

SOLIDWORKS Apps for Kids are designed to inspire students to create, invent, and shape their futures, and BlocksCAD injects coding and mathematics into this engineering process. In conjunction, educators can engage their students in all essential steps of the design process.

## **Wearable Device**

with BlocksCAD and SOLIDWORKS Apps for Kids



### **LESSON SUMMARY**

In this activity, students will consider and practice how material scientists, designers, doctors, and engineers dream up and then build wearable health devices. They will use the SOLIDWORKS Apps for Kids for the ideation phase of their design, sculpting their object and decorating the model. Students will then use BlocksCAD to formally engineer their design using coding and transformations on 3D axes. Full standards alignment can be found below.

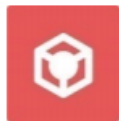


## CONSIDER THIS

Have you ever heard the term, “wearables?” It’s the name for devices people wear that collect data about the person’s activities and use that data in helpful ways. A common example of a wearable is a smartwatch that tracks you as you exercise to help you train better. Most wearables are designed by experts in the fields of electronics, software programming, materials science, and industrial engineering. Wearables have the potential to give people better information about themselves, and the things they do every day.

- What are some types of wearable electronics that could collect data about a person?
- What are some benefits of a device that monitors a person’s heart rate, blood pressure, and breathing rate while they exercise?
- How could a wearable technology, like a device that lets a person see Apps through their eyeglasses change the way people work and live?

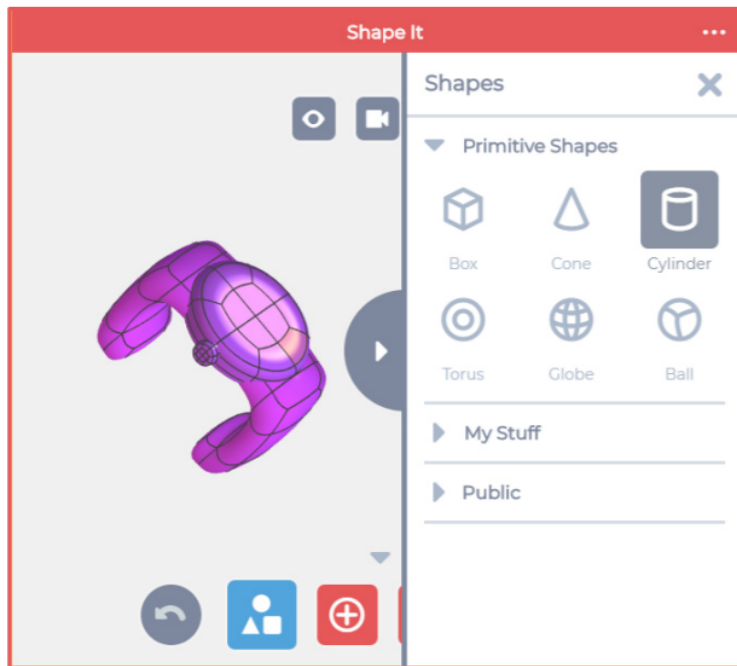
**TIP:** If the students are having trouble thinking of way wearables could impact people’s lives, ask them to consider situations where devices like smartphones, laptops, and tablets can’t be carried, or held while doing something important.



## MODELING THE NEW WEARABLE

Once the students have had time to consider the wearable devices they would like to create, have them launch SOLIDWORKS Apps for Kids Classroom. SOLIDWORKS has some video tutorials that can help students get familiar with the Shape It App’s basic features. Students can watch the videos by clicking the Help icon in the main menu at the top of the App. But since the Shape It App works a lot like modeling clay, many students will be comfortable jumping right in and learning about the App as they go.

