An AACPS Guide to

Sphero indi

INTEGRATING CODING INTO OUR CLASSROOMS

Resources from the AACPS Office of Instructional Technology

AACPS Office of Instructional Technology
2671 Carver Road, Gambrills, MD 21054
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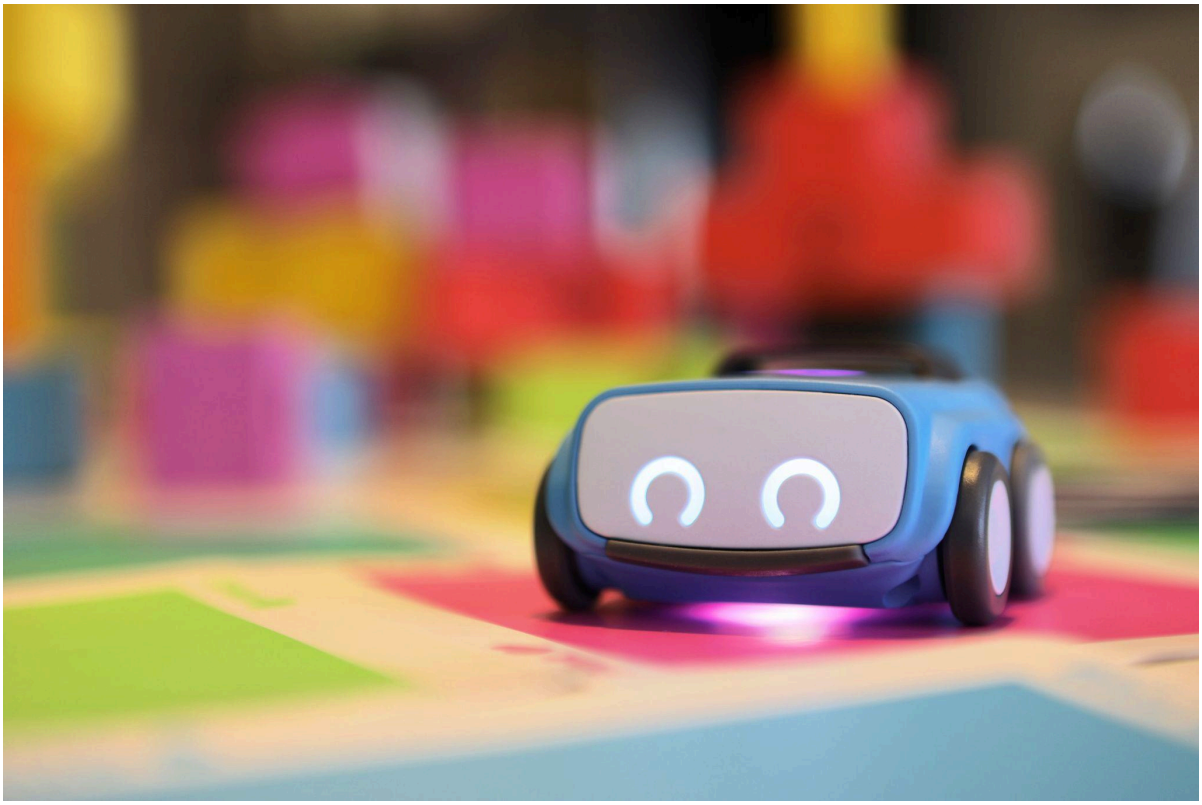
10 Reasons You Should Use indi in the Classroom

The idea of coding, learning one more thing, or figuring out how to incorporate a new tool into your classroom can be intimidating. So why should you integrate Sphero indi into your classroom instruction?

1. Students become better problem solvers and thinkers as they develop their computational thinking skills (decomposition, pattern recognition, abstraction, algorithms).
2. Reading is not required with indi. He relies on visuals so students on any reading level can participate in the activities.
3. Easily differentiated! Use the Sphero EDU Jr app for students ready for a challenge. Have them reprogram the color tiles to do different things. Or, use the provided challenge card template to create challenges based on the needs of your students.
4. Students quickly and easily grasp how indi works; place him on a colored tile, and he will complete a specific and expected action. They can be actively coding with little instruction.
5. Supports and encourages collaboration and teamwork with classmates.
6. Supports the development of basic language concepts such as colors, temporal cues, and positional cues.
7. Helps develop fine motor skills.
8. Can be used in a variety of scenarios- whole group, small group, and independent centers.
9. Screen free coding; no device needed.
10. He's cute!

Getting Started with Sphero indi



What to Know

What's included:

In the Fall of 2023, every elementary school and special center received one class pack of Sphero indi robots. The class pack consists of everything a teacher needs to incorporate indi into instruction and includes:

- 8 indi robots
- 8 student cases
- 1 charging case to charge and store 8 indi robots
- 1 educator guide book
- 1 classroom tote
- 160 durable, latex-free rubber color tiles
    - 20 per student case including:
        - 2 red tiles
        - 3 orange tiles
        - 2 yellow tiles
        - 3 green tiles
        - 3 teal tiles
        - 3 blue tiles
        - 3 pink tiles
        - 1 purple tile

- 8 sets of 15 Beginner's Programming Challenge Cards (1 set per student case)
- 2 sets of 30 replacement color cards with adhesive tape sheets
- 8 sets of 2 decorative sticker sheets for students to customize indi (1 set per student case)
- 8 charging cables

How should indi be used in school?

Sphero indi can be used by individual teachers in their classrooms, by the cultural arts teachers with all grade levels, and/or as an after-school club activity. Indi also makes a great activity for early childhood teaching assistants to utilize with students.

Access to indi

The class pack was purchased so that ALL teachers and students have access to learning fundamentals of computational thinking and coding. The materials should be stored in a location where all classroom teachers have access to them. It is recommended that a check-out system be designed to keep track of the robots and corresponding materials. Each school should decide if the robots must be checked out as an entire group or if individual cases can be checked out for small group or center activities.

Lesson Ideas and Supplemental Resources

It is recommended that teachers utilize the Sphero indi Educator Guide Book and the challenge cards included in the class pack to introduce indi and how he works to students. Additional lesson ideas and supplemental resources can be found later in this AACPS resource book, the Sphero website (www.sphero.com) and the AACPS Office of Instructional Technology's Creative Coding with Robots website. (https://sites.google.com/aacps.org/creative-coding-with-robots/home)

Help & Resources

You can find support for indi on Sphero's site at: sphero.com/pages/sphero-indi. You can also visit the AACPS Creative Coding with Robots website for ideas and resources. The website can be found at https://sites.google.com/aacps.org/creative-coding-with-robots/home, or on Classlink in the orange Instructional Technology Folder. QR codes to these and other helpful resources can be found in the back of this guide.

Tips & Tricks for using indi with Students

- Encourage students to collaborate as a team to complete the challenges or activities. To facilitate working in groups, consider assigning roles or jobs to students. A slide deck of these jobs is available in the resource section of this guide and on the AACPS OIT Creative Coding with Robots website under Teacher Resources> indi. (https://sites.google.com/aacps.org/creative-coding-with-robots/teacher-resources/indi-resources)
    - **Coding Captain**- Makes sure all team members are working together and keeps the team organized. Listens to everyone and keeps the members motivated.
    - **Programmer-** Places the tiles based on the challenge and team's solution ideas.
    - **Robot Wrangler**- Places indi on the starting tile when it's time to test the team's solution. Brings indi back if he goes off the path
    - **Recorder-** Records the team's ideas and solutions. Takes notes, photos, and/or videos of the group working together and of indi following the path.
- If students are having difficulty lining up the tiles correctly for the challenges, create an 8x8 grid for them to use. This can be created on bulletin board or butcher paper so it can be reused, or by laying down blue painter's tape on the floor.
- Be aware of the texture and color of the surface indi is traveling on. Thick carpeting and bright colored floor tiles can impede indi's movement. You may want to test the surface before student use.
- For younger students, or for those that are easily overwhelmed, provide only the color tiles required for the challenge.
- For students struggling with the task or challenge card, consider giving them one of the challenge cards labeled 1, 2, or 15. These give visual cues on the angles and directions for each color tile.
- Provide planning sheets for students to map out their ideas for solving the challenges or for creating their own challenges. A paper version is located in the supplemental resource portion of this guide. Templates that allow students to complete the planning sheet digitally are available on the AACPS OIT Creative Coding with Robots website under teacher resources> indi. (https://sites.google.com/aacps.org/creative-coding-with-robots/teacher-resources/indi-resources)
- For students who are struggling, encourage them to break the challenge into smaller chunks and test these smaller chunks rather than tackling the entire path at once.
- Have students reflect on their successes and challenges when coding indi either orally or in writing. Not only should this include the actual code they created, but also a reflection on working as a team and their thought processes. A list of reflection questions and a reflection sheet are located in the supplemental resource portion of this guide. Templates that allow students to reflect in a digital format are available on the AACPS OIT Creative Coding with Robots website under Teacher Resources> indi. (https://sites.google.com/aacps.org/creative-coding-with-robots/teacher-resources/indi-resources)

Meeting Standards with indi

Incorporating Sphero indi into instruction allows teachers to meet multiple national, state, and local standards including the Maryland Digital Learning standards, Maryland's Computer Science standards, and content specific standards such as Common Core and the Next Generation Science Standards. Let's look at each one of these more closely.

