Energy Breakthrough Pushcart & Robotics Unit

Unit Name: The Energy Breakthrough	
Big Idea	The "Pushcart Design and Engineering Challenge" is a two-term immersive unit for primary school students, strategically aligned with the Energy Breakthrough competition. Beginning with an introduction to the competition, students explore design principles and fundamental forces like push and pull. They engage in hands-on activities, transitioning from brainstorming and design drawings to prototyping and construction. Safety considerations are integrated during material and tool exploration. The unit emphasizes teamwork and effective communication throughout. As the design phase culminates, students refine their pushcart designs, leading to construction and testing. Physical fitness is seamlessly integrated, ensuring students are prepared for the competition. The unit provides a comprehensive educational experience, combining practical engineering skills, creativity, teamwork, and physical fitness in preparation for the real-world challenges of the Energy Breakthrough pushcart competition. The Sphero Robotics unit for the Energy Breakthrough Challenge is a dynamic exploration spanning various phases. Beginning with an introduction to Sphero Robotics, students delve into programming and controlling these devices. Hands-on activities follow, focusing on collaborative navigation through obstacle courses. The unit progresses to integrate Sphero Robotics into the Energy Breakthrough Challenge, enhancing pushcart design and programming skills. Emphasis is placed on safety considerations specific to working with robotics. The culmination involves teams designing, building, and programming pushcarts featuring Sphero Robotics elements, with testing and refinement for the competition. Throughout, teamwork, effective communication, and problem-solving are emphasized, ensuring students not only understand Sphero Robotics intricacies but can seamlessly apply these skills to broader Energy Breakthrough challenges.
From Scope & Sequence	

Level	**Design & Technologies**		**Science**			**Digital Technologies**	
Victorian Curriculum	**Level 5 & 6**	VCDSCD039	**Level 5 & 6**	VCSIS083	VCSSU073	**Level 5 & 6**	VCDTCD033
		VCDSCD040		VCSIS085	VCSSU081		
		VCDSTC034		VCSIS086			

Learning Intentions and Success Criteria for Students:

Understanding Energy Breakthrough:

Learning Intentions:

1. Gain a comprehensive understanding of the Energy Breakthrough competition, encompassing its rules and objectives.
2. Develop an appreciation for the integral role of creativity and teamwork in a competitive setting.

Success Criteria: 1.1. Demonstrate knowledge of the specific rules governing the Energy Breakthrough competition. 1.2. Articulate the primary objectives of the Energy Breakthrough competition. 2.1. Showcase creativity through active participation in team-based activities. 2.2. Collaborate effectively with peers to achieve common goals in a competitive environment.

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Forces and Principles:

Learning Intentions:

1. Explore and comprehend fundamental forces such as push and pull.
2. Apply these forces to grasp design and engineering principles relevant to pushcart construction.

Success Criteria: 1.1. Identify and define fundamental forces like push and pull through practical examples. 1.2. Demonstrate an understanding of how these forces impact the construction and functionality of pushcarts. 2.1. Apply the principles of push and pull to design considerations in the construction of pushcarts. 2.2. Evaluate and explain the relationship between fundamental forces and the engineering principles applied in pushcart design.

Design Thinking:

Learning Intentions:

1. Engage in the design thinking process, from brainstorming to creating rough sketches and detailed design drawings.
2. Understand how to translate creative ideas into practical and feasible design plans.

Success Criteria: 1.1. Actively participate in the design thinking process, contributing innovative ideas during brainstorming sessions. 1.2. Create rough sketches that visually represent conceptualized ideas for pushcart design. 2.1. Demonstrate the ability to translate creative concepts into detailed and feasible design plans. 2.2. Justify design decisions based on practical considerations and engineering feasibility.

Materials, Tools, and Safety:

Learning Intentions:

1. Identify and utilize various materials and tools commonly used in construction.
2. Emphasize safety guidelines to ensure the responsible use of materials and tools.

Success Criteria: 1.1. Identify and categorize a range of materials and tools applicable to pushcart construction. 1.2. Demonstrate proficiency in using selected materials and tools for construction purposes. 2.1. Communicate and apply safety guidelines during the use of materials and tools. 2.2. Exhibit responsible and safe practices in the handling and manipulation of construction materials.

