Ice-Skating Dash

Summary

Description

Dash is a little nervous, but also very determined to master the ice for the big Wonder Ice-Skating Show. It may even lead to a spot competing in the Wonder Olympics! Dash will start out slow, but by the end of this practice session, Dash will be skating like a pro!

Learning Procedure

Over the course of **9 challenges**, students will create a dramatic ice-skating program for Dash that includes driving the robot forward and backward in a straight line, turning forward in left and right arcs and circles by adjusting the wheel speed differential located in the **Set Wheel Speed** block, as well as stopping drive movement by using the **Stop Wheels** block. Students will also practice customizing and programming **Eye Pattern Lights** to create various expressions for Dash, as well as programming **All Lights** in various colors for a stunning ice-skating performance everyone will long remember!

Concepts Covered

- **Differential Drive**
    - students will learn that when one wheel rotates faster than the other, the robot turns in an arc towards the slower wheel.

  *From Reflection Questions & Activity Extensions -
    - When the left and right wheels rotate in **opposite directions** at the **same rate**, the robot spins in a 360° circle.
    - When the left and right wheels rotate in **opposite directions**, at **different rates,** the robot turns in place.
- **Set Wheel Speed**
    - students will learn that when left and right wheels rotate at the same speed in a two-wheeled drive system in the same direction, the robot drives straight forward or back.
    - students will learn how to edit left and right wheel speeds independently in the **Accelerometer**: from very slow to very fast.
- **All Lights** - students will practice programming **All Lights** in colors, red, yellow, orange and green, to light up Dash's ears and chest.
- **Eye Patterns** - students will customize eye lights to create different expressions, e.g., smile, determined, happy and innovate new expressions.
- **Stop Wheels** - students will program the robot to stop movement using the **Stop Wheels** block.

- **Sound** - students will **record** their own **happy sound** for Dash in the **My sounds** block.

In App

Vocabulary

Differential Drive: a two-wheeled drive system with independent movement controls for each wheel
Set Wheel Speed - a block that allows you to adjust the speed in which the wheels turn
Stop Wheels - a block that immediately stops the movement of the wheels

Reflection Questions

1. Explain how you programmed the robot to move forward in a straight line?

2. When programming the robot, why was it necessary to program the left and right wheel to turn at different speeds? What happened when you did this?

3. How did you program the speed for each wheel to make the robot spin right? left?
   **When the left wheel rotated faster than the right one, the robot turned right while traveling forward. When the right wheel rotated faster than the left one, the robot turned left while traveling forward.*

4. How do you think different sized wheels would affect the robot's ability to turn? Do you think it matters? (Experiment with cardboard wheels and straw for axel.)

5. Does it matter what type of surface the robot spins on? Explain. Test your hypothesis.

6. What do you think would happen if you programmed the left and rights wheels to move in opposite directions at the same rate? At opposite rates? Program Dash and test it out. Were you correct in your predictions?

Activity Extensions

1. Olympic Skater
Read to Students: Now you have an ice-skating robot! Adjust the left and right wheel speeds in the **Set Wheel Speed block** and see what happens as Dash glides across the ice! You can also make Dash skate backwards! Dash is now ready to skate in the Robot Olympics. Program an exciting routine for Dash in "Create New" section of the Blockly App. Test out what happens when the wheels move in opposite directions at the **same speed**. How is this movement different than when the wheels are moving in opposite directions at **different speeds**?

Incorporate all types of tricky spins and turns in Dash's performance. Dash must end the routine right in front of the judge's table, using the **Stop Wheel** block. Your teacher will be the Olympic judge. Don't forget to create a dramatic ice-skating costume for Dash, too.
Standards: K-PS2-1; K-PS2-2

2. Speed Skating
In this exercise, students will extend the logic of wheel speed differential to the length of the inner and outer lanes of an ice-rink. Read to Students: Dash has been practicing skating and is now fast enough to race against the other robots in the Speed Skating event. The judge flips a coin and Dash gets to choose a starting point on the 400-meter rink first. Should Dash choose a position on the most outer ring of the rink or the most inner ring of the rink? Is there a difference? If so, how can you make the race between ice-skating robot fair?
Standard: CC Math 5.G.B.3

3. Explaining Wheel Differential
Students will watch an old-fashioned, but informationally accurate video on wheel differential. After students understand the underlying mechanics of wheel differential, their knowledge will be assessed, as experts, explaining and teaching it to their peers. Download the app, *Explain Everything*, and have students create a movie screencast that includes text, voice overs, music, images, drawings and any student-produced videos that demonstrate the principles of wheel speed and turns. The objective is to create a multimedia presentation that will be more relevant to the current times in terms of the presentation and technology used to present it.
http://www.geek.com/geek-cetera/a-brilliant-explanation-of-how-a-cars-differential-works-1450429/
Standards: SL.1.1; SL.2.1; SL.3.1; SL.4.1; S.L.5.1; W.1.6 W.2.6; W.3.6; W.4.6; .W.5.6;

4. Obstacle Course Race
In this activity, your students will practice programming Dash, to make left or right turns, using wheel speed differentials. Have students design an obstacle course using books, building blocks or any other large units that can partition a large space into alleyways like a maze. Now students are ready for the newest event in the Wonder Winter Olympics. Divide students into groups of 4 to collaborate on programming a robot to maneuver through the maze from start to finish. Students will design this program in the "Create New" section of the *Blockly App*. Each team must incorporate, at least, 2 left turns and 2 right turns using wheel speed differentials. Dash must end the program coming to a complete stop at the exit of the maze. The team whose robot makes it through the maze in the shortest amount of time is the winner.
Standard: MS-ETS1-4.

Educational Standards

CC Mathematical Practices:
1, 2, 4, 5, 6, 7, 8

CSTA K-12 Computer Science Standards

- CT.L1:3-03. Understand how to arrange information into useful order
- CT.L1:6-01. Understand and use the basic steps in algorithmic problem-solving.
- CT.L1:6-02. Develop a simple understanding of an algorithm
- CPP.L1.3-04. Construct a set of statements to be acted out to accomplish a simple task.
- CPP.L1:6-05. Construct a program as a set of step-by-step instructions to be acted out.
- CT.L2-03. Define an algorithm as a sequence of instructions that can be processed by a computer.
- CT.L2-06. Describe and analyze a sequence of instructions being followed