Maryland Digital Learning Standards

When integrating technology into the classroom, teachers should refer to the Maryland Digital Learning Standards (https://marylandpublicschools.org/programs/Documents/ITSLM/Maryland_Digital_Learning_Standards_for_Students.pdf). Adopted in 2022, the standards focus on critical thinking, creativity, collaboration, communication, information literacy, media literacy, technology literacy, and flexibility. They provide a framework for effective technology integration in classrooms that empowers students and ensures that they are college and career-ready, while being responsible digital citizens.

The standards are divided into seven domains:

1. Empowered Learner
2. Digital Citizen
3. Knowledge Constructor
4. Innovative Designer
5. Computational Thinker
6. Creative Communicator
7. Global Collaborator

Coding with indi meets several of the indicators under the various domains including:

- 1.d: Understand the fundamental concepts of technology operations, demonstrate the ability to choose, use and troubleshoot current technologies and are able to transfer their knowledge to explore emerging technologies.
- 2.b: Engage in positive, safe, legal, and ethical behavior when using technology and during online social interactions.
- 3.d: Build knowledge by actively exploring real-world issues and problems, developing ideas and theories, and pursuing answers and solutions.
- 4.a: Know and use a design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.
- 4.c: Develop, test, and refine prototypes (models) as part of a cyclical design process.
- 5.c: Break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.
- 6.c: Communicate complex ideas clearly and effectively by creating or using a variety of digital content such as visualizations, models, or simulations.
- 7.c: Contribute constructively to project teams, assuming various roles and responsibilities to work effectively towards a common goal.

Maryland Computer Science Standards

Adopted in 2018, the Maryland Computer Science standards provide a framework for teaching computer science starting in kindergarten and continuing through high school. As part of Maryland's 15-year computing education goals, and to ensure access to computer science education for all students, school systems are required to make every effort to incorporate CS instruction in each public elementary and middle school.

Coding with indi addresses the indicators found under Maryland's Algorithms and Programming concept. For simplicity's sake, the lessons in this guide reference the overarching national CSTA standards for algorithms and programming (https://www.csteachers.org/Page/standards). For the specific grade level indicator, please refer to the Maryland Computer Science Standards document.
https://marylandpublicschools.org/programs/Documents/CTE/K-12StandardsLandscape.pdf.

Content Specific Standards

Integrating indi into English language arts, math, science, social studies, etc allows teachers to address digital learning standards and computer science standards within the context of their usual content area. Lessons involving sequencing of events, cycles, measurement, and geometry particularly lend themselves to coding paths for indi. The lessons and lesson sparks in this guide provide examples of how indi can be effectively used to teach content specific concepts to students in pre-kindergarten through fifth grade.

The Importance of Computational Thinking

You may never have heard of computational thinking, but as we go about our daily lives solving problems we are using computational thinking skills. Computational thinking is the process of breaking complex problems down into parts, recognizing patterns, and devising a solution. It has four pillars or processes:

Decomposition	Pattern Recognition	Abstraction	Algorithms
Breaking a complex problem into small parts	Identifying patterns and similar ideas in the world to help understand a problem.	The process of identifying and focusing on the important details and ignoring irrelevant details.	Developing and/or following sequential steps or rules to solve a problem.

While computational thinking is most associated with computer science, it is found throughout the content areas and everyday tasks.

	Decomposition	Pattern Recognition	Abstraction	Algorithms
Math	Understanding place value. Breaking down three dimensional shapes into nets.	Sorting shapes by a commonality. Learning to skip count.	Solving for an unknown in an equation. Solving word problems.	Solving an addition problem using the traditional regrouping method. Solving for area, volume, and perimeter.
ELA	Breaking a story down into the setting, characters, problem, and solution. Analyzing text structure.	Identifying patterns in spelling words. Using prefixes, suffixes, and/or base words to understand unknown words.	Identifying the main idea and details of a story. Summarizing a story in 6 words.	Writing a How-to/procedural informational paper. Deciding when to use different types of ending punctuation.
Science	Identifying the parts of a plant and their job. Identifying the components of a food web.	Learning the pattern of day and night and what is visible in the sky. Using weather patterns to decide what to wear for certain weather conditions.	Formulating a hypothesis based on what is known.	Following steps to complete a science lab. Creating different types of circuits.

Social Studies	Understanding the relationships between continents, countries, states, towns, etc.	Identifying commonalities between areas people have settled in to predict migration. The causes & effects of wars.	Identifying wants and needs when talking about goods and services.	Creating a flow map to understand how settlers migrated across the country.
Everyday Life	Planning a budget with different categories. Breaking a large task into smaller to-do items.	Building a lego set that requires a part to be built multiple times.	Making a list of things to buy at the store. Packing for a vacation to a specific location.	Following a recipe. Tying your shoes or brushing your teeth.

By purposefully incorporating computational thinking in our instruction, we improve students' capacity to learn and problem solve in school and life. Coding is one area in which we can engage students with the four pillars in a meaningful, concrete way that provides real world context. Sphero's indi provides accessible coding activities that are flexible based on teacher schedules and their content areas.

Frequently Asked Questions about indi

Working with indi

What does indi do?

Sphero indi is a codable robot; students place color tiles on the ground to code a path for indi to travel.

How does indi work?

Color sensors on the bottom of indi “read” the colors of the tiles. This then tells indi what action to complete.

Do I need a device to code indi?

No device is needed to code indi. He will work out of the box with his preprogrammed color recognition. A device is only needed if you or your students wish to change the defaults.

What do we need to code with indi?

You will need indi and a set of the silicon or paper tiles that are provided in the kit. Other optional materials would be a grid, painter’s tape to create a grid the floor, or materials to make obstacles.

How far apart should the tiles be placed?

Tiles can be placed edge to edge or at a distance. Indi will stop rolling after 3 seconds if he does not detect another color tile. Many of the introductory lessons in the Sphero indi Educator Guide are based around students exploring how far apart they can place the tiles.

How long will indi roll before stopping?

If another color tile is not detected, indi will stop rolling after 3 seconds.

How much space will students need to code indi?

For general activities using the challenge cards, a space approximately 5’ by 5’ will give students enough space to work through the card. For lessons in the Sphero Educator guide, space guidelines are provided. However, we’ve seen students code with indi in much smaller spaces- including on tables!

If I have more than one indi, can they interact with one another?

No, each indi works independently and will not interact with another indi.

What is the Sphero EDU Jr app?

By default, indi is programmed to do specific actions for each color tile included in the kit. However, students can change these actions using the Sphero EDU Jr app. Any changes can be easily reset to the defaults by pressing indi's power button for 3 seconds.

My students used the Sphero EDU jr app to reprogram indi. How do I reset him?

To reset indi after using the Sphero EDU Jr app, press and hold indi's power button for 3 seconds.

Can indi be coded using any other Sphero apps or Sphero's website?

No. Sphero indi can only be coded using the colored tiles. If students want to change the actions associated with each colored tile, they must use the Sphero EDU Jr. app.

Maintenance & Charging

How do I charge indi?

If you need to charge a single indi, use his included USB Micro B cable. Plug the other end into a USB port or wall adapter. If you are charging a class pack, make sure each indi is inserted into the case fully and the metal charging pieces are clean. Then, plug the power cord into an outlet.

How long does it take indi to charge?

It takes approximately 2 hours for indi to fully charge.

How do I know when indi is done charging?

You will know indi is fully charged when his eyes are no longer lit up.

How long will indi last on a full charge?

Sphero indi lasts approximately 7 hours on a full charge.

How should we store indi?

Sphero indi should be stored in his case or in the class pack container. For long term storage, make sure the charging case is unplugged. The color tiles (both silicon and paper) should be kept out of direct sunlight as extended exposure can cause the colors to fade, resulting in indi being unable to correctly sense each color.

How can I clean indi?

Lightly spray a clean cloth with a disinfectant and wipe clean.

How can I clean the silicone tiles?

The silicone tiles can be wiped clean using a clean cloth and disinfectant. They can also be washed in a washing machine or dishwasher on the gentle cycle. DO NOT put the tiles in the dryer.

Classroom Management

How should students work with indi? Whole group? Small group? Individually?

Like any other lesson, what will work best depends on a number of factors including the content being covered, the nature of the class, and the amount of space available.

What suggestions do you have for managing groups working with an indi?

When working in small groups (3 to 4 students works well), we recommend assigning roles or jobs to each of the students. Make sure each group has enough space to work; how much Documenwill depend on the lesson. If you have multiple robots, distinguish them from one another using the stickers provided in the kit or by labeling each robot with a different color dot or name.

Resources

Where can I go for help?

You can find support for indi on Sphero's site at: sphero.com/pages/sphero-indi. You can also visit the AACPS Creative Coding with Robots website for ideas and resources: (https://sites.google.com/aacps.org/creative-coding-with-robots/teacher-resources/indi-resources).

Where can I go for lesson ideas?

Lesson ideas can be found in multiple places including the Sphero indi Educator guide and the AACPS Creative Coding with Robots website. Additional lesson plans can also be found in the lesson plan section of this guide. Social media platforms such as Twitter, Pinterest, and Facebook often have lesson ideas from teachers utilizing coding and robots in their classrooms.

Can I purchase more tiles?

Additional sets of tiles can be purchased from Sphero's website.

Is training available?

Yes! Contact your OIT Teacher Specialist to arrange training.

Lesson Plans & Reflection Questions

These optional lesson plans and ideas have been written by the AACPS Office of Instructional Technology.