Prototyping and Construction:

Learning Intentions:

1. Develop small-scale prototypes of pushcart designs for testing and evaluation.
2. Apply learned principles to construct pushcarts, fostering hands-on experience in engineering and teamwork.

Success Criteria: 1.1. Successfully construct small-scale prototypes that represent designed pushcart concepts. 1.2. Evaluate and iterate on prototypes to improve functionality and address design considerations. 2.1. Apply acquired principles to construct pushcarts that align with design plans. 2.2. Collaborate effectively with team members to ensure cohesive and efficient construction processes.

Physical Fitness Integration:

Learning Intentions:

1. Recognize the importance of physical fitness in the context of the Energy Breakthrough competition.
2. Integrate physical fitness activities, such as warm-up exercises and endurance training, to prepare students for the physical demands of the challenge.

Success Criteria: 1.1. Articulate the significance of physical fitness in enhancing overall performance in the Energy Breakthrough competition. 1.2. Acknowledge the correlation between physical well-being and successful participation in competitive events. 2.1. Engage actively in designated physical

fitness activities to enhance endurance and preparedness. 2.2. Demonstrate an understanding of how physical fitness contributes to meeting the physical demands of the Energy Breakthrough challenge.

Learning Intentions and Success Criteria for Sphero Bolts Fundamentals Unit

Week 1: Introduction to Sphero Bolts *Learning Intentions:*

- Gain a foundational understanding of the basic features and capabilities of Sphero Bolts.
- Recognize the potential applications of Sphero Bolts in various fields.

Success Criteria:

- Successfully navigate and control Sphero Bolts using the Sphero Edu app.
- Participate in discussions demonstrating comprehension of Sphero Bolts' components and functionalities.

Week 2: Coding Basics with Sphero Edu App *Learning Intentions:*

- Develop foundational coding skills using the Sphero Edu app.
- Understand the interface and key components of block-based coding.

Success Criteria:

- Create simple programs to control Sphero Bolts' movement.
- Demonstrate proficiency in using basic coding blocks within the Sphero Edu app.

Week 3: Exploring Sensors and Lights *Learning Intentions:*

- Understand the sensors and lighting features of Sphero Bolts.
- Apply coding skills to program responses to different sensor inputs.

Success Criteria:

- Successfully program Sphero Bolts to respond to sensor inputs.
- Create visually appealing effects using LED lights on the Sphero Bolts.

Week 4: Advanced Coding Techniques *Learning Intentions:*

- Enhance coding skills by exploring advanced programming concepts.
- Apply advanced coding blocks, including loops, conditionals, and events.

Success Criteria:

- Create programs with loops, conditionals, and events within the Sphero Edu app.
- Collaborate in coding challenges, demonstrating problem-solving and creativity.

Week 5: Sphero Bolts and Problem-Solving Projects *Learning Intentions:*

- Apply coding skills to solve real-world problems using Sphero Bolts.
- Collaborate in team-based projects: Navigating a Maze and Creating a Two-Bolt Synchronous Dance.

Success Criteria:

- Successfully program Sphero Bolts to navigate through a maze, demonstrating precision and problem-solving.
- Collaborate effectively in creating a synchronized dance routine using two Sphero Bolts.

Week 6: Sphero Bolts Mini-Project and Showcase *Learning Intentions:*

- Apply all learned concepts in a culminating mini-project.
- Present and showcase independent or small-group projects to the class.

Success Criteria:

- Independently or collaboratively design and implement a creative application of Sphero Bolts.

- Effectively present and articulate the mini-project, demonstrating a comprehensive understanding of Sphero Bolts fundamentals.

Formative Assessments:

1. **Energy Breakthrough Quiz:**
    - A brief quiz assessing students' knowledge of the Energy Breakthrough competition rules and objectives.
2. **Design Thinking Reflection:**
    - A reflective exercise where students share insights gained during the design thinking process, highlighting creativity and problem-solving skills.
3. **Materials and Tools Identification Task:**
    - Students categorize and explain the uses of various materials and tools commonly used in construction for the Pushcart Challenge.
4. **Prototyping Workshop Checkpoints:**
    - Regular check-ins during the prototyping phase to assess the development of small-scale pushcart prototypes, providing feedback for improvement.
5. **Team Collaboration Observation:**
    - An observational assessment focusing on teamwork and effective communication during group activities, emphasizing collaboration skills.
6. **Coding and Robotics Mini-Project:**
    - A small coding project using Sphero Bolt robots to assess students' understanding of coding principles, debugging, and problem-solving.
7. **Design Drawing Peer Review:**
    - Students exchange and review design drawings, offering constructive feedback on the feasibility and creativity of their peers' pushcart designs.