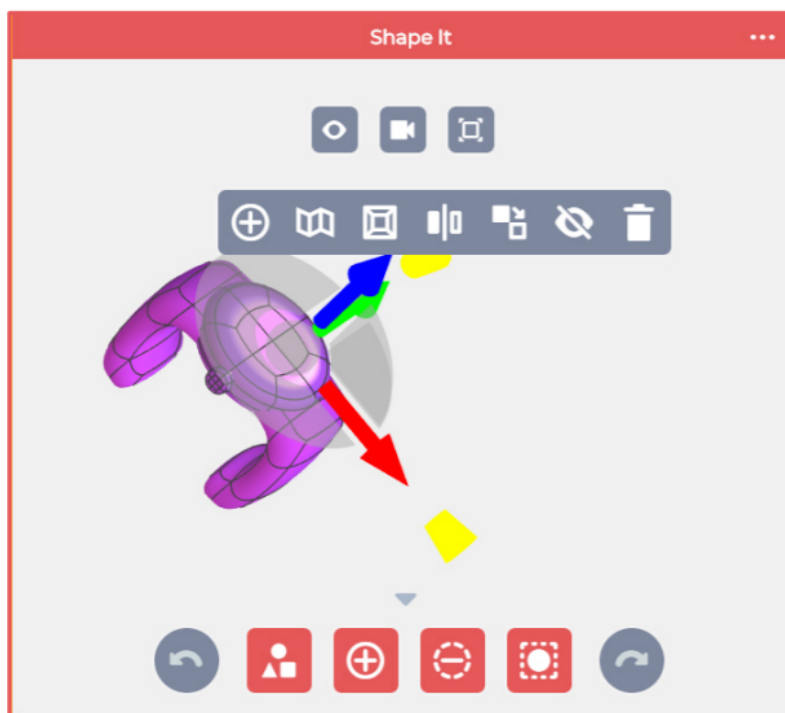
For inspiration we’ve created a few sample models for this exercise. You can access the Sample Content in the Sample Lessons section of the Organization tab in your Classroom account. Share this content to your class and the students can use it as a starting point by clicking the “Riff” button on the model they like. Students can also start completely from scratch by launching the Shape It App from the plus sign in the main menu at the top of the App.



The **Shape It** app allows students to place multiple objects together to make more complex models.

To add new shapes, click the Shapes button at the bottom of the app, then select the shape you want to add. If you want to work with a simple shape, choose the Box, Cone, or Cylinder. The app also allows you add more complex shapes like a Torus, Globe, or Ball as well.

Click the shape you want and it will be added to your model.



The **Shape It** app works similar to modeling clay. Just click on a section of a shape and drag it somewhere to begin changing the shape. You can also click on edges and corners between sections of a shape, and then drag those as well.

When you click on a section of a shape, a popup menu with more editing options appears. These extra options can allow you make big changes to the shape, like add new sections, smooth or sharpen a section, or even make a duplicate of the shape in the model.

Experiment with different options to see how creative you can be with your new device.



## DECORATING THE NEW WEARABLE

Once students have shaped their models, they can decorate them in the SOLIDWORKS Style It app to create a more unique design. Students can open the Style It app by clicking the Apps button in the main menu at the top of the app. Students should experiment with the different painting and styling tools in the app. Once the students have finished styling their new wearables, they can add in the Store background with the app's Scenes feature.

The Style It app has a collection of powerful styling tools for students to use:

- The Bucket tool lets students paint an entire shape a single color in Body Color mode, or paint just parts of a shape in Patch Color mode.
- The Paint tool lets students select a brush size and paint colors directly onto shapes.
- The Stickers tool lets students add even more detail with stickers on the shapes.
- The Scene tool lets students add a background picture to their model.



To add a background picture behind your wearable, click the Scene tool at the bottom of the app. This will open up the Scene tool side menu.

The Scene tool will let you add a background picture, or a solid color behind your model. Click either the scene or the color you'd like to complete the scene.