Design an Obstacle Course

Overview

Sphero indi needs some exercise! Design a fun obstacle course for him to complete using materials found in the classroom.

Objectives

- I can help indi turn and move through the classroom.
- I can use positional words to explain the relationship between two objects.

Vocabulary

- Positional word- a word or phrase that describes the position of people or objects.

CS Practices

- **1A-AP-09:** Model the way programs store and manipulate data by using numbers or other symbols to represent information.
- **1A-AP-12:** Develop plans that describe a program's sequence of events, goals, and expected outcomes.
- **1A-AP-15:** Using correct terminology, describe steps taken and choices made during the iterative process of program development.

Content Connections

- **L.PK.1.e** Gain exposure to the most frequently occurring prepositions.
- **L.K.1.e** Use the most frequently occurring prepositions.
- **L.1.1.i** Use frequently occurring prepositions

Color Tiles Needed

All 20 color tiles (Red x2, Orange x3, Yellow x2, Green x3, Teal x3, Blue x3, Purple x1, Pink x3)

Additional Supplies

- Building materials such as Legos, Duplos, cardboard, pattern blocks, unifix cubes, etc.
- Reflection journal (optional)
- Masking tape or blue tape

Preparation

- Each student kit needs to have a charged indi robot and the above color tiles.
- Prepare a space on the board to discuss positional words that describe how things relate to one another (under, over, around, through, past).

- Designate boundaries or zones for each group to work within.

Engage

- Place indi on a chair or desk. Ask students to explain where indi is located in relation to the object. For example, indi is on the chair.
- Record the sentence on the board and have students identify the word that tells where indi is located.
- Repeat this several times using scenarios where indi is above, below, under, around, etc. different objects in the room.
- Once students have a firm understanding of positional words, explain that now indi is going to travel a path that includes an obstacle.
- Place a chair in the middle of the floor. Taking suggestions from the class, lay tiles down so that indi will travel around or under the chair.
- Place indi on the green tile; after he travels the path ask students where indi went in relation to the chair. Example: He went under the chair. He went around the chair.

Explore

- Now students will have the opportunity to build their own obstacle course for indi to navigate in groups. They must have at least four places where they can describe how indi relates to elements of the obstacle course. (He went around the chair, between the books, etc).
- Divide students into groups and assign jobs within the group.
- Have each group build a course using the materials provided for them.
- Have students place the color tiles so that indi will travel through the course.
- As indi goes from tile to tile, students verbally describe how indi relates to the objects in the course using positional words.

Closure

- As a class, compose a list of sentences describing where their robots traveled that include positional words.
- Discuss and reflect on their obstacle course and process. Suggested reflection questions:
    - If you exchanged this tile for this one, where would indi go?
    - How did you break the challenge down to make it easier?
    - What did you do in this activity that you are most proud of?

Modifications/Extensions

- Use blue tape to outline a path that indi must follow. Students then have to build their course utilizing the given path.
- Specify starting and ending points for each group using tape, dots, etc.
- Have students write sentences retelling the path their indi traveled. In each sentence have them circle or highlight the positional word.

Making Words

Overview

Sphero indi is learning how to make words. Create a path for indi to follow that will connect letters and letter sounds to create words.

Objectives

- I can demonstrate an understanding of sounds.
- I can orally produce single-syllable words by blending sounds.
- I can spell words using what I know about sound-letter relationships.

CS Practices

- **1A-AP-09:** Model the way programs store and manipulate data by using numbers or other symbols to represent information.
- **1A-AP-12:** Develop plans that describe a program's sequence of events, goals, and expected outcomes.
- **1A-AP-15:** Using correct terminology, describe steps taken and choices made during the iterative process of program development.

Content Connections

- **L.K.2.d:** Spell simple words phonetically, drawing on knowledge of sound-letter relationships.
- **L.1.2.d:** Use conventional spelling for words with common spelling patterns and for frequently occurring irregular words.
- **L.2.2.d:** Generalize learned spelling patterns when writing words.

Color Tiles Needed

All 20 color tiles (Red x2, Orange x3, Yellow x2, Green x3, Teal x3, Blue x3, Purple x1, Pink x3)

Additional Supplies

- A set of letter flash cards for each group based on the word family you will be working with.
- Word recording sheet (digital or printed)

Preparation

- Select a word family that you have been working on in class. For example: -at, -ate, -an, -ing.
- Prepare letter cards for each group that will allow them to spell multiple words within the word family.
- Each student kit needs to have a charged indi robot and the above color tiles.
- Prepare a space on the board to brainstorm common words within the word family.
- Designate boundaries or zones for each group to work within.

Engage

- Begin by displaying a series of images on the board that are all from one word family (cat, hat, sat, bat, etc).
- As students identify each object, write the word under the image. What do they all have in common?
- Identify the word family and/or spelling pattern. Brainstorm other words that use the same word family and/or spelling pattern.
- Explain that now we are going to teach indi how to spell one of the words on the board. Select one of the words from the board and place the corresponding letter cards on the floor. Depending on your class, this can be in the correct order in a straight line, or jumbled in a random pattern.
- As a class, work together to place indi's color tiles by each letter so that he will go from the first letter in the word to the last in the correct order.

Explore

- Explain that indi loves spelling, and wants to learn more words.
- Divide students into groups and assign jobs within the group. Provide each group with their own set of letter cards.
- Direct students to place their cards within their work space. How many words can they build with their letters?
- Students "teach" indi to spell each word by using the color tiles to create paths that will take him sequentially past the letters in the word.
- The recorder should write down each word that the group spells.

Closure

- As a class, compose a list of all the words they were able to spell.
- Discuss and reflect on the process. Suggested reflection questions:
    - Did you notice any patterns in the paths you created? Why do you think this happened?
    - How did your team communicate ideas with one another?
    - What did you like the most about this challenge? Why?

Modifications/Extensions

- Provide groups with a grid that shows where each letter card should be placed.
- Provide groups with image cards that show a picture of the words they are to spell with indi.
- Provide letter cards that will not work within the letter family.
- Provide word cards to build compound words.
- Instead of placing letters in the correct order, have students use word cards to build complete sentences.

Storytime with indi

Overview

Storytime is something that indi loves! Tell indi a story by having him travel a path that goes over the major events in order.

Objectives

- I can retell a story using the important events.
- I can sequence the important events in a story.

Vocabulary

- **Setting**- where and when an event in a story takes place.
- **Sequence**- putting related items in a particular order.

CS Practices

- **1A-AP-11:** Decompose (break down) the steps needed to solve a problem into a precise sequence of instructions.
- **1A-AP-12:** Develop plans that describe a program's sequence of events, goals, and expected outcomes.
- **1A-AP-15:** Using correct terminology, describe steps taken and choices made during the iterative process of program development.

Content Connections

- **RL.PK.2:** With modeling and support, retell familiar stories/poems
- **RL.PK.3:** With modeling and support, identify characters, settings, and major events in a story.
- **RL.K.2:** With prompting and support, retell familiar stories, including key details.
- **RL.K.3:** With prompting and support, identify characters, settings, and major events in a story.
- **RL.1.2:** Retell stories, including key details, and demonstrate understanding of their central message or lesson.
- **RL.1.3:** Describe characters, settings, and major events in a story, using key details.
- **RL.2.1:** Ask and answer such questions as who, what, where, when, why, and how to demonstrate understanding of key details in a text.
- **RL.2.3:** Describe how characters in a story respond to major events and challenges.

Color Tiles Needed

All 20 color tiles (Red x2, Orange x3, Yellow x2, Green x3, Teal x3, Blue x3, Purple x1, Pink x3)

Additional Supplies

- Story of your choice
- Drawing paper and crayons

Preparation

- Each student kit needs to have a charged indi robot and the above color tiles.
- Designate boundaries or zones for each group to work within.

Engage

- Read or reread the chosen story to the class.
- As a class, discuss what happens in the story. What are the main events?
- Sequence the events on the board in a list format using transition words such as first, next, and last. Brainstorm additional transition words that students can use when retelling or summarizing a story.
- Explain that in groups, students will retell the story to indi using the events they have identified.

Explore

- Divide students into groups and assign jobs within the group.
- Have each group illustrate the story's main events, drawing each event on its own sheet of paper.
- Have the groups place their illustrations within their workspace in any order.
- Each group should place the color tiles in such a way that indi will travel to each main event in the correct order.
- As indi goes from tile to tile, students verbally retell the story using transition words.

Closure

- Discuss and reflect on the activity. Suggested reflection questions:
    - What transition words did you use? Why?
    - How could this activity be made more challenging?
    - Would this type of activity work with a different number of events?

Modifications/Extensions

- Have groups choose a story to retell or write their own unique story to sequence.
- Have students design costumes for indi to turn him into one of the characters in the story.
- Provide students with random events that they have to sequence into their own unique story. Individually or in groups, students can record their story adding additional details and dialogue as needed.
- Any topic that requires sequencing of steps will work including the steps of solving a math problem, historical timelines, or life cycles.

Make a Shape

Overview

Help Sphero indi learn his shapes! Create paths that outline shapes using indi's tiles.

Objectives

- I can identify rectangles, squares, and triangles.
- I can draw rectangles, squares, and triangles.

Vocabulary

- **Plane figure**- A closed two-dimensional, or flat figure.
- **Square**- A plane figure with four equal straight sides and four right angles.
- **Rectangle**- A plane figure with four straight sides and four right angles.
- **Triangle**- A plane figure with three straight sides and three angles that total 180 degrees.
- **Angle-** A figure formed by two rays or lines that share a common endpoint.