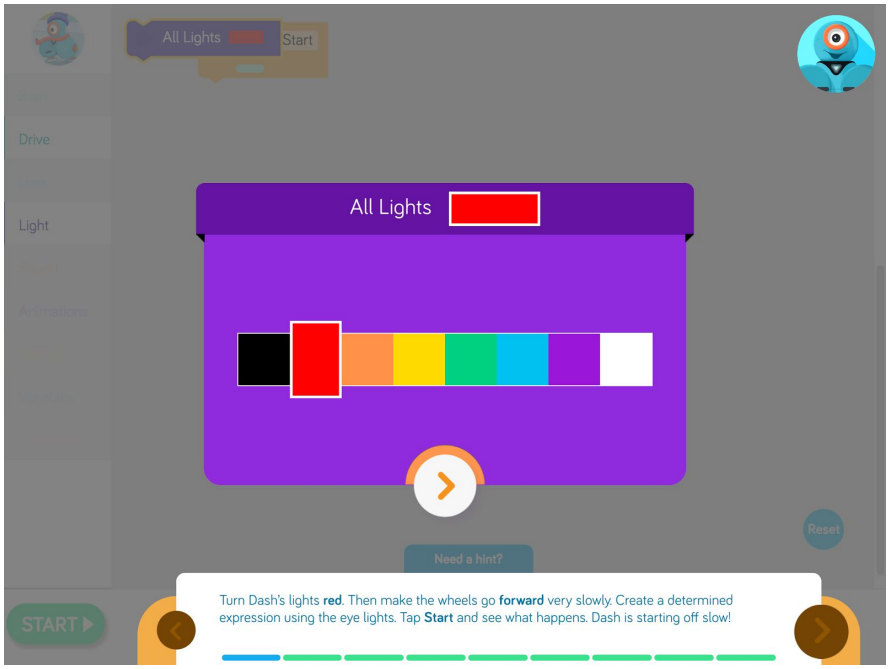
Next Generation Science Standards NGSS

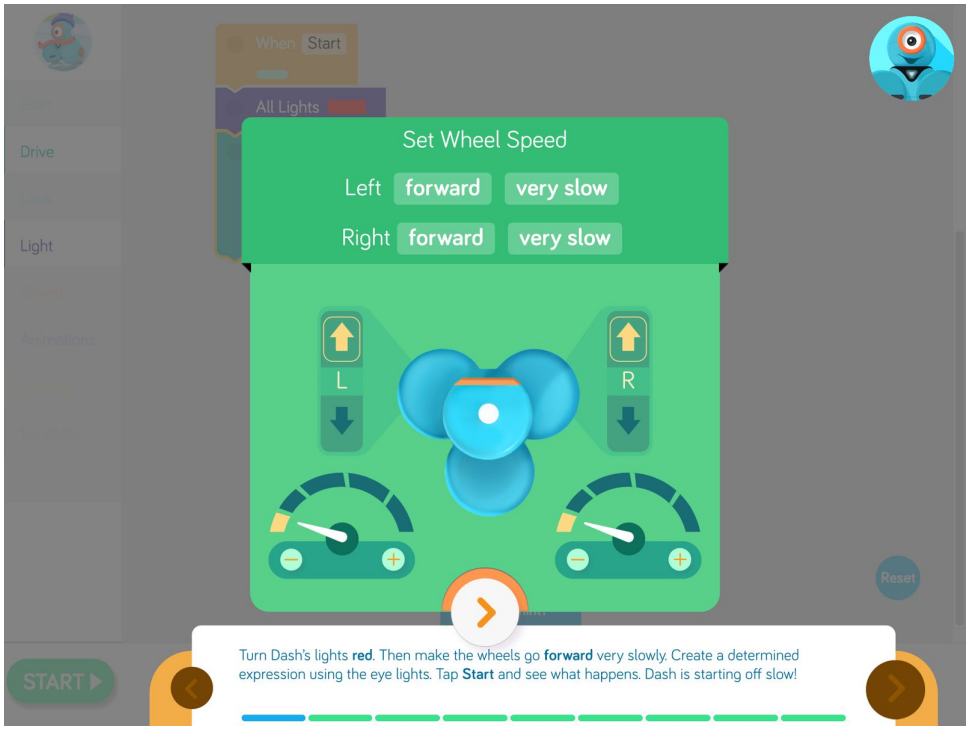
- K-PS2-1 Motion and Stability: Forces and Interactions Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.
- K-PS2-2 Motion and Stability: Forces and Interactions Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.*
- K-2-ETS1-1 Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.
- K-2-ETS1-2 Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem. *Applicable to Winter-Wheeling Downhill Activity Extension
- 4-PS3-1 Use evidence to construct an explanation relating the speed of an object to the energy of that object.*Applicable to Winter-Wheeling Downhill Activity Extension.

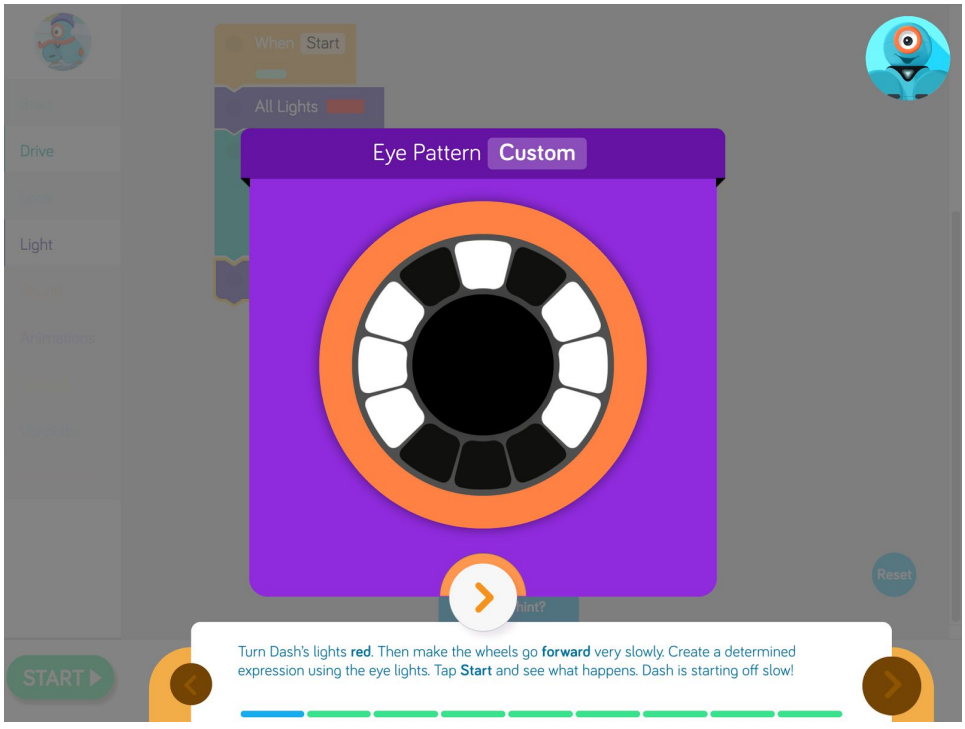
Solutions

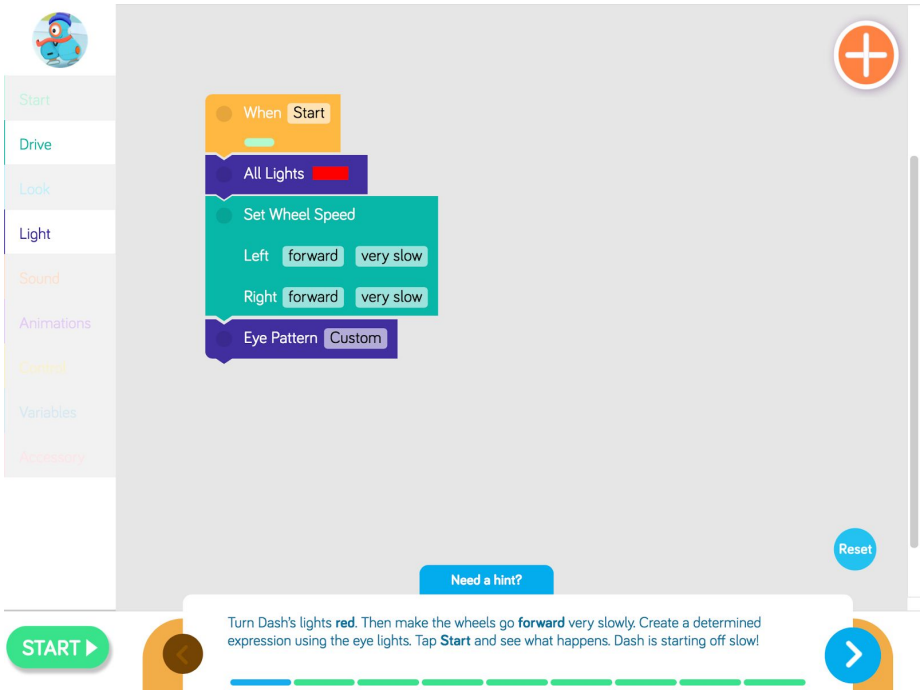
Challenge 1

Turn Dash's lights **red.** Then make the wheels go **forward** very slowly. Create a determined expression using eye lights. Tap **Start** and see what happens. Dash is starting off slow.


All Lights
Start
Drive
Light
All Lights
Reset
Need a hint?
START
Turn Dash's lights red. Then make the wheels go forward very slowly. Create a determined expression using the eye lights. Tap Start and see what happens. Dash is starting off slow!

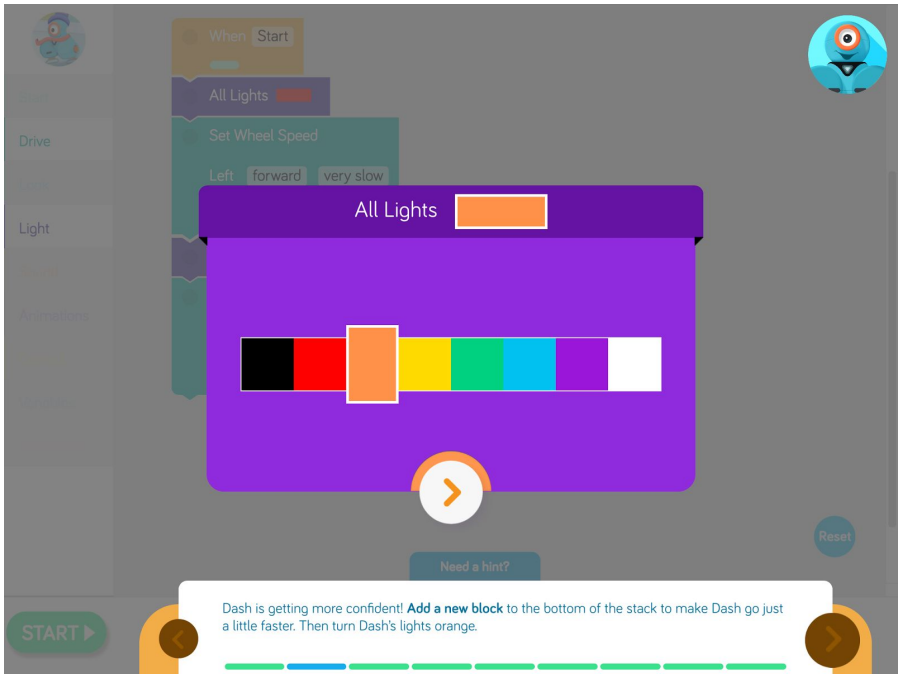

When Start
All Lights
Drive
Light
Animations
Set Wheel Speed
Left forward very slow
Right forward very slow
L
R
Reset
START
Turn Dash's lights red. Then make the wheels go forward very slowly. Create a determined expression using the eye lights. Tap Start and see what happens. Dash is starting off slow!