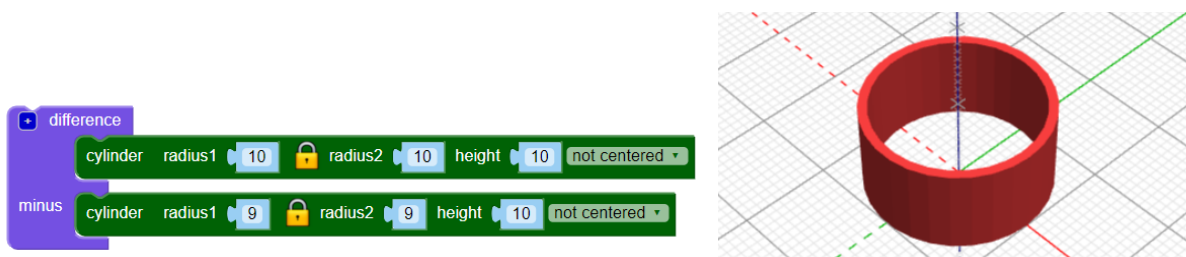
**TIP:** For this exercise, we recommend using the Store Scene to show how your new wearable might look in a department store or other professional setting one day.



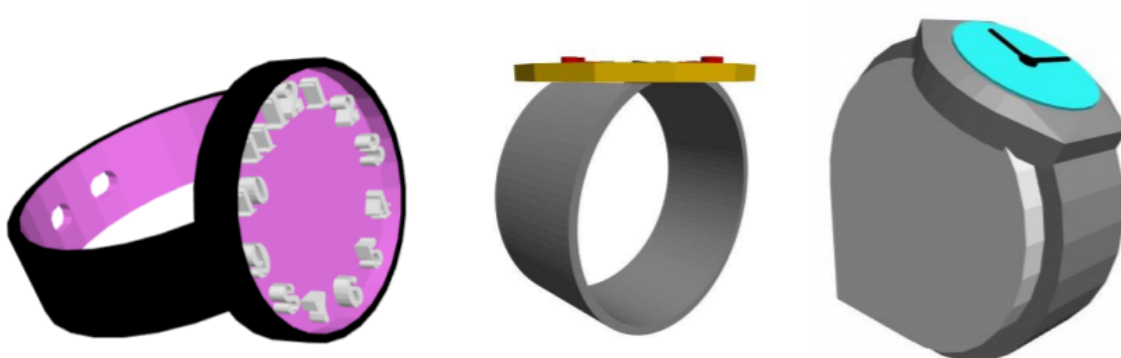
Now that students have explored possible shapes and styles for their new wearable, it's time for them to formally engineer their device by programming the exact specifications of their model.

Direct students to [www.blockscad3d.com](http://www.blockscad3d.com) and help them either login using their Google accounts or with new usernames and passwords. When they login they will be guided through a brief tutorial, but you can also show essential skill videos such as [translation](#), [rotation](#), and [scaling](#). Early in the building process students may be ready to learn how to [organize and label](#) their code.

In particular students will likely find the [difference block](#) a useful tool for carving one shape out of another, such as two cylinders to form a ring:



Teachers can use or share these [starting blocks](#) for the watch design shown below on the left. This example code can help students see how to build particular parts of the watch or can provide a starting foundation on which younger students can build the rest of their design.





## DISCUSSING WEARABLES

After students have shaped, styled, and programmed their models, have them consider and discuss the following questions about the future of wearable technology:

- Think about the wearable you created. Why did you choose that type of wearable?
- How is the look and design of your wearable important to the way it works?
- What are some of the things your wearables does to improve people's lives?
- What are some ways your wearable is better than current devices or technology?



## WEARABLES IN THE REAL WORLD

The videos listed below can help students explore and understand how industrial and commercial design affect how new products like wearables improve our world. Read the introduction paragraph below to the students, then have them view the videos for that topic. After students have viewed the videos, you can use the included questions to encourage discussion on those to.

**Engineering Good Designs:** Have you ever thought about how the products and devices are designed and made? In the following videos, you'll learn how mechanical and industrial engineers use their knowledge and experience with materials and intricate parts and mechanisms to turn ideas into the products we buy and use every day. After you watch the videos, you'll have a chance to talk about what these engineers do. So, pay attention to the skills needed to create amazing new products.