CS Practices

- **1A-AP-09:** Model the way programs store and manipulate data by using numbers or other symbols to represent information.
- **1A-AP-11:** Decompose (break down) the steps needed to solve a problem into a precise sequence of instructions.
- **1A-AP-12:** Develop plans that describe a program's sequence of events, goals, and expected outcomes.
- **1A-AP-15:** Using correct terminology, describe steps taken and choices made during the iterative process of program development.

Content Connections

- **PK.G.A:** Identify and describe two dimensional shapes (circles, triangles, rectangles, including a square which is a special rectangle).
- **K.G.A:** Identify and describe shapes (squares, circles, triangles, rectangles, hexagons, cubes, cones, cylinders, and spheres).
- **K.G.B:** Analyze, compare, create, and compose shapes.
- **1.G.A:** Reason with shapes and their attributes.
- **2.G.A.1:** Recognize and draw shapes having specific attributes, such as a given number of angles or a given number of equal faces, identify triangles, quadrilaterals, pentagons, hexagons, and cubes.
- **3.G.A.1:** Understand that shapes in different categories (e.g., rhombuses, rectangles, and others) may share attributes (e.g., having four sides), and that the shared attributes can define a larger category (e.g., quadrilaterals, and draw examples of quadrilaterals that do not belong to any of these subcategories.

Color Tiles Needed

All 20 color tiles (Red x2, Orange x3, Yellow x2, Green x3, Teal x3, Blue x3, Purple x1, Pink x3)

Additional Supplies

- Dry erase boards and markers or paper and pencil for each student
- Blank copies of the create your own challenge cards (paper or digital)

Preparation

- Each student kit needs to have a charged indi robot and the above color tiles.
- Designate boundaries or zones for each group to work within.
- Prepare a space on the board to record a list of steps for drawing shapes.

Engage

- Using a method of your choice, review the basic plane shapes that students will be working with during the lesson.
- Have each student draw a square; direct them to think carefully about how they drew the shape (I drew a straight line down, then drew a line that went to the right, etc).
- Once students have drawn the square, have them turn to a partner and describe their steps. How are they alike? How are they different?
- As a class, discuss the steps students took and together write a class set of directions for drawing a square. Be sure to include terms like right and left.

Explore

- Explain that to test their steps for drawing a square, students are going to design a path for indi that makes a square.
- Divide the class into small groups and assign jobs within the group, making sure each group has a recorder.
- Have each group design a square path for indi. The recorder should complete a grid showing the group's solution.
- Have each team report out their solution. How are they alike and how are they different?
- Now, ask students how they would adjust indi's path so that he travels a rectangular path.
- Have students complete the challenge as the recorder records the steps.
- Repeat with other shapes as desired (triangles, trapezoid, rhombus, etc). For each shape, have students verbally describe what indi does to travel the path (he goes straight, and then turns 45 degrees to the right, etc). ***Note**- Students will be able to create irregular plane shapes; they cannot create regular rhombi, trapezoids, pentagons, hexagons, etc.*

Closure

- Have each group share their steps for creating each shape. Discuss how they are alike and different.
- As a class, record a set of directions for creating each shape with indi.
- Suggested reflection questions:
    - What patterns do you see in the path?
    - How many degrees did indi have to turn?
    - Could we design a circular path for indi to travel?
    - Did this activity lend itself to being creative or was there only one solution?

Modifications/Extensions

- Have students measure the perimeter of the path/shape that indi travels.
- Can you combine two different shape paths to create a different shape?

Numbers All Around

Overview

Sphero indi is learning how to count and sequence numbers. Help him learn ordering in this activity.

Objectives

- I can count and sequence numbers in the correct order.

Vocabulary

- **Sequencing**- arranging something in a particular order.

CS Practices

- **1A-AP-09:** Model the way programs store and manipulate data by using numbers or other symbols to represent information.
- **1A-AP-12:** Develop plans that describe a program's sequence of events, goals, and expected outcomes.
- **1A-AP-15:** Using correct terminology, describe steps taken and choices made during the iterative process of program development.

Content Connections

- **PK.CC.A.1:** Verbally count to 10 by ones and then develop rote counting to 20 by ones.
- **PK.CC.A.2:** Identify which number comes just after or just before a given number in the counting sequence to 10 with visual supports and manipulatives.
- **K.CC.A.1:** Count to 100 by ones and by tens.
- **K.CC.A.2:** Count forward beginning from a given number within the known sequence (instead of having to begin at 1).
- **1.OA.C.6:** Add and subtract within 20, demonstrating fluency for addition and subtraction within 20.
- **1.OA.D.8:** Determine the unknown whole number in an addition or subtraction equation relating three whole numbers. *For example, determine the unknown number that makes the question true in each of the equations 8+?= 11, 5=?-3, 6+6=?.*

Color Tiles Needed

All 20 color tiles (Red x2, Orange x3, Yellow x2, Green x3, Teal x3, Blue x3, Purple x1, Pink x3)

Additional Supplies

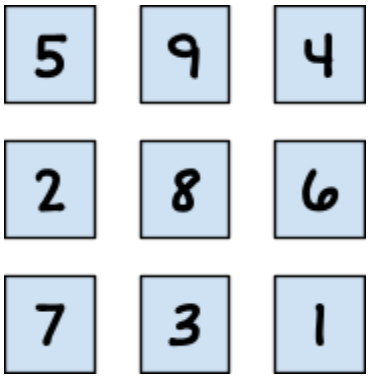
Cards or paper with the numbers 1 through 9. **Note: This activity can be modified for the grade group by changing the numbers on the cards.*

Preparation

- Each student kit needs to have a charged indi robot and the above color tiles.
- Designate boundaries or zones for each group to work within.
- A set of number cards for each group.

Engage

- Lay the number cards out in a random order in a three by three grid. For example:



- As a class, place the color tiles so that indi travels from 1 to 9.
- Shuffle the numbers and play again.

Explore

- Once students are comfortable, divide the class into small groups.
- Have students play a few rounds in their small groups.

Closure

- Have each group share their strategies for creating paths for indi.
- Suggested reflection questions:
    - Did you make any mistakes? If so, how did you fix them?
    - What advice would you give to other students completing this activity?
    - What did you do in this activity that you are most proud of?

Modifications/Extensions

- Use cards labeled by 2s, 5s, and 10s, to incorporate skip counting.
- Instead of using numbers 1-9, extend the numbers to 20. Create a larger grid, or replace numbers and have them order numbers from least to greatest or greatest to least.
- Have students connect three numbers in a math equation like 2+3= 5.
- Replace the numbers with letters or words and practice alphabetizing.

Fact Families

Overview

Students will use indi to order numbers and create equations.

Objectives

- I can order numbers from least to greatest.
- I can use three or more numbers to create equations.

Vocabulary

- **Ordering**- placing of objects in a specific sequence.
- **Equation**- a statement that the values of two mathematical expressions are equal (indicated by the sign =).

CS Practices

- **1A-AP-09:** Model the way programs store and manipulate data by using numbers or other symbols to represent information.
- **1A-AP-12:** Develop plans that describe a program's sequence of events, goals, and expected outcomes.
- **1A-AP-15:** Using correct terminology, describe steps taken and choices made during the iterative process of program development.

Content Connections

- **3.OA.C.7:** Fluently multiply and divide within 100, using strategies such as the relationship between multiplication and division (e.g, knowing that 8 x 5=40, one knows 40 ÷ 5=8) Or properties of operations. By the end of Grade 3, know from memory all the products of two one-digit numbers.
- **4.OA.C.5:** Generate a number or shape pattern that follows a given rule. Identify apparent features of the pattern that were not explicit in the rule itself.
- **5.OA.A.2:** Write simple expressions that record calculations with numbers, and interpret numerical expressions without evaluating them.

Color Tiles Needed

All 20 color tiles (Red x2, Orange x3, Yellow x2, Green x3, Teal x3, Blue x3, Purple x1, Pink x3)

Additional Supplies

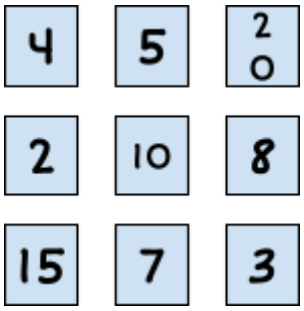
Number cards that create fact families

Preparation

- Each student kit needs to have a charged indi robot and the above color tiles.
- Designate boundaries or zones for each group to work within.
- A set of number cards for each group

Engage

- Lay the number cards out in a random order in a three by three grid. For example:



- Present the question “Using the numbers in the grid, can you write an equation with the answer of __” (use a number in the grid).
- Give students a few minutes to identify a possible solution to the problem.
- Have a few students share their solutions and record the equations on the board.
- Explain to students that they will now teach indi the equation by having him travel a path over the numbers. Choose a solution from the board and ask students to create a path using indi’s color tiles so indi can learn the equation.
- Test their path to see if it is correct. Repeat with a second equation.

Explore

- Once students are comfortable with the above process, divide the class into small groups.
- Have students place the same or different sets of numbers in a grid on the floor.
- Present the challenge to the groups: How many different equations can you teach indi?
- Students work together to identify as many equations as possible within their given numbers and code indi to teach him said equations.