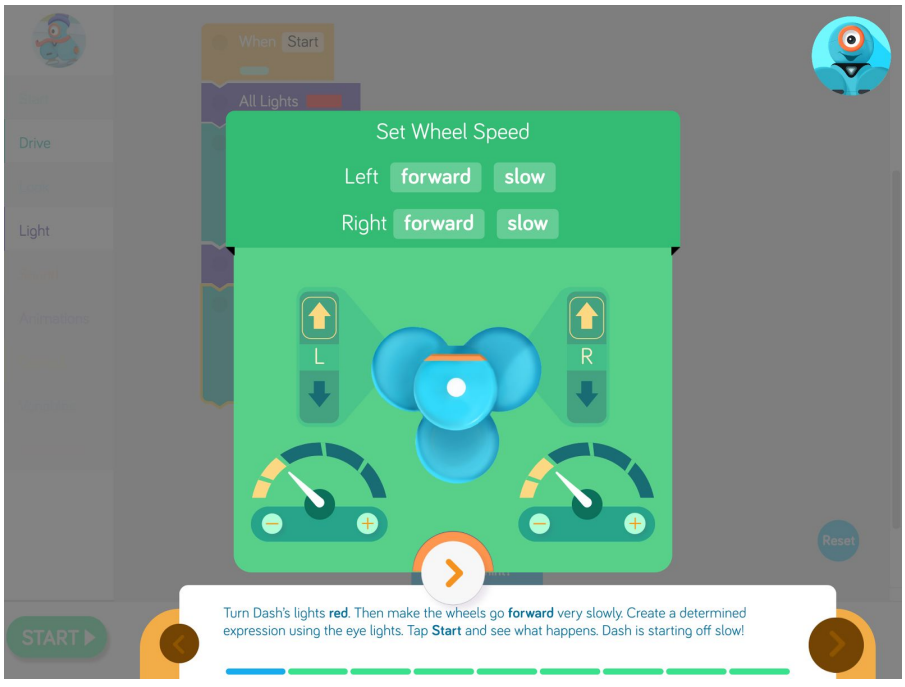

When Start
All Lights
Drive
Light
Animations
Eye Pattern Custom
Reset
START
Turn Dash's lights red. Then make the wheels go forward very slowly. Create a determined expression using the eye lights. Tap Start and see what happens. Dash is starting off slow!

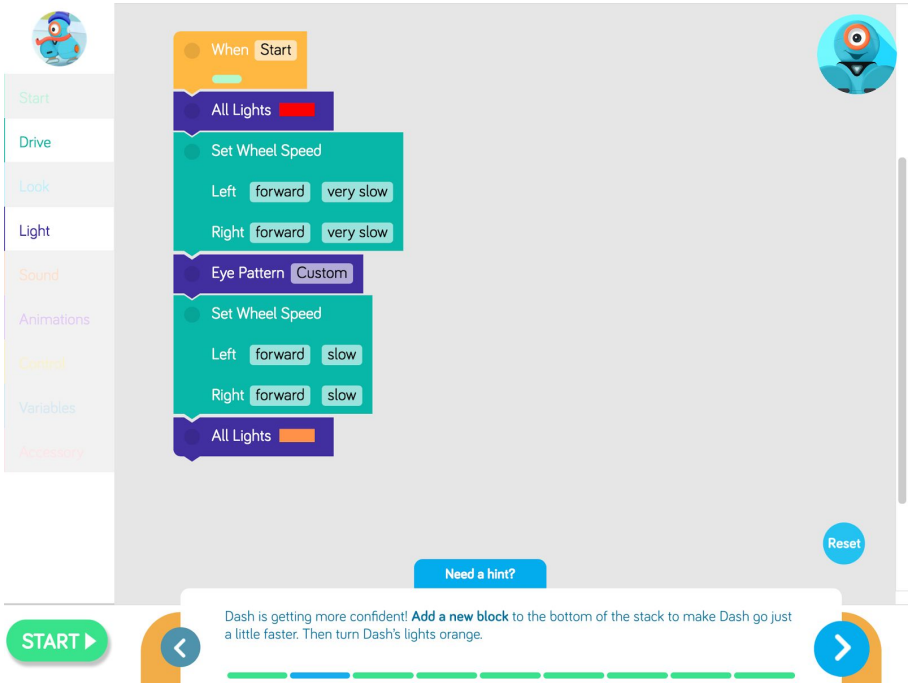


Challenge 2

Dash is getting more confident! **Add a new block** to the bottom of the stack to make Dash go just a little faster. Then turn Dash's lights orange.

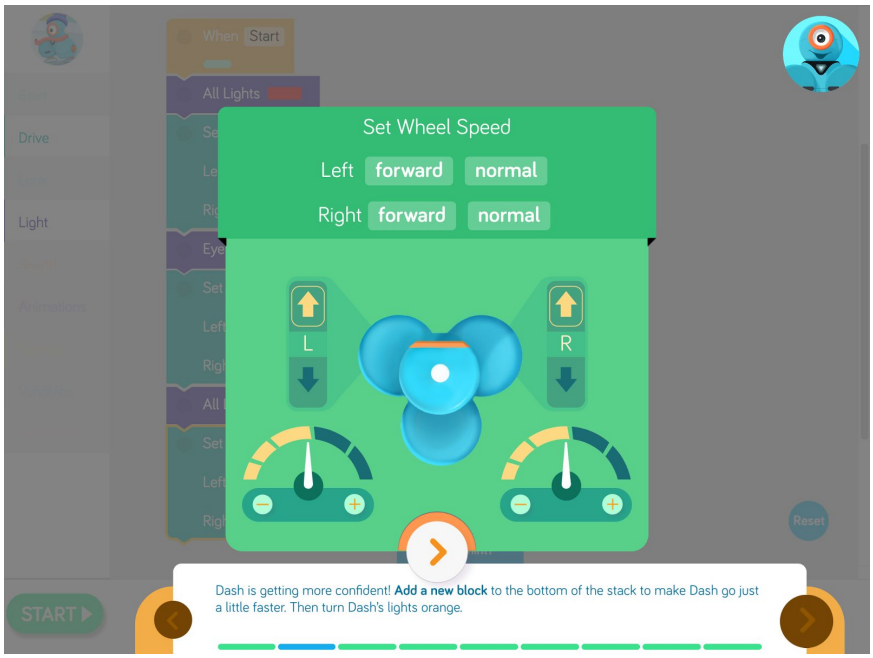

When Start
All Lights
Set Wheel Speed
Left forward very slow
Drive
Light
All Lights
Reset
Need a hint?
START
Dash is getting more confident! Add a new block to the bottom of the stack to make Dash go just a little faster. Then turn Dash's lights orange.

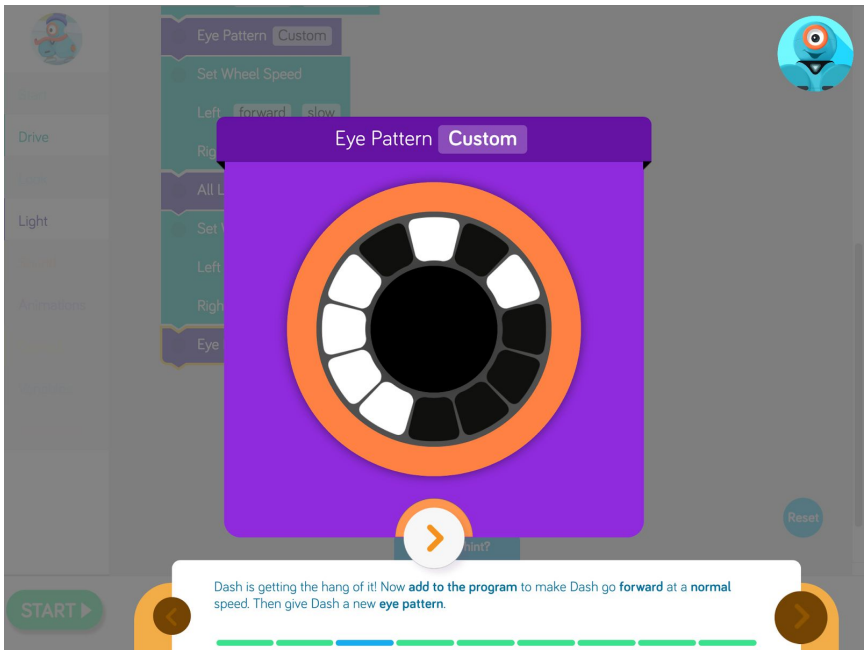

When Start
All Lights
Drive
Light
Set Wheel Speed
Left forward slow
Right forward slow
L
R
Reset
START
Turn Dash's lights red. Then make the wheels go forward very slowly. Create a determined expression using the eye lights. Tap Start and see what happens. Dash is starting off slow!