Day in the Life: Mechanical & Industrial Engineers: [www.youtube.com/watch?v=ocgceS7KlZE](http://www.youtube.com/watch?v=ocgceS7KlZE)

- Why do engineers go through so many different versions of a design for a new product?
- How would the products we use be different if engineers could only design and test one version of a product before it was sent out to stores?
- Why is teamwork important in creating new devices and products?
- What types of skills would be needed to design and build a real world version of the wearable you modeled?

An Industrial Designer works to create new technologies and products that will be mass produced. These engineers are typically part of a design team that works together to not only create new devices, but to also develop the processes needed to make them efficiently, and on a large scale. You can learn more about this career by going to: <http://bit.ly/career2100>



## PRINTING THE NEW WEARABLE

Students can print a 2D or 3D version of their new wearable in the SOLIDWORKS Print It app. Students can open the Print It app by clicking the Apps button in the main menu at the top of the app. The 2D Print feature can print out a color rendering of the wearable with the background selected in the Style It app. The 3D Print feature will let students download an STL file to be imported into the software that comes with most 3D printers. Students should make sure their models are scaled to fit within the printable area of their 3D printer before 3D printing.

Students can also export and print their BlocksCAD model using the “Generate STL” button in the bottom right corner or the render window:

STL (Binary) ▼

Generate STL

**TIP:** In either case, the 3D design may need modifications in order to maximize the flat surface and minimize delicate or dangling parts that pose challenges for the 3D printer.





## EDUCATOR RUBRIC

Section	Does Not Meet Expectations	Meets Expectations	Exceeds Expectations
<b>Consider This</b>	Student does not express opinions, or could not name any types of wearables.	Student is able to name some wearable devices and vegetables, or can express how they collect and use important data.	Student can express how wearables could be used in typical situations, e.g. monitoring a person's health or giving easy access to information.
<b>Modeling the New Wearable</b>	Student was unwilling or unable to add shapes and objects to a new model, or add or adjust objects in a riffed copy of an existing model.	Student modified an existing model or created a new one by adding or modifying shapes in the model.	Student demonstrated original creativity and/or artistic ability by making substantial modifications or new models that are associated with the goals of the lesson.
<b>Coding</b>	Student did not create a coded program to to arrange any 3D shapes.	Student used several different pieces of code to create a recognizable 3D object.	Student spatially organized and/or labeled many different pieces of code to create a cohesive 3D output.
<b>Transformation</b>	Student showed no evidence of understanding how to manipulate 3D objects in BlocksCAD.	Student was able to build a recognizable wearable in BlocksCAD using tools including translation and rotation..	Student used transformations including translation and rotation and intermediate tools like difference to creatively design a wearable model.
<b>Discussing Wearables (optional)</b>	Student was unwilling or unable to express why he/she created their wearable, or what the device would do.	Student was able to express reasoning for the new wearable device they created, and why the design is important to the device's functions.	Student was able to express reasoning for creating the wearable, how it is an improvement to current devices, and how it could improve people's lives.
<b>Wearables in the Real World (optional)</b>	Student did not express or understand how engineers work through design changes, or how wearables can impact jobs and careers.	Student is able to express how engineers work through design changes, or how wearables can impact jobs and careers.	Student is able to express how engineers work with others to create new products, or how wearables cold change the way people work in the future.





## STANDARDS ALIGNMENT

### CCSS Mathematics:

5.G.1: Use axes to define a coordinate system...Understand that the first number indicates how far to travel from the origin in the direction of one axis, and the second number indicates how far to travel in the direction of the second axis

7.G.1: Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.

8.G.1: Verify experimentally the properties of rotations, reflections, and translations.

HSG.CO.A.2: Represent transformations in the plane using, e.g., transparencies and geometry software.

### CSTA Coding:

1B-AP-11 Modularity: Decompose (break down) problems into smaller, manageable subproblems to facilitate the program development process.

2-AP-16 Program Development: Incorporate existing code, media, and libraries into original programs, and give attribution.

### NGSS Engineering and Life Science:

MS-ETS1-4: Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

MS-LS1-4: Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic specialized plant structures affect the probability of successful reproduction of plants.

HS-ESS3-2: Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.

HS-ESS3-4: Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.