Closure

- Have each group share out the equations they were able to create using the numbers.
- Suggested reflection questions:
    - What patterns do you see in the equations you created?
    - Did this activity lend itself to being creative, or was there only one solution?
    - If you shuffled the location of the cards, what would change?

Modifications/Extensions

- Restrict the fact families to either addition and subtraction or multiplication and division.
- Instead of whole numbers, use number cards with fractions or decimals and have students create paths from least to greatest/greatest to least.
- After working with the 3 by 3 grid, have students determine 3 additional numbers to add to the grid. What numbers would give you the most new equations?

Fraction Time

Overview

Students will create indi paths following rules involving fractions.

Objectives

- I can identify fractional parts of a set.

Vocabulary

- **Fraction-** represents equal parts of a whole
- **Numerator**- the number above the line in a common fraction. It shows how many of the parts indicated by the denominator.
- **Denominator-** the number below the line in a fraction. It shows the total number of parts a whole has been divided into.

CS Practices

- **1A-AP-09:** Model the way programs store and manipulate data by using numbers or other symbols to represent information.
- **1A-AP-12:** Develop plans that describe a program's sequence of events, goals, and expected outcomes.
- **1A-AP-15:** Using correct terminology, describe steps taken and choices made during the iterative process of program development.

Content Connections

- **3.NF.A.1:** Understand a fraction $\frac{1}{b}$ as the quantity formed by 1 part when a whole is partitioned into b equal parts; understand a fraction $\frac{a}{b}$ as the quantity formed by a parts of size $\frac{1}{b}$.
- **4. NF.B.3:** Understand a fraction $\frac{a}{b}$ with $a > 1$ as a sum of fractions $\frac{1}{b}$.

Color Tiles Needed

All 20 color tiles (Red x2, Orange x3, Yellow x2, Green x3, Teal x3, Blue x3, Purple x1, Pink x3)

Additional Supplies

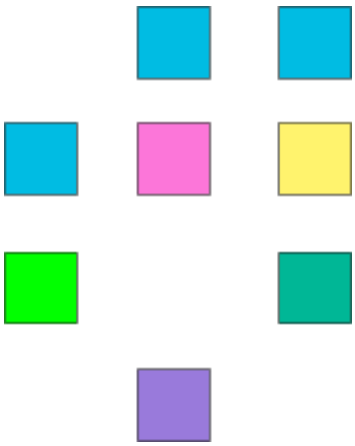
Recording sheet

Preparation

- Each student kit needs to have a charged indi robot and the above color tiles.
- Designate boundaries or zones for each group to work within.

Engage

- Create a path for indi to travel using 8 tiles. Example:



- Have students describe the tiles used in fractional parts (example- $\frac{1}{8}$ of the tiles are purple. $\frac{3}{8}$ of the tiles are blue, etc.)
- If necessary, create a second path and repeat the process until you are confident the class understands the concept of fractions of a set.

Explore

- Explain to students that they are now going to create their own paths for indi that they will need to describe using fractions.
- Divide the students into groups and assign jobs.
- Have students create at least three paths for indi. If desired, set a minimum number of tiles that must be used. Members should record the path and label the fractions.

Closure

- Have each group share one of their paths with the fraction descriptions.
- Suggested reflection questions:
    - Did any of the groups have the same fraction of tiles? How were their paths alike and different?
    - What is the smallest fractional part that can be represented in a path? The greatest?
    - Did this activity lend itself to being creative or was there only one solution?

Modifications/Extensions

- Have groups exchange the fractional descriptions of their paths with one another. Can group B recreate the path that group A created, or is there another option?
- Provide fraction riddles for students to solve where they are given the fractions they must include: Example:
    - ¼ of the tiles used are red
    - ¼ of the tiles used must be yellow.
    - $\frac{2}{4}$ of the tiles used must be green.

Indi Lesson Sparks

There are so many ways to incorporate indi into your classroom. Here are some lesson ideas to get your creative juices flowing.

- Provide a starting and ending point for indi's path. Challenge students to design three different ways to get indi from point A to point B.
- Do different ground textures affect how far indi travels? Have students test different floors, tile, carpet, etc to see if he travels the same distance.
- If every tile in the path represents 5 miles, how long is indi's journey? 2 miles? 10 miles? Create a path based on a given total distance.
- Create a path representing a cycle using tiles and drawings. Examples: phases of the moon, life cycle, food web.
- Design a map with the elements of a community. Students code indi to run errands around the town. Where does he need to go first, second, third, etc? Is there a right and wrong order?
- Use letter cards to break words down into parts. As indi travels a path in front of the cards, students blend the letters together to sound out the word.
- Assign different numerical values to different colored tiles. Have students write and solve the expressions represented by the tiles.
- Challenge students to create a path for indi using as many of the tiles as possible.
- Challenge students to build a course for 2 indi robots where they each loop forever and never crash.
- Create a maze and then use the color tiles to navigate from start to finish.
- Design a bridge strong enough for indi to travel across.
- Create a character costume for indi and sequence the events of a story.
- Challenge groups to see who can have indi run the longest.
- Given specific tiles to use, challenge students to create a path for indi utilizing all the tiles.

Suggested Reflection Questions

Have students reflect on their successes and challenges when coding indi either orally or in writing. Not only should this include reflecting on the actual code they created, but also reflecting on working together as a team and their thought processes. The questions below are suggestions for getting a discussion started; choose those that work best for the class and the activity completed.

- Did you make any mistakes? If so, how did you fix them?
- What did you like the most about this challenge? Why?
- How did you get indi to do that?
- Why didn't indi do what you wanted him to do?
- How can you build on ideas you see and collaborate on new ones?
- Can you create another solution to the problem?
- If you exchanged this tile for this one, where would indi go?
- What patterns do you see in the path?
- How many degrees did indi have to turn?
- What challenges did you face as a team?
- What did you do well as a team?
- How is your group's solution alike and different from another group's?
- What advice would you give to other students completing this challenge/activity?
- What was the most difficult part of this challenge?
- What would you do differently next time?
- What did you do in this activity that you are most proud of?
- How did your team communicate ideas with one another?
- Did this activity lend itself to being creative or was there only one solution?
- How did you break the challenge down to make it easier?

Resources & References

Roles for Coding indi

sphero

Roles for Coding Robots

Coding Captain
Makes sure all team members are working together and keeps the team organized. Listens to everyone, and keeps the members motivated.

Programmer
Places the tiles based on the challenge and the team's solution ideas.

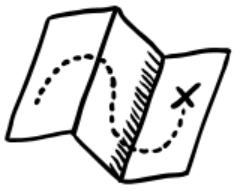
Robot Wrangler
Places indi on the starting tile when it's time to test the team's solution. Brings indi back if he goes off the path.

Recorder
Records the team's ideas and solutions. Takes notes, photos and/or videos of the group working together and of indi following the path.

Coding Captain

Makes sure all team members are working together and keeps the team organized. Listens to everyone, and keeps the members motivated.

Programmer



Places the tiles based on the challenge and the team's solution ideas.

Robot Wrangler

Places indi on the starting tile when it's time to test the team's solution. Brings indi back if he goes off the path.

Recorder

Records the team's ideas and solutions. Takes notes, photos and/or videos of the group working together and of indi following the path.

3

Programmer

Places the tiles based on the challenge and the team's solution ideas.

5

Recorder

Records the team's ideas and solutions. Takes notes, photos and/or videos of the group working together and of indi following the path.

2

Coding Captain

Makes sure all team members are working together and keeps the team organized. Listens to everyone, and keeps the members motivated.

4

Robot Wrangler

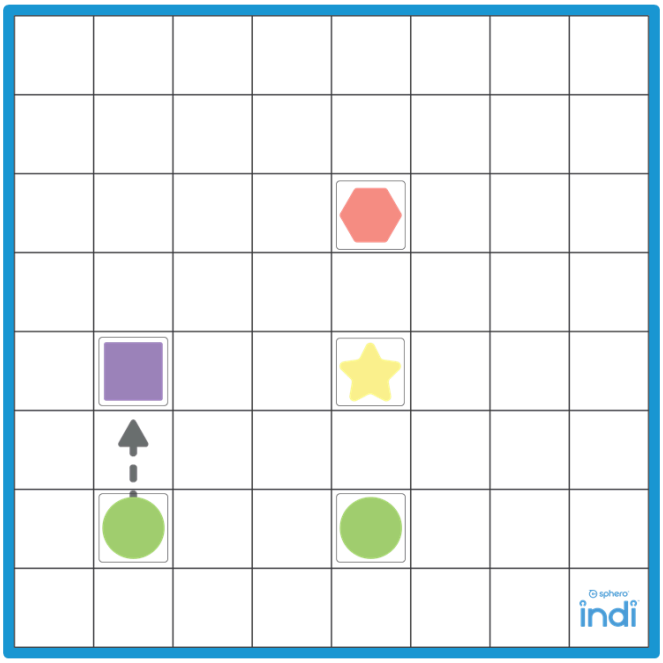
Places indi on the starting tile when it's time to test the team's solution. Brings indi back if he goes off the path.