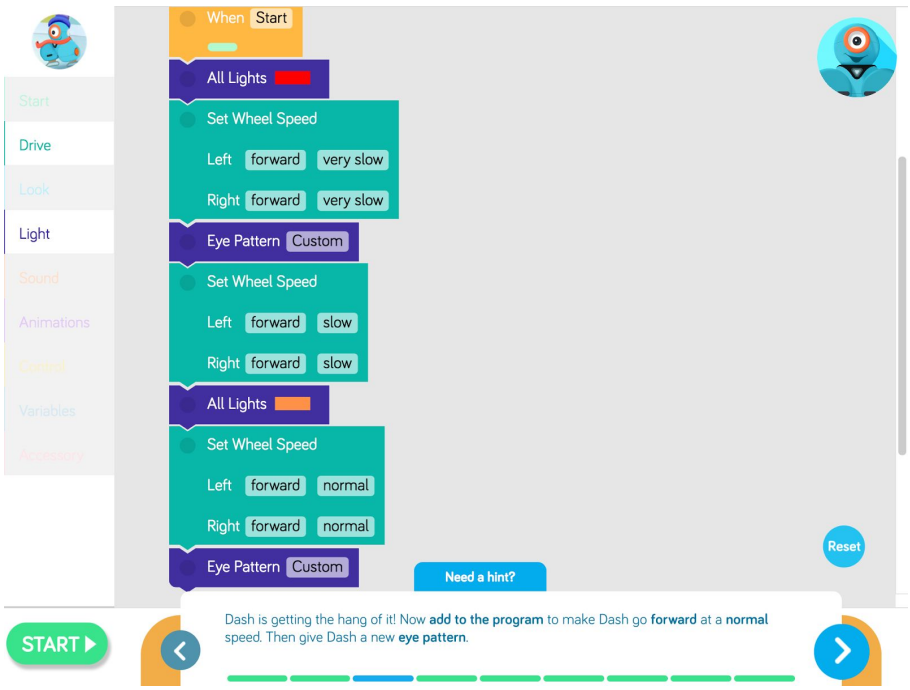


Challenge 3

Dash is getting the hang of it. Now **add to the program** to make Dash go **forward** at a **normal** speed. Then give Dash a new **eye pattern**.

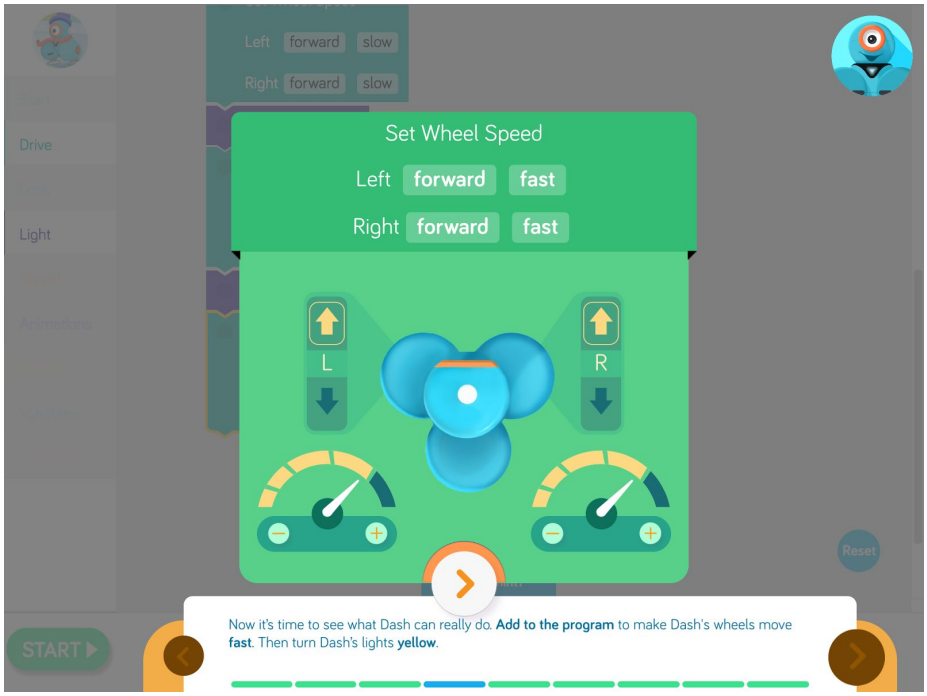

When Start
All Lights
Drive
Light
Set Wheel Speed
Left forward normal
Right forward normal
L
R
Reset
START
Dash is getting more confident! Add a new block to the bottom of the stack to make Dash go just a little faster. Then turn Dash's lights orange.

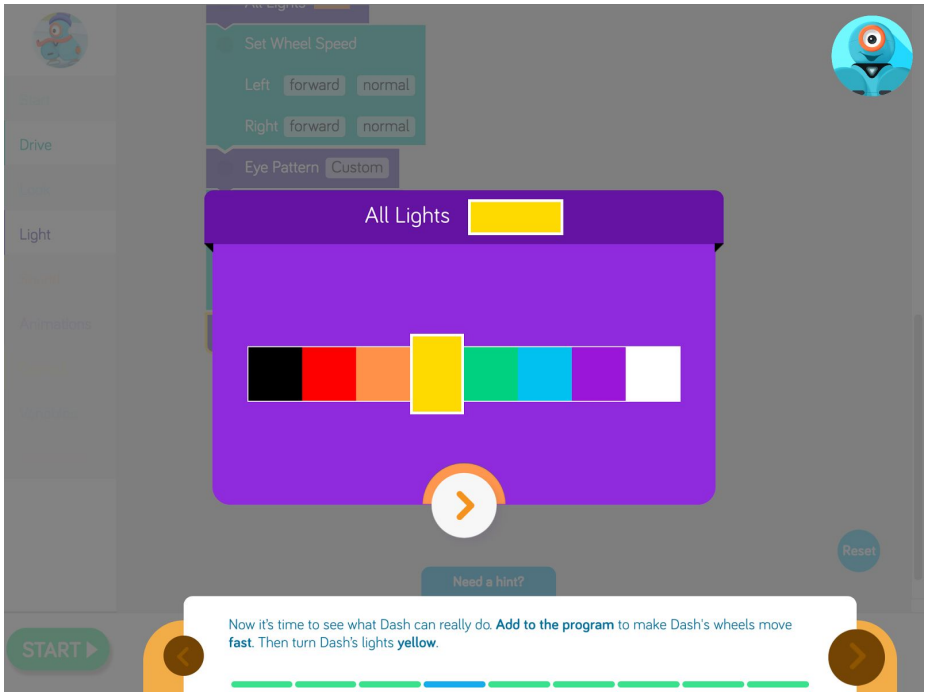

Eye Pattern Custom
Set Wheel Speed
Drive
Light
Eye Pattern Custom
Reset
START
Dash is getting the hang of it! Now add to the program to make Dash go forward at a normal speed. Then give Dash a new eye pattern.

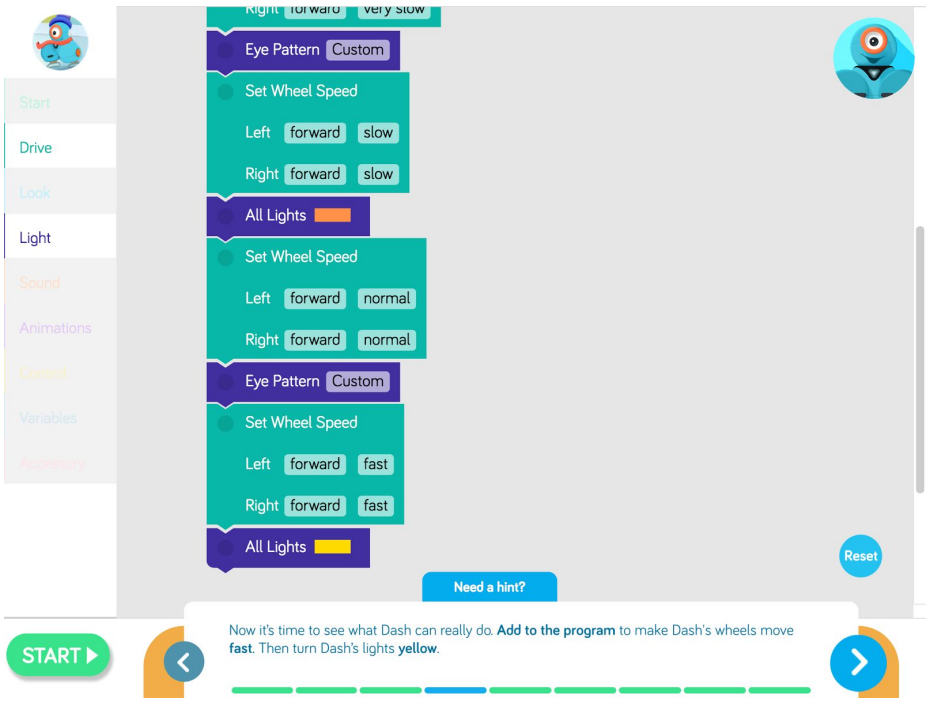


Challenge 4

Now it's time to see what Dash can really do. **Add to the program** to make Dash's wheels move **fast.** Then turn Dash's lights **yellow**.