Summative Assessments:

1. **Pushcart Construction and Presentation:**
    - Assessment of the final pushcart construction, considering adherence to design plans, use of materials, and overall presentation.
2. **Energy Breakthrough Competition Reflection:**
    - A written reflection where students analyze their experiences in the competition, discussing challenges faced, lessons learned, and areas of improvement.
3. **Forces and Principles Exam:**
    - An exam assessing students' understanding of fundamental forces (e.g., push, pull) and their application in the construction of pushcarts.
4. **Coding and Robotics Challenge:**
    - A comprehensive assessment of students' coding skills and problem-solving abilities through a more complex Sphero Bolt robotics challenge.
5. **Design Thinking Portfolio:**
    - A portfolio showcasing the evolution of design thinking throughout the unit, including brainstorming notes, rough sketches, and final design plans.
6. **Teamwork Evaluation:**

- A peer and self-assessment tool where students reflect on their contributions to teamwork, communication, and collaboration during the entire unit.

7. **Physical Fitness Preparedness Assessment:**
    - An assessment of students' physical fitness levels, including their performance in warm-up exercises and endurance training, evaluating their preparedness for the Energy Breakthrough competition.

Lesson Plans: Pushcarts Challenge

Lesson Plan: Understanding Energy Breakthrough

Objective: Gain a comprehensive understanding of the Energy Breakthrough competition.

Introduction and Discussion (20 minutes):

1. Introduction to Energy Breakthrough (10 minutes)
    - Briefly introduce the Energy Breakthrough competition, emphasizing its significance.
2. Discussion on Rules and Objectives (10 minutes)
    - Explore the specific rules governing the Energy Breakthrough competition.
    - Discuss the primary objectives of the competition.

Activity: Team-Based Creativity (40 minutes): 3. Team-Based Activity (30 minutes)

- Engage students in team-based activities that require creativity.
- Emphasize the integral role of creativity in a competitive setting.

4. Peer Collaboration (10 minutes)
    - Facilitate a discussion on effective collaboration within teams.
    - Encourage students to articulate and share their creative ideas.

Reflection (15 minutes): 5. Reflection on Learning Intentions (15 minutes)

- Ask students to reflect on their understanding of Energy Breakthrough rules and objectives.
- Discuss the importance of creativity and teamwork in a competitive environment.

Homework: 6. Research Assignment (20 minutes)

- Assign a research task to deepen students' knowledge of Energy Breakthrough history and past innovative designs.

Lesson Plan: Forces and Principles

Objective: Explore and comprehend fundamental forces and apply them to pushcart construction.

Introduction to Forces (20 minutes):

1. Introduction to Fundamental Forces (10 minutes)
    - Explore and define fundamental forces such as push and pull through practical examples.
2. Discussion on Forces and Pushcart Construction (10 minutes)
    - Discuss how fundamental forces impact the construction and functionality of pushcarts.
    - Introduce the relationship between forces and engineering principles in pushcart design.

Hands-on Activity: Applying Forces (45 minutes): 3. Applying Forces to Design (30 minutes)

- Guide students in applying the principles of push and pull to design considerations in pushcart construction.

4. Evaluation and Explanation (15 minutes)
    - Have students evaluate and explain the relationship between fundamental forces and engineering principles in their pushcart designs.

Reflection (15 minutes): 5. Reflective Discussion (15 minutes)

- Facilitate a discussion on the application of forces in design.
- Discuss any challenges faced and lessons learned.

Homework: 6. Design Analysis (20 minutes)

- Assign a homework task where students analyze a real-world object's design, considering fundamental forces.

Lesson Plan: Design Thinking

Objective: Engage in the design thinking process and translate creative ideas into practical design plans.

Introduction to Design Thinking (20 minutes):

1. Overview of Design Thinking (10 minutes)
    - Introduce the design thinking process, emphasizing its stages.
2. Brainstorming Session (10 minutes)
    - Actively engage students in a brainstorming session to generate innovative ideas for pushcart design.