Name: _____ Date_____

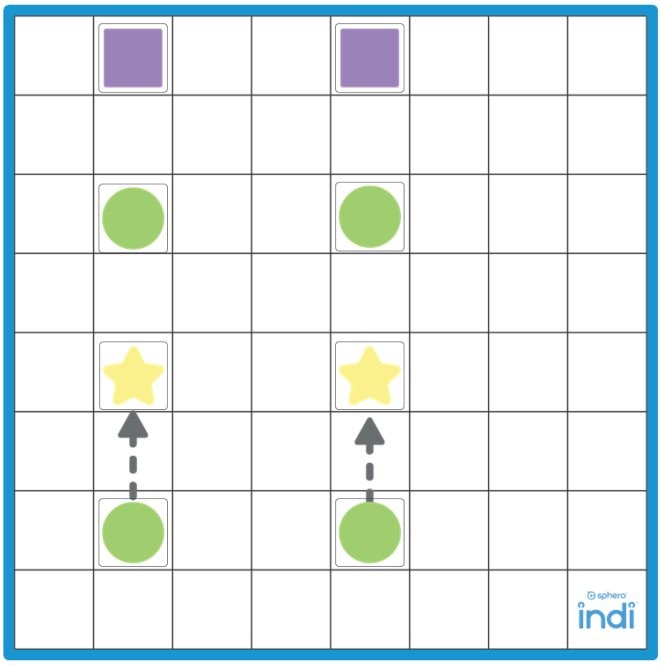
Indi Reflection Journal

Challenge Title:	
Who did you work with to complete this challenge?	
What were you trying to get indi to do?	
What did indi do when you ran your program?	
Did you make any mistakes? If so, how did you fix them?	
What did you like the most about this challenge? Why?	

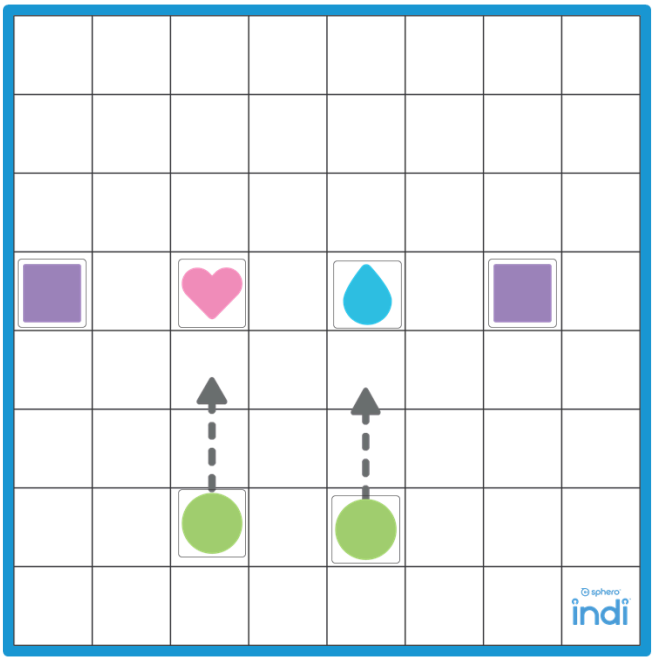
Beginner's Programming Challenge Card Solutions