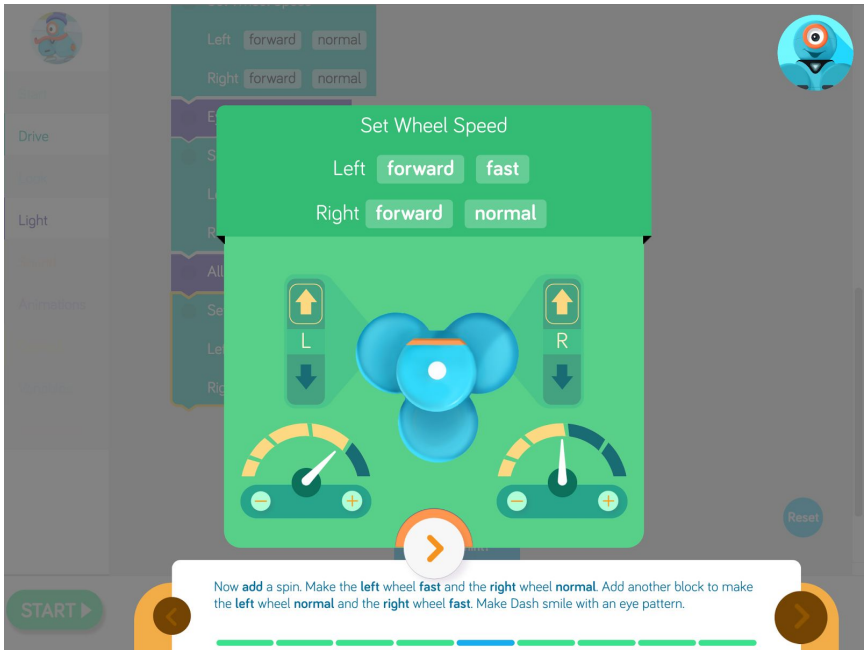

Left forward slow
Right forward slow
Drive
Light
Animations
Set Wheel Speed
Left forward fast
Right forward fast
L
R
Reset
START
Now it's time to see what Dash can really do. Add to the program to make Dash's wheels move fast. Then turn Dash's lights yellow.

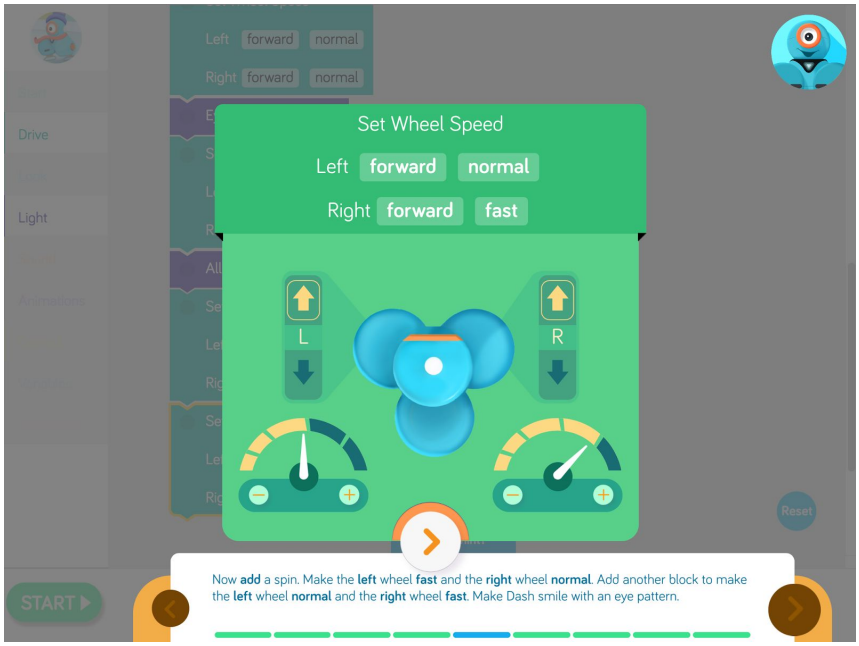

Set Wheel Speed
Left forward normal
Right forward normal
Eye Pattern Custom
Drive
Light
Animations
All Lights
Reset
Need a hint?
START
Now it's time to see what Dash can really do. Add to the program to make Dash's wheels move fast. Then turn Dash's lights yellow.

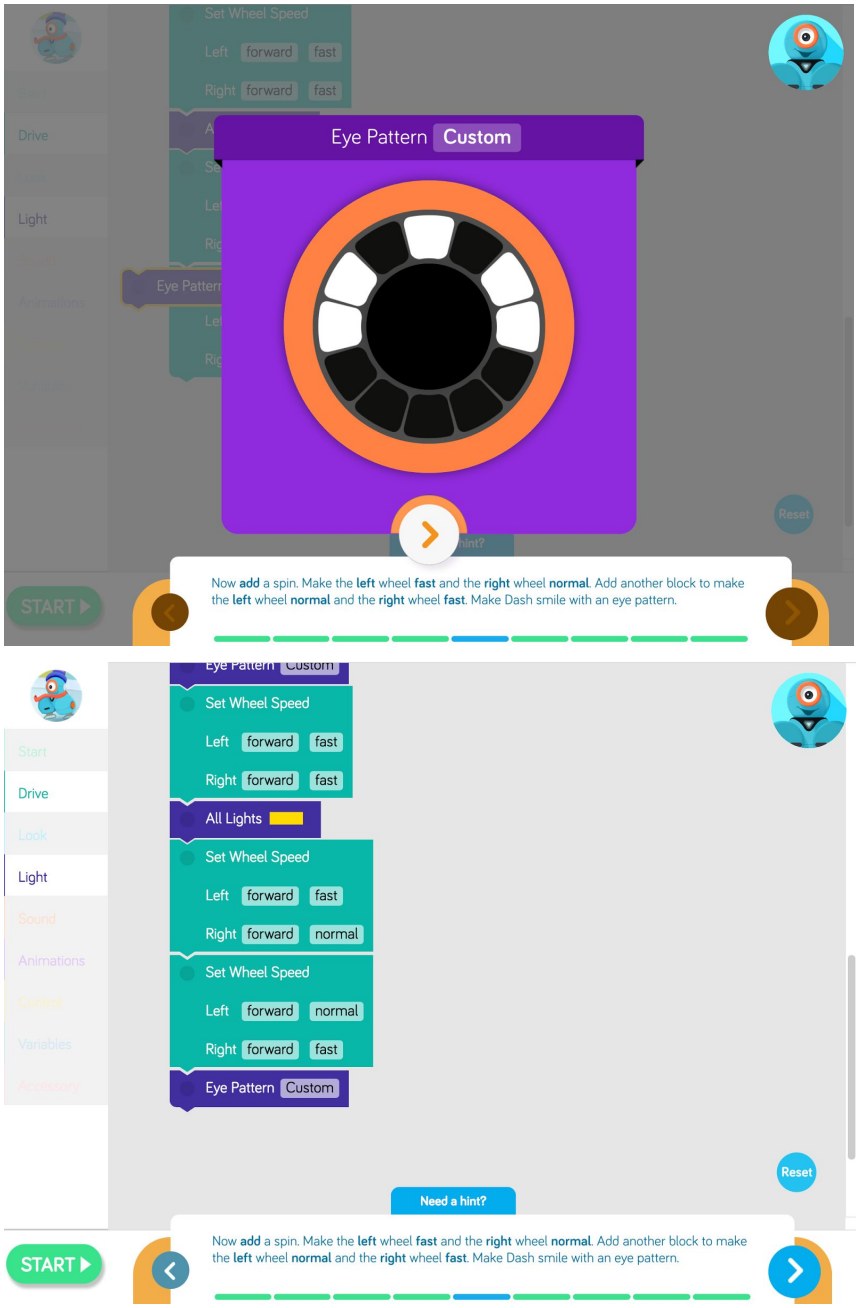


Challenge 5

Now **add** a spin. Make the **left** wheel **fast** and the **right** wheel **normal**. Add another block to make the **left** wheel **normal** and the **right** wheel **fast.** Make Dash smile an eye pattern.

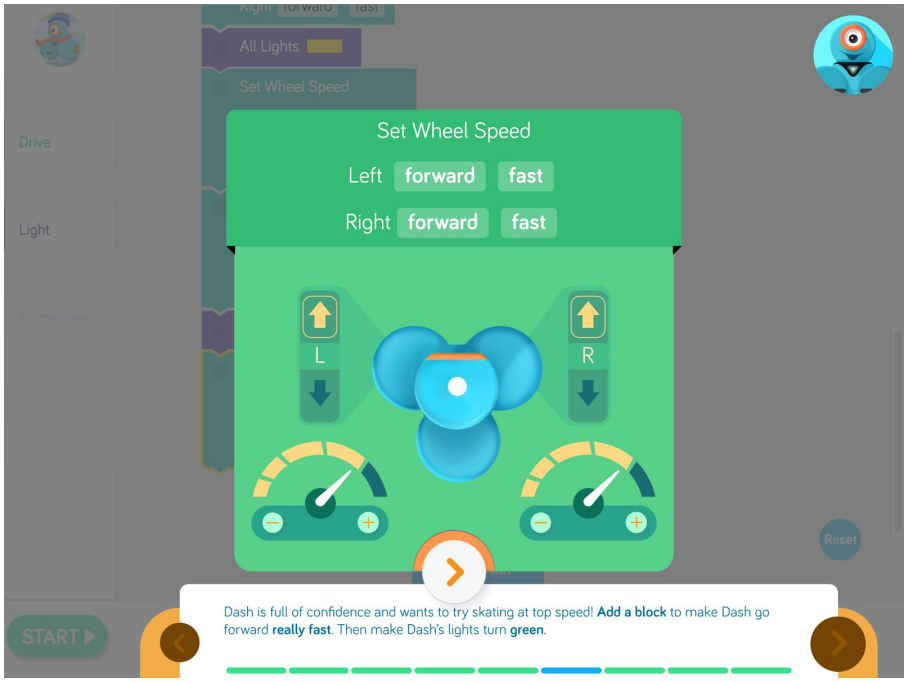

Left forward normal
Right forward normal
Drive
Light
Set Wheel Speed
Left forward fast
Right forward normal
L
R
Reset
START
Now add a spin. Make the left wheel fast and the right wheel normal. Add another block to make the left wheel normal and the right wheel fast. Make Dash smile with an eye pattern.