Hands-on Activity: Sketching and Planning (40 minutes): 3. Rough Sketches (20 minutes)

- Guide students in creating rough sketches that visually represent conceptualized ideas for pushcart design.

4. Detailed Design Drawings (20 minutes)
    - Instruct students on how to translate rough sketches into detailed and feasible design plans.

Justification and Critique (20 minutes): 5. Design Justification (10 minutes)

- Discuss the importance of justifying design decisions based on practical considerations and engineering feasibility.

6. Peer Critique (10 minutes)
    - Facilitate a session where students critique each other's design plans, providing constructive feedback.

Homework: 7. Justification Write-Up (20 minutes)

- Assign a homework task where students justify specific design decisions made in their plans.

Lesson Plan: Materials, Tools, and Safety

Objective: Identify and utilize materials and tools for pushcart construction while emphasizing safety guidelines.

Introduction to Materials and Tools (20 minutes):

1. Materials Identification (10 minutes)
    - Introduce various materials commonly used in pushcart construction.
2. Tools Overview (10 minutes)
    - Provide an overview of tools applicable to pushcart construction.

Hands-on Activity: Tool Exploration (45 minutes): 3. Tool Exploration (30 minutes)

- Allow students to explore and practice using selected tools for construction purposes.

4. Safety Guidelines (15 minutes)
    - Emphasize safety guidelines for the responsible use of materials and tools during construction.

Application and Discussion (20 minutes): 5. Practical Application (10 minutes)

- Have students apply the identified materials and tools to a small construction task.

6. Group Discussion (10 minutes)

- Facilitate a discussion on the importance of safety in the handling and manipulation of construction materials and tools.

Homework: 7. Safety Quiz (20 minutes)

- Assign a safety quiz to ensure understanding and adherence to safety guidelines.

Lesson Plan: Prototyping and Construction

Objective: Develop small-scale prototypes of pushcart designs and apply principles to construct pushcarts.

Introduction to Prototyping (20 minutes):

1. Prototyping Overview (10 minutes)
    - Introduce the concept of prototyping and its importance in the design process.
2. Small-Scale Prototypes (10 minutes)
    - Discuss the purpose of creating small-scale prototypes for testing and evaluation.

Hands-on Activity: Prototyping Session (45 minutes): 3. Small-Scale Prototype Construction (30 minutes)

- Guide students in constructing small-scale prototypes of their pushcart designs.

4. Evaluation and Iteration (15 minutes)
    - Instruct students to evaluate and iterate on their prototypes to improve functionality and address design considerations.

Construction Phase (20 minutes): 5. Construction Principles (10 minutes)

- Apply learned principles to construct pushcarts that align with design plans.

6. Collaboration in Construction (10 minutes)
    - Emphasize the importance of collaboration with team members to ensure cohesive and efficient construction processes.

Reflection (15 minutes): 7. Reflective Discussion (15 minutes)

- Facilitate a discussion on the construction process, focusing on successes and areas for improvement.

Homework: 8. Construction Journal (20 minutes)

- Assign a homework task where students maintain a construction journal, documenting challenges faced and solutions implemented.

Lesson Plan: Physical Fitness Integration

Objective: Recognize the importance of physical fitness in the Energy Breakthrough competition and integrate fitness activities.

Introduction to Physical Fitness (20 minutes):

1. Significance of Physical Fitness (10 minutes)
    - Discuss the importance of physical fitness in enhancing overall performance in the Energy Breakthrough competition.
2. Correlation with Performance (10 minutes)
    - Explore the correlation between physical well-being and successful participation in competitive events.

Hands-on Fitness Activities (45 minutes): 3. Warm-Up Exercises (20 minutes)

- Engage students in designated warm-up exercises to enhance endurance and preparedness.

4. Endurance Training (25 minutes)
    - Incorporate endurance training activities to prepare students for the physical demands of the Energy Breakthrough challenge.

Application and Reflection (20 minutes): 5. Fitness in Action (10 minutes)

- Connect physical fitness activities to the practical demands of the Energy Breakthrough competition.

6. Reflection on Physical Fitness (10 minutes)
    - Facilitate a reflective discussion on how physical fitness contributes to meeting the challenges of the Energy Breakthrough challenge.