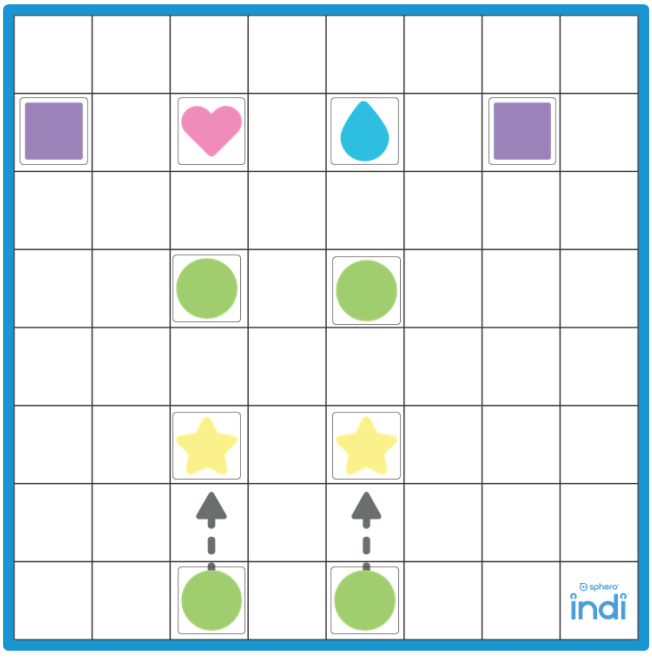
Challenge Card #3



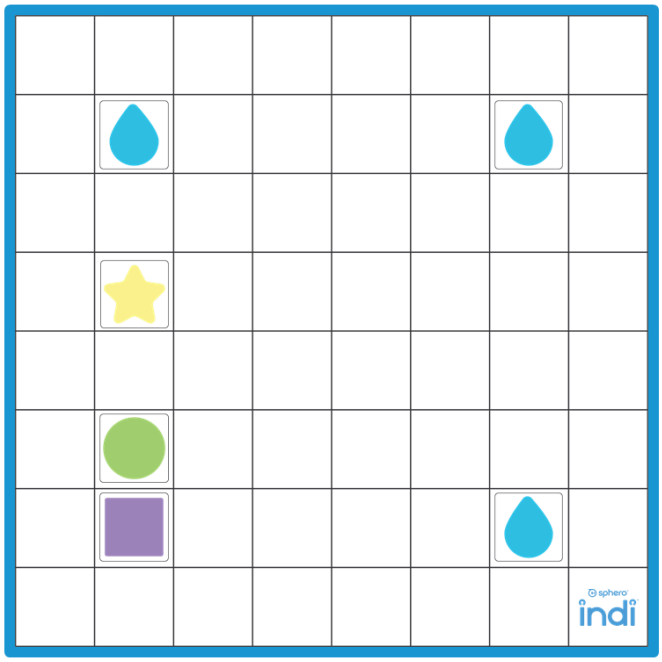
Challenge Card #4



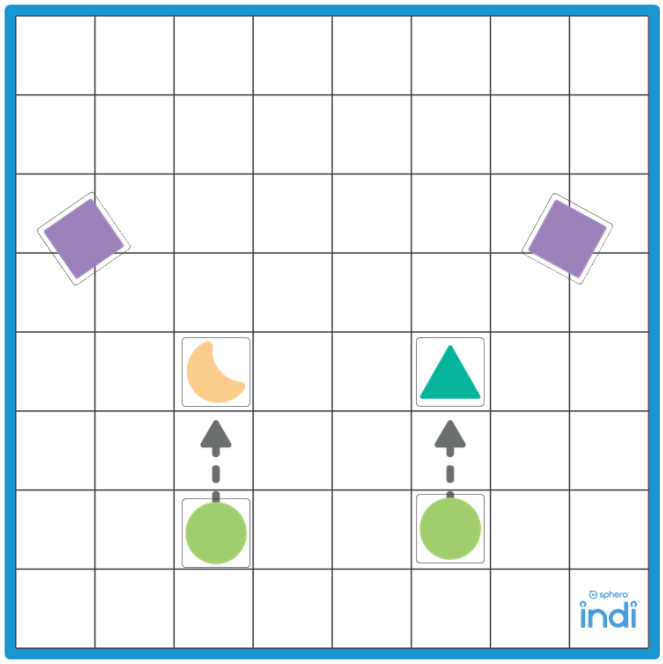
Challenge Card #5



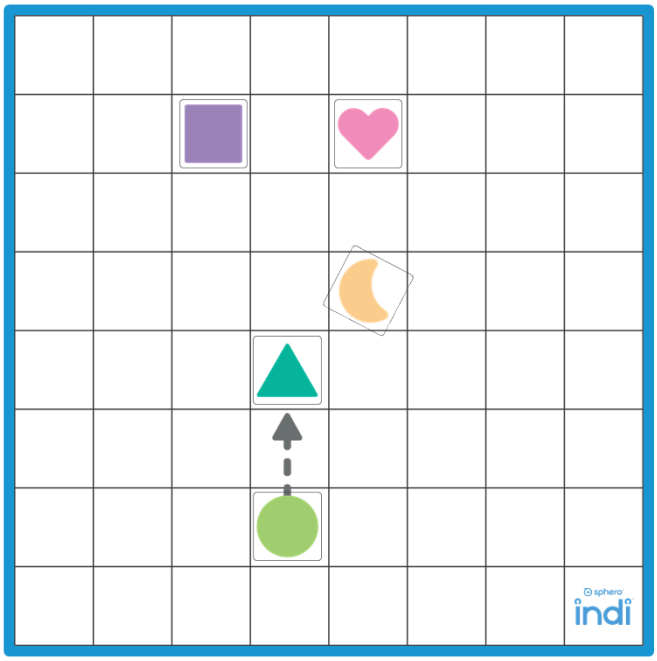
Challenge Card #6



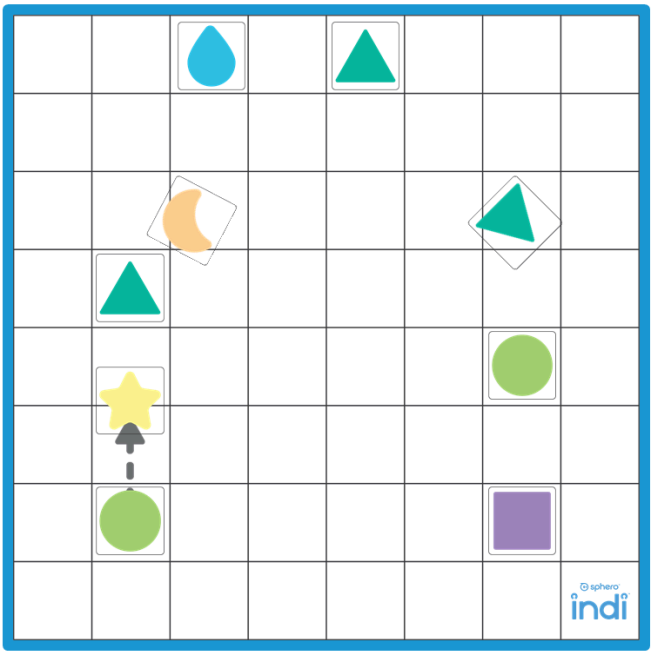
Challenge Card #7



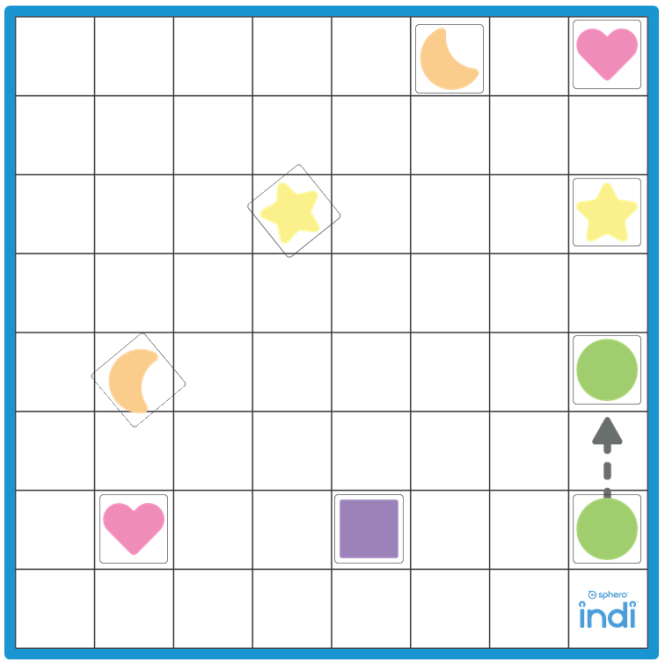
Challenge Card #8



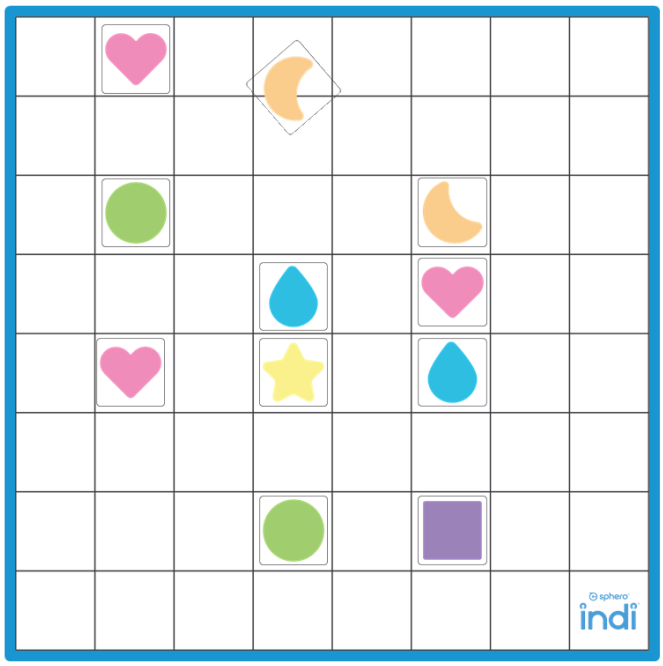
Challenge Card #9



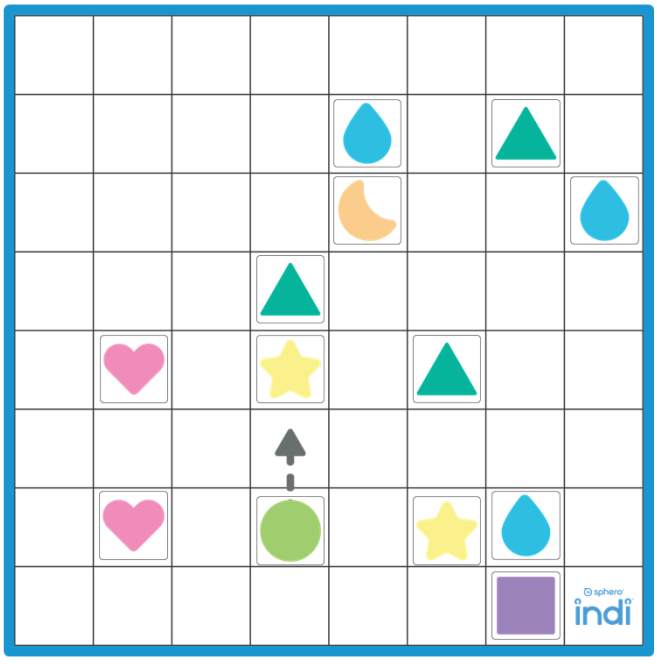
Challenge Card #10



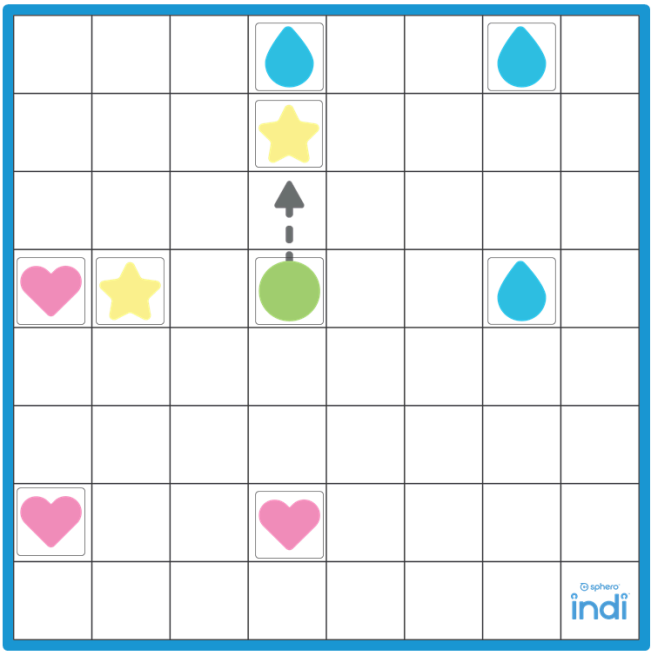
Challenge Card #11



Challenge Card #12

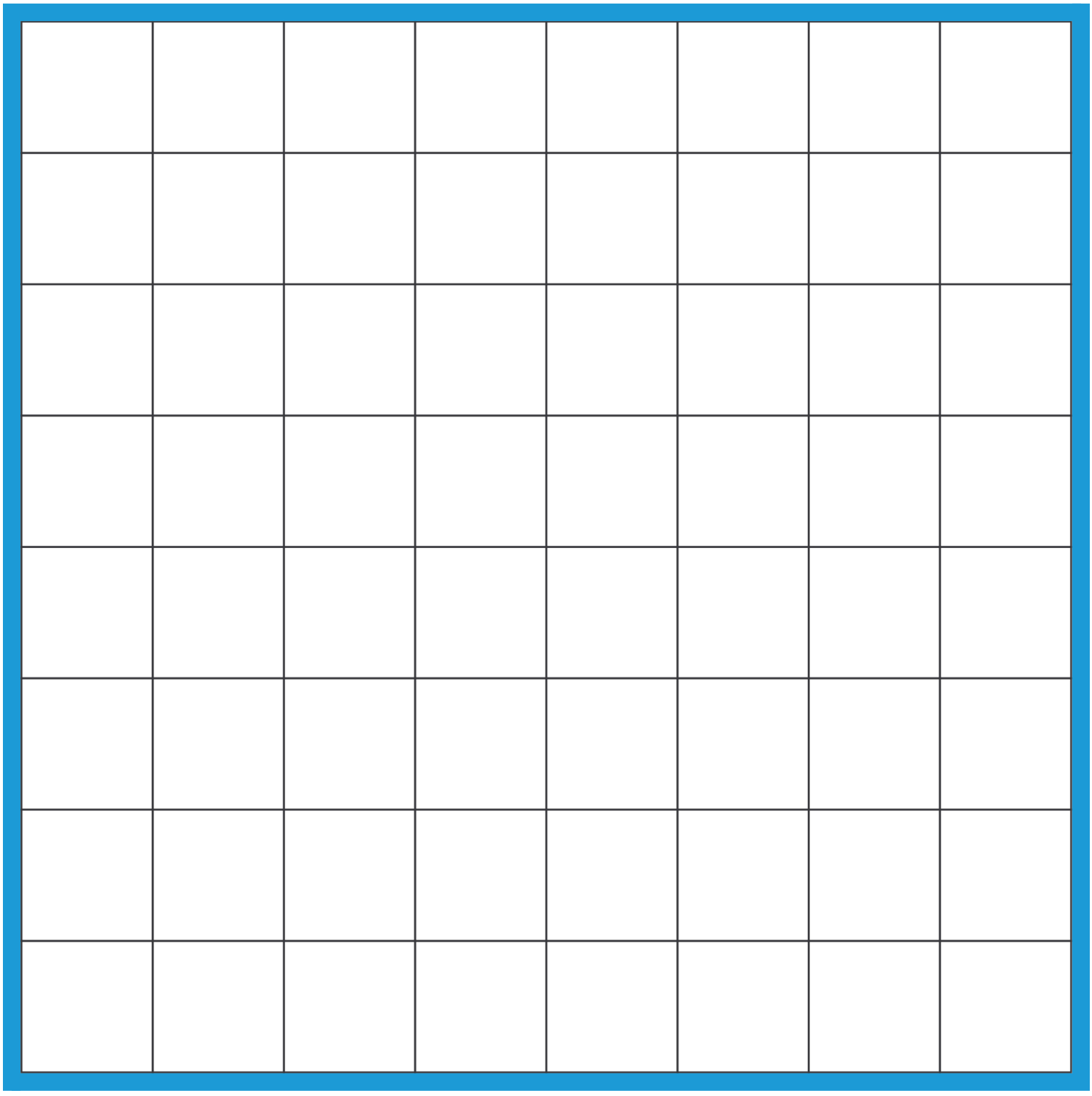


Challenge Card #13

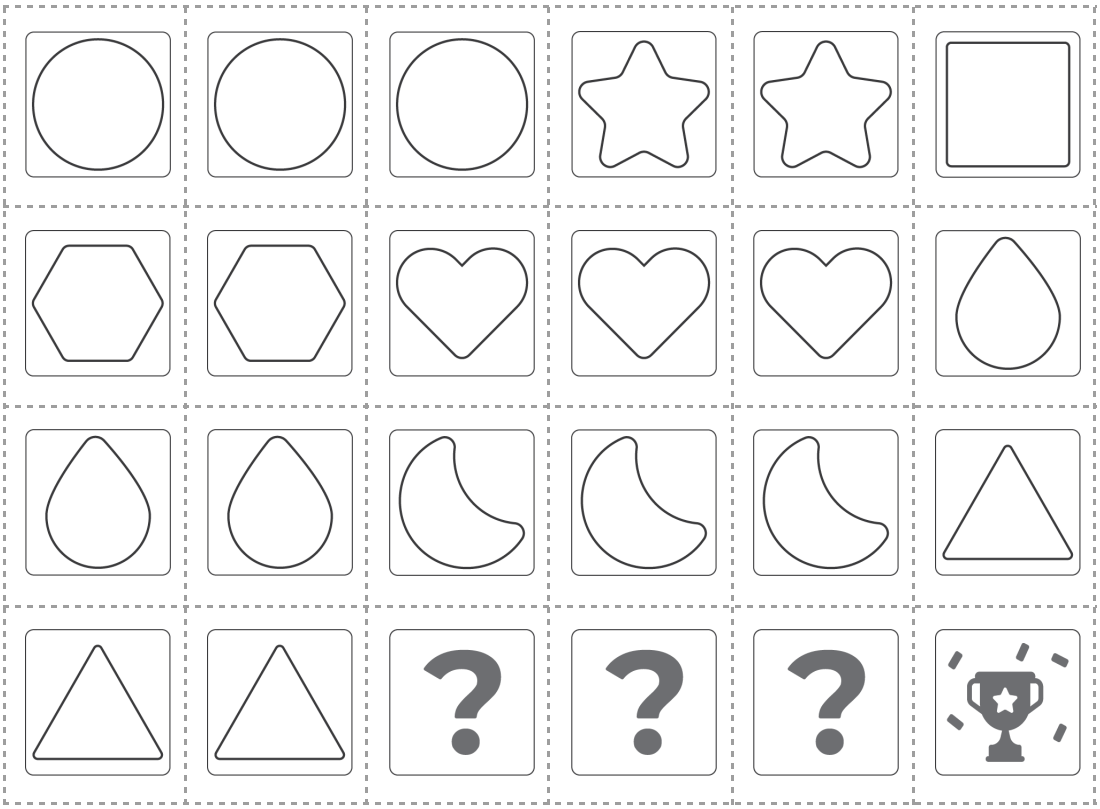


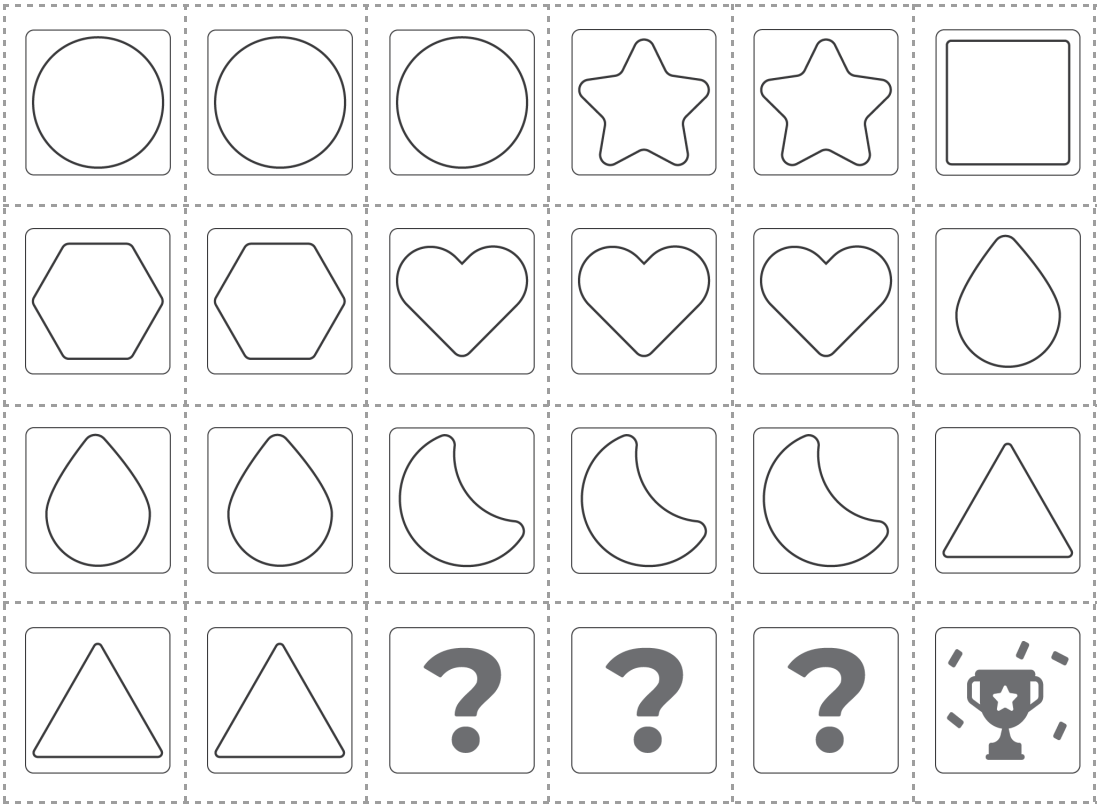
Challenge Card #14

Blank indi Challenge Card



Black and White Printable Squares





Resources

Official Sphero Website
https://sphero.com/

Official Sphero indi Website
https://sphero.com/pages/sphero-indi

Sphero EDU Jr. App
https://sphero.com/pages/apps#shopify-section-tugkxftrcv

AACPS Creative Coding with Robots Website
https://sites.google.com/aacps.org/creative-coding-with-robots/home

Maryland Digital Learning Standards
https://marylandpublicschools.org/programs/Documents/ITSLM/Maryland_Digital_Learning_Standards_for_Students.pdf

Maryland Computer Science Standards
https://marylandpublicschools.org/programs/Documents/CTE/K-12StandardsLandscape.pdf

References

"About CSTA's K-12 Standards." *Computer Science Teachers Association*, https://www.csteachers.org/page/about-csta-s-k-12-nbsp-standards. Accessed 23 May 2023.