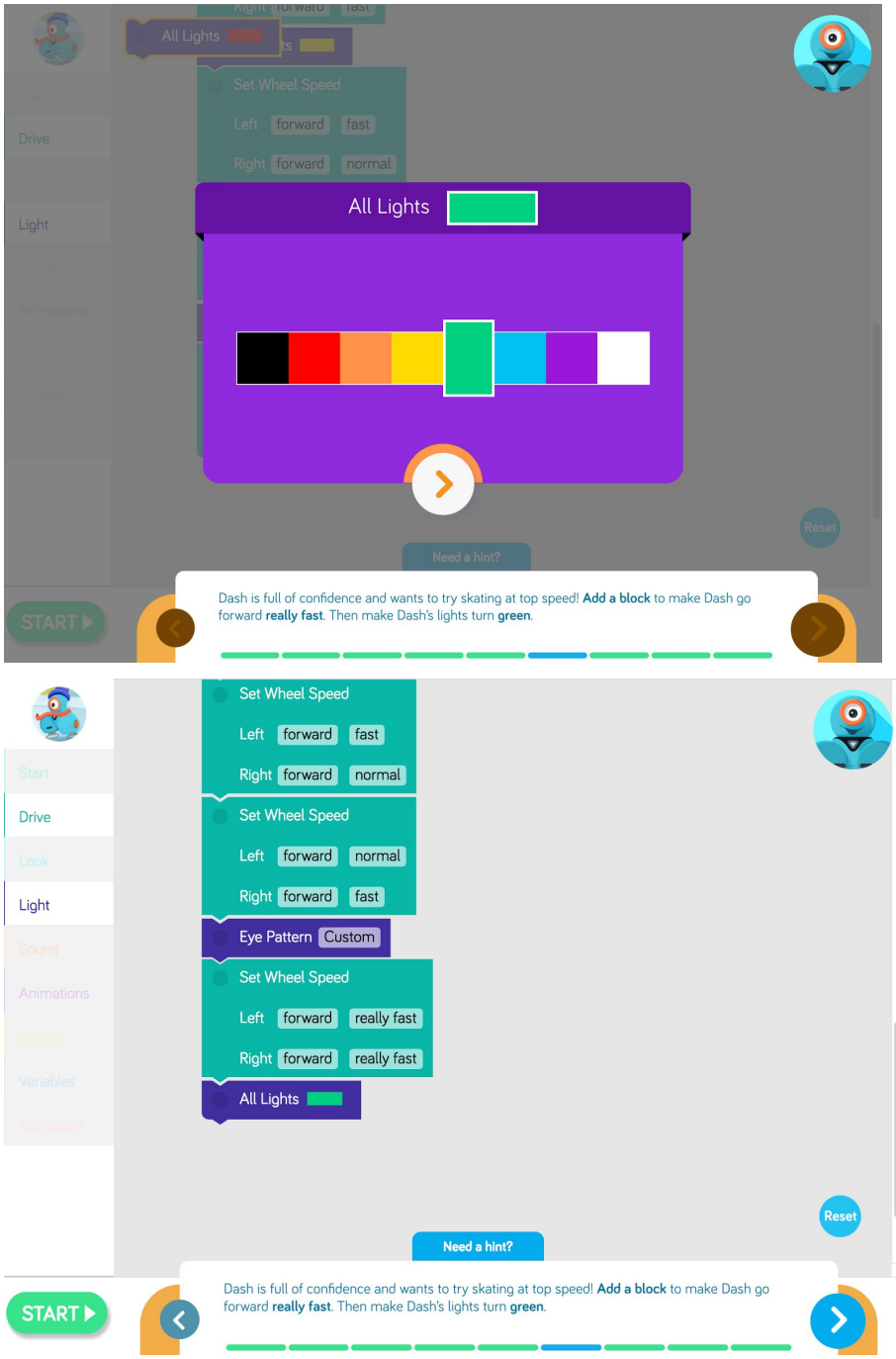

Left forward normal
Right forward normal
Drive
Light
Set Wheel Speed
Left forward normal
Right forward fast
L
R
Reset
START
Now add a spin. Make the left wheel fast and the right wheel normal. Add another block to make the left wheel normal and the right wheel fast. Make Dash smile with an eye pattern.



Challenge 6

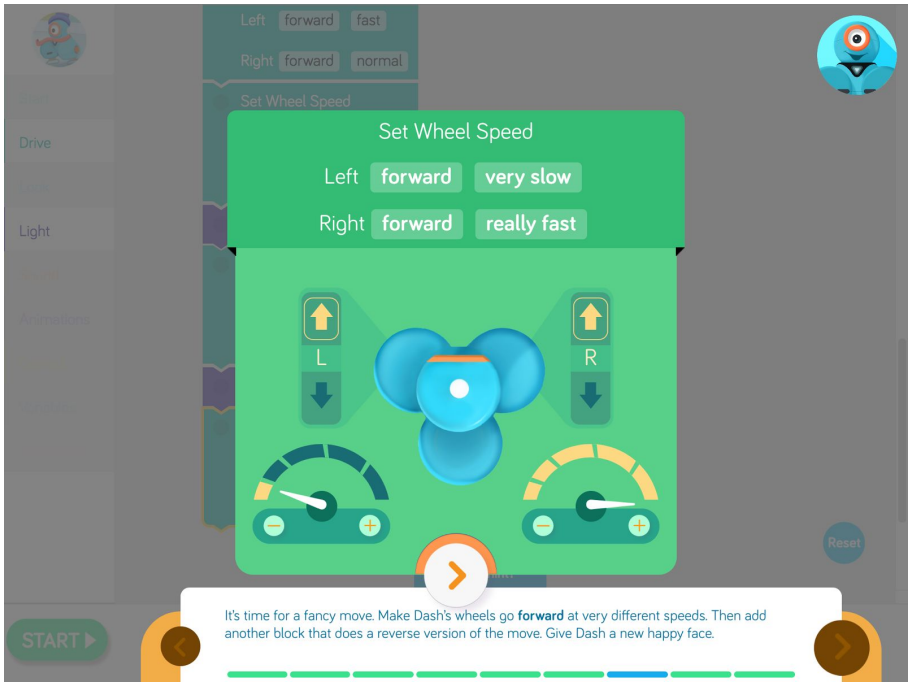
Dash is full of confidence and wants to try skating at top speed! **Add a block** to make Dash go forward **really fast.** Then make Dash's lights turn **green.**

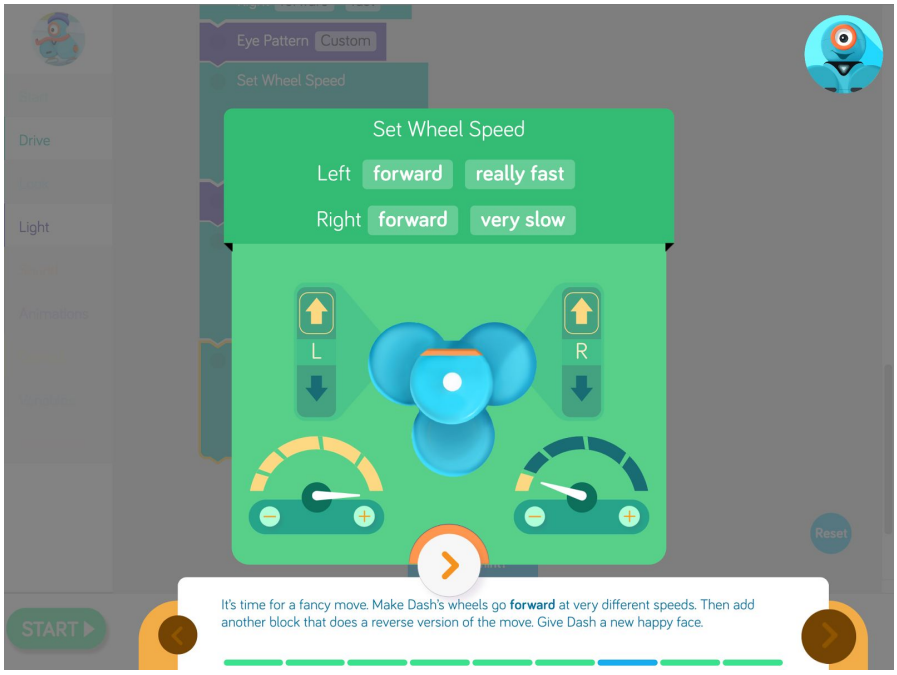

All Lights
Set Wheel Speed
Drive
Light
Set Wheel Speed
Left forward fast
Right forward fast
L
R
Reset
START
Dash is full of confidence and wants to try skating at top speed! Add a block to make Dash go forward really fast. Then make Dash's lights turn green.