Homework: 7. Personal Fitness Goals (20 minutes)

- Assign a homework task where students set personal fitness goals aligned with the Energy Breakthrough requirements.

Lesson Plans: Robotics

Lesson Plan: Week 1 - Introduction to Sphero Bolts

Objective: Understand the basic features and capabilities of Sphero Bolts.

Introduction (15 minutes):

1. Welcome and Introduction to Sphero Bolts (5 minutes)
    - Briefly introduce Sphero Bolts and its components.
    - Highlight the key features and capabilities.
2. Hands-on Exploration (30 minutes)
    - Distribute Sphero Bolts to students.
    - Guided exploration: students use the Sphero Edu app to drive the Sphero Bolts.
    - Encourage experimentation with basic controls and movements.

Discussion and Reflection (15 minutes): 3. Group Discussion (10 minutes)

- Facilitate a discussion on students' experiences with Sphero Bolts.
- Encourage questions and observations.

4. Potential Applications (5 minutes)
    - Discuss potential applications of Sphero Bolts in various fields (education, robotics, entertainment).

Homework: 5. Reflection (15 minutes)

- Reflect on the introduction to Sphero Bolts.
- Write a short paragraph on potential applications discussed in class.

Lesson Plan: Week 2 - Coding Basics with Sphero Edu App

Objective: Develop foundational coding skills using the Sphero Edu app.

Review (15 minutes):

1. Recap of Sphero Bolts Features (10 minutes)
    - Quick review of the key features and controls of Sphero Bolts.

Coding Basics (40 minutes): 2. Introduction to Sphero Edu App (10 minutes)

- Overview of the Sphero Edu app interface and key components.

3. Hands-on Coding (30 minutes)
    - Guided exercises: students create simple programs to control Sphero Bolts' movement.
    - Emphasize the use of basic coding blocks.

Homework: 4. Coding Challenges (15 minutes)

- Assign coding challenges using the Sphero Edu app for homework.
- Encourage creativity and exploration in coding.

Lesson Plan: Week 3 - Exploring Sensors and Lights

Objective: Understand the sensors and lighting features of Sphero Bolts.

Review and Introduction (15 minutes):

1. Recap of Coding Basics (10 minutes)
    - Quick review of basic coding concepts from the previous lesson.
2. Sensors Exploration (30 minutes)
    - Introduction to Sphero Bolts' sensors (gyroscope, accelerometer).
    - Hands-on activity: students program Sphero Bolts to respond to sensor inputs.

Creative Activities (30 minutes): 3. LED Lights Exploration (15 minutes)

- Explore the use of LED lights on Sphero Bolts.
- Students create visual effects using LED lights in their programs.

Homework: 4. Sensor Response Program (15 minutes)

- Assign a homework task: program Sphero Bolts to respond creatively to sensor inputs.

Lesson Plan: Week 4 - Advanced Coding Techniques

Objective: Enhance coding skills and explore advanced programming concepts.

Review and Introduction (15 minutes):

1. Recap of Sensor Exploration (10 minutes)
    - Brief review of the previous lesson's sensor activities.

Advanced Coding Blocks (40 minutes): 2. Introduction to Advanced Blocks (15 minutes)

- Introduce more advanced coding blocks within the Sphero Edu app.

3. Hands-on Activities (25 minutes)
    - Guided activities: students create programs with loops, conditionals, and events.
    - Collaborative coding challenges to encourage problem-solving and creativity.

Homework: 4. Advanced Coding Challenge (15 minutes)

- Assign an advanced coding challenge as homework.
- Encourage students to explore the new coding concepts introduced.

Lesson Plan: Week 5 - Sphero Bolts and Problem-Solving Projects

Objective: Apply coding skills to solve real-world problems using Sphero Bolts.

Introduction and Discussion (20 minutes):

1. Discussion on Problem-Solving (15 minutes)
    - Discuss the role of robotics, specifically Sphero Bolts, in real-world problem-solving.

Team-Based Projects (60 minutes): 2. Project 1: Navigating a Maze (30 minutes)

- Team-based activity: students program Sphero Bolts to navigate through a maze.
- Emphasize precision and problem-solving.

3. Project 2: Two-Bolt Synchronous Dance (30 minutes)
    - Collaborative project: students create a synchronized dance routine using two Sphero Bolts.