"5 Ways to Teach Computational Thinking in the Classroom." *Sphero*, 26 July 2021, https://sphero.com/blogs/news/how-to-teach-computational-thinking-in-classroom. Accessed 23 May 2023.

Macdonald, Jeremy, and Michelle Acaley. *Indi Educator Guide Book*. Sphero, Incorporated, 2021.

"Maryland Approves New Standards for Computer Science Education." *Maryland News*, 5 October 2018, https://news.maryland.gov/msde/maryland-approves-new-standards-for-computer-science-education/. Accessed 23 May 2023.

"Maryland Center for Computing Education." *MLDSC Home Page*, https://mldscenter.maryland.gov/egov/Publications/ResearchSeries/2020/MCCE_MLDS_262020.pdf. Accessed 23 May 2023.

"Maryland Digital Learning Standards." *Maryland State Department of Education*, 21 May 2019, https://www.marylandpublicschools.org/stateboard/Documents/05212019/TabH-MDDigitalLearningStandards.pdf. Accessed 23 May 2023.

"Screenless Coding & Learning Robot for Kids | indi Robot Car." *Sphero*, https://sphero.com/pages/sphero-indi. Accessed 23 May 2023.

Sphero. *Computational Thinking Guide*. Sphero, 2023. *Sphero.com*, https://cdn.shopify.com/s/files/1/0306/6419/6141/files/Computational_Thinking_Guide.pdf?v=1680544401.

"Sphero Education | STEM & STEAM EdTech Company." *Sphero*, https://sphero.com/pages/educators. Accessed 23 May 2023.

Williams, Heidi. *No Fear Coding: Computational Thinking Across the K-5 Curriculum*. International Society for Technology in Education, 2017.