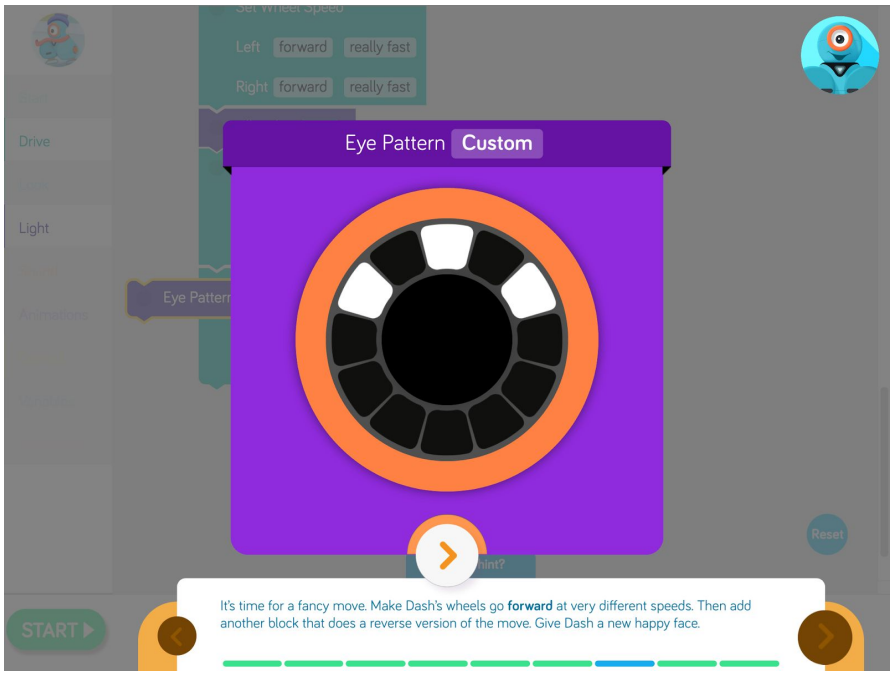


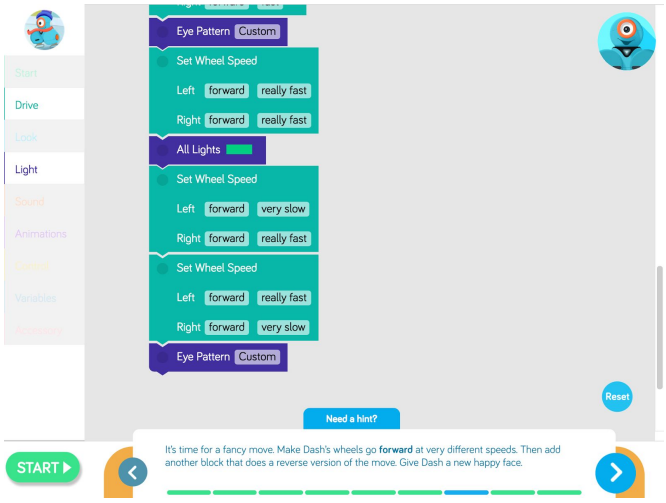
Challenge 7

It's time for a fancy move. Make Dash's wheels go **forward** at very different speeds. Then add another block that does a reverse version of the move. Give Dash a new happy face.


Left forward fast
Right forward normal
Set Wheel Speed
Drive
Light
Animations
Set Wheel Speed
Left forward very slow
Right forward really fast
L
R
Reset
START
It's time for a fancy move. Make Dash's wheels go forward at very different speeds. Then add another block that does a reverse version of the move. Give Dash a new happy face.

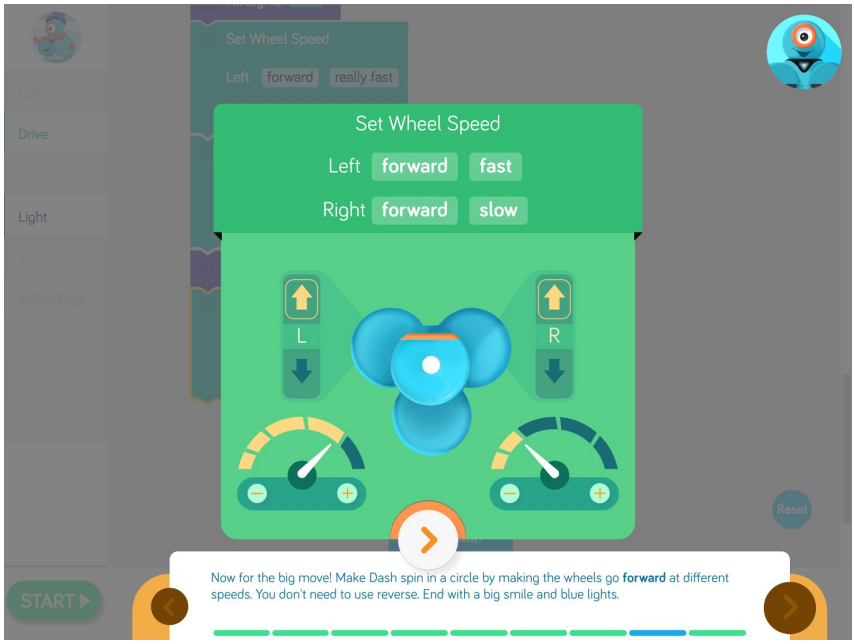

Eye Pattern Custom
Set Wheel Speed
Drive
Light
Animations
Set Wheel Speed
Left forward really fast
Right forward very slow
L
R
Reset
START
It's time for a fancy move. Make Dash's wheels go forward at very different speeds. Then add another block that does a reverse version of the move. Give Dash a new happy face.

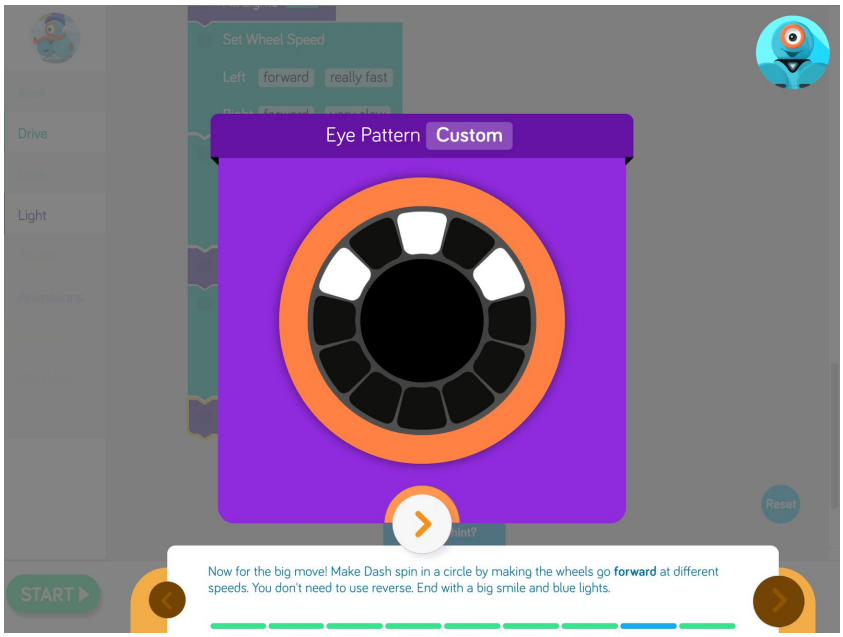

Left forward really fast
Right forward really fast
Drive
Light
Animations
Eye Pattern Custom
Reset
START
It's time for a fancy move. Make Dash's wheels go forward at very different speeds. Then add another block that does a reverse version of the move. Give Dash a new happy face.

