prepare for the next session.

6.3 Reward or Party session

Preparation Checklist

As a group, we decided how the participants wanted to end the last session. We offered participants the choice of a party or a type of reward activity to help them celebrate the success of completing the program.

- ☐ Certificates for participants – these will need to be pre-printed (and possibly laminated).
- ☐ Party food and drink if required (being mindful of potential food allergies or intolerances).

Running the session

1. The way the session is ran will depend on what the group decided to do in the last session.
2. Encourage participants to exchange contact details and to catch up outside of the group if appropriate.

Participant Schedule: Reward and Party Session

1	Hello	
2		
3		
4		
5		
6		
7	Pack up and check out	 

1,2,3,4 images- PCS and Boardmaker are trademarks of Tobii Dynavox LLC. All rights reserved. Used with permission.

After the session

1. Facilitators complete *Participant Assessment Sheet* and *Participant Observation Assessment sheet.*
2. Ensure all the *Participant Check Out sheets* results are recorded on the Participant Assessment Sheet.

LEGO® Robotics Therapy

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Photo by Ralf Siegesmund on Unsplash

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