Homework: 4. Project Reflection (15 minutes)

- Assign a reflection on the problem-solving process in both projects.

Lesson Plan: Week 6 - Sphero Bolts Mini-Project and Showcase

Objective: Apply all learned concepts in a culminating mini-project.

Introduction and Mini-Project (60 minutes):

1. Overview of Mini-Project (15 minutes)
    - Introduce the mini-project: students design and implement a creative application of Sphero Bolts.

2. Mini-Project Work Session (30 minutes)
    - Independent or small-group work on the mini-project.
3. Mini-Project Showcase Preparation (15 minutes)
    - Discuss guidelines for presenting and showcasing the mini-projects.

Mini-Project Showcase (45 minutes): 4. Mini-Project Presentations (30 minutes)

- Students present their mini-projects to the class.

Reflection and Conclusion (15 minutes): 5. Reflection and Future Applications (15 minutes)

- Reflect on the overall learning journey.
- Discuss potential future applications of Sphero Bolts and robotics.

Homework: 6. Final Reflection (15 minutes)

- Assign a final reflection on the entire Sphero Bolts Fundamentals unit.

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Assessment Rubric: Sphero Bolt Maze Challenge

Navigation Skills (10 points):	*Exceptional (10 points):* The Sphero Bolt successfully navigates the maze with precision, avoiding obstacles and taking efficient paths.	*Proficient (7 points):* The Sphero Bolt navigates the maze well but may encounter minor challenges in avoiding obstacles.	*Basic (4 points):* The Sphero Bolt faces difficulties navigating the maze, encountering obstacles, and taking less optimal paths.	*Limited (1 point):* The Sphero Bolt struggles significantly in navigating the maze, frequently colliding with obstacles.
Problem-Solving (8 points):	*Exceptional (8 points):* The student effectively troubleshoots and adjusts the Sphero's path when faced with challenges, showcasing innovative problem-solving skills.	*Proficient (6 points):* The student demonstrates good problem-solving abilities, making adjustments to the Sphero's path when necessary.	*Basic (4 points):* The student struggles to address challenges effectively, requiring assistance in resolving issues.	*Limited (1 point):* The student faces significant challenges in problem-solving, requiring constant support.
Coding Proficiency (12 points):	*Exceptional (12 points):* The student utilizes advanced coding commands to program the Sphero Bolt, demonstrating a deep understanding of coding concepts.	*Proficient (9 points):* The student effectively employs basic and intermediate coding commands to control the Sphero Bolt.	*Basic (6 points):* The student struggles with coding, utilizing only basic commands and facing difficulties in creating a functional program.	*Limited (2 points):* The student has significant challenges in coding, requiring substantial assistance to create a basic program.

Total Points: 30

Note: This rubric is designed to assess students' skills in navigating the Sphero Bolt through a maze challenge, considering their problem-solving abilities, and coding proficiency.

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Sphero Bolt Dance Routine

Choreography (10 points):	*Excellent (10 points):* The dance routine demonstrates a clear and simple choreography that is well-coordinated between the two Sphero Bolts.	*Satisfactory (7 points):* The choreography is basic but lacks some coordination between the Sphero Bolts.	*Limited (3 points):* The choreography is minimal, and there are noticeable challenges in coordinating the movements.
Programming Proficiency (8 points):	*Effective (8 points):* Basic coding commands are used to program the Sphero Bolts for a simple and engaging dance routine.	*Adequate (5 points):* The programming is basic, but there may be some issues in the execution of the routine.	*Limited (2 points):* The programming is rudimentary, and the dance routine lacks smooth transitions.
Creativity (7 points):	*Innovative (7 points):* The dance routine includes some creative elements, adding interest to the performance.	*Basic (5 points):* The routine is somewhat creative, but there is room for additional elements.	*Limited (2 points):* Little creativity is evident in the dance routine.
Technical Execution (5 points):	*Precise (5 points):* The dance routine is executed with basic precision, and the Sphero Bolts move smoothly.	*Adequate (3 points):* Technical execution is inconsistent, with occasional errors impacting the performance.	*Limited (1 point):* Technical execution is challenging, and errors significantly detract from the routine.

Total Points: 30

Note: This rubric is designed for a basic and simple assessment of a Sphero Bolt dance routine. It considers choreography, programming proficiency, creativity, and technical execution.