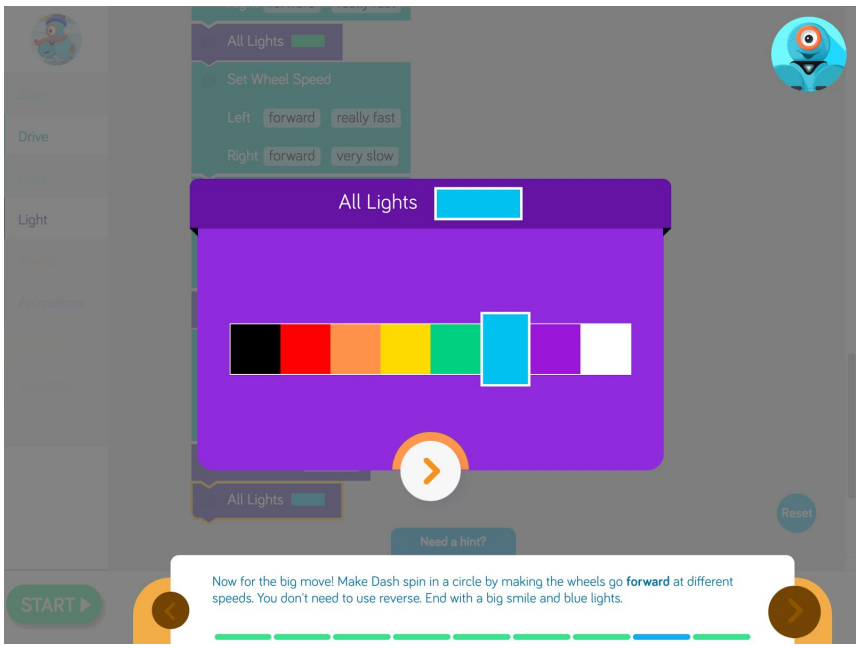


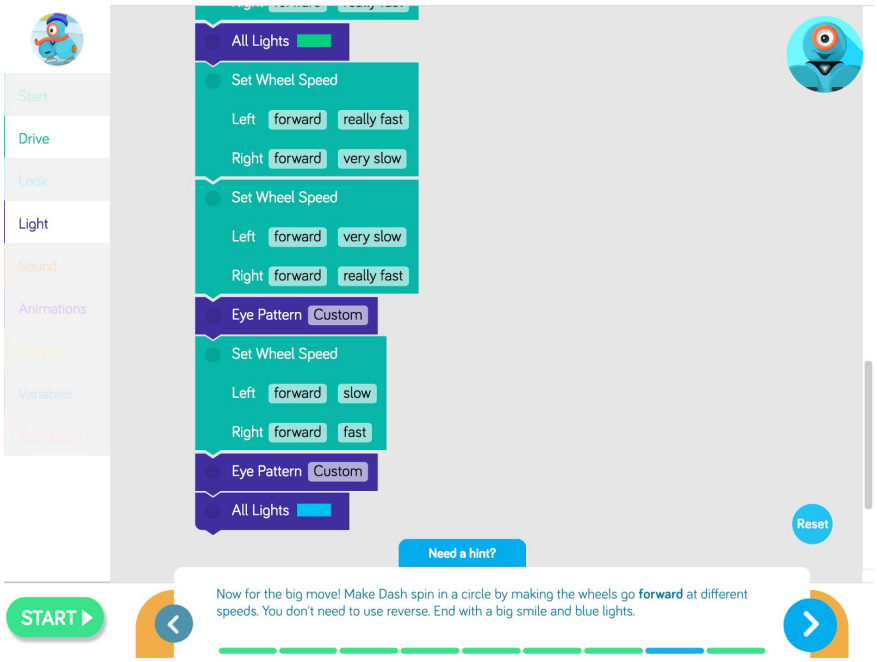
Challenge 8

Now for the big move~ Make Dash spin in a circle by making the wheels go **forward** at different speeds. You don't need to use reverse. End with a big smile and blue lights.


Set Wheel Speed
Left forward really fast
Drive
Light
Animations
Set Wheel Speed
Left forward fast
Right forward slow
L
R
Reset
START
Now for the big move! Make Dash spin in a circle by making the wheels go forward at different speeds. You don't need to use reverse. End with a big smile and blue lights.

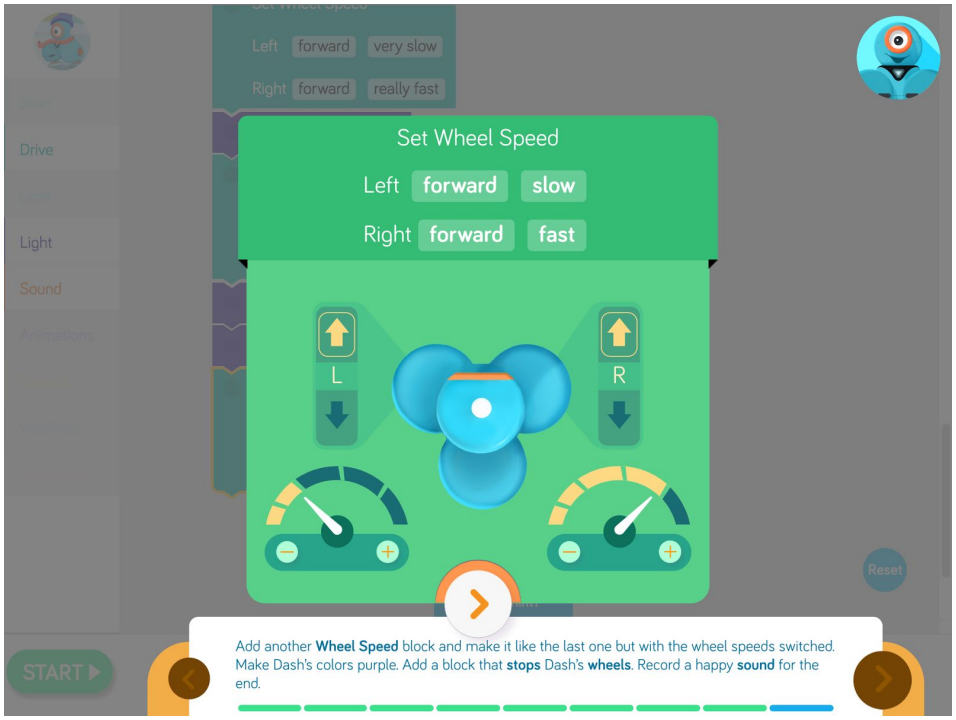

Set Wheel Speed
Left forward really fast
Drive
Light
Animations
Eye Pattern Custom
Reset
START
Now for the big move! Make Dash spin in a circle by making the wheels go forward at different speeds. You don't need to use reverse. End with a big smile and blue lights.

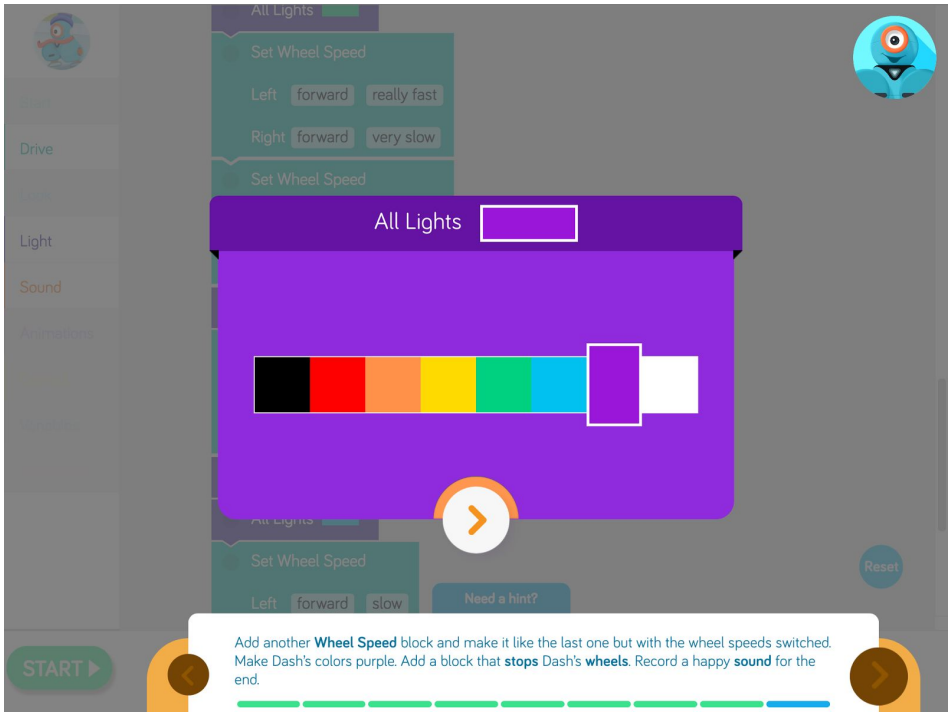




Challenge 9

Add another **Wheel Speed** block and make it like the last one but with the wheel speeds switched. Make Dash's colors purple. Add a block that **stops** Dash's **wheels**. Record a happy **sound** for the end.


Left forward very slow
Right forward really fast
Drive
Light
Sound
Animations
Set Wheel Speed
Left forward slow
Right forward fast
L
R
Reset
START
Add another Wheel Speed block and make it like the last one but with the wheel speeds switched. Make Dash's colors purple. Add a block that stops Dash's wheels. Record a happy sound for the end.


All Lights
Set Wheel Speed
Left forward really fast
Right forward very slow
Set Wheel Speed
All Lights
Drive
Light
Sound
Animations
Set Wheel Speed
Left forward slow
Need a hint?
Reset
START
Add another Wheel Speed block and make it like the last one but with the wheel speeds switched. Make Dash's colors purple. Add a block that stops Dash's wheels. Record a happy sound for the end.

Left forward very slow
Right forward really fast
Eye Pattern Custom
Set Wheel Speed
Left forward really fast
Right forward very slow
Eye Pattern Custom
All Lights
Set Wheel Speed
Left forward slow
Right forward fast
All Lights
Stop Wheels
My sounds #1
Start
Drive
Look
Light
Sound
Animations
Control
Variables
Accessory
Reset
Need a hint?
START
Add another Wheel Speed block and make it like the last one but with the wheel speeds switched. Make Dash's colors purple. Add a block that stops Dash's wheels. Record a happy sound for the end.