OVERVIEW:

Lesson Plan 3

SUBROUTINES

Grades:	**K-2**
Group Size:	**Pairs**
Setup Time:	**5 minutes**
Total Time:	**100 minutes**
Activities:	**4**

LESSON PLAN OUTLINE

- Activity 1: KUBO Takes a Trip – 25 minutes
  - 2 tasks
- Activity 2: Your Turn to Be a Robot – 25 minutes
  - 2 tasks
- Activity 3: KUBO Goes to the Baker – 25 minutes
  - 2 tasks
- Activity 4: KUBO Leaves the Baker – 25 minutes
  - 2 tasks

OUTCOMES AND ASSESSMENT

- By the end of this section, students should be able to:
  - Build subroutines within functions.
  - Explain your subroutines to classmates.
  - Come up with stories to fit your subroutines.
  - Explain how your classmates' subroutines work.

TEACHER PREPARATION

- Make copies of worksheets for each student.
- Make sure all KUBOs have been fully charged before beginning.
- Find an appropriate place to do the activities. KUBO can be used on a table or the floor, but the surface must be level and clean. If you're using KUBO on a tabletop, make sure KUBO doesn't fall off the table.
- Help students find the TagTiles and activity map they will need. You might want to consider hanging up one activity map in front of the whole class to use for discussions and demonstrations.
- It's helpful to show students how to properly handle and store KUBO and TagTiles. Stress the importance of taking care of both KUBO and TagTiles.
- It's also helpful to let students know it's OK to make mistakes as long as they "debug" and figure out what they did wrong and how to fix it.
- When they create routes and functions, it is important for students to understand that KUBO has the same capabilities humans do. For example, KUBO can't drive through walls, fences, water, fire, and so forth.
- During some activities, students are asked to repeat subroutines more than one time. Since there are only two Play Function tiles, students might need to borrow Play Function tiles from another group.
- You might find it helpful to review with students what they have already learned before going on to teach the new material.

MANAGEMENT

- It is recommended the students be put in groups of two.
- You might find it helpful to create roles for students so that each student gets a turn being in charge of KUBO.
- You might find it helpful for students to detach KUBO's head from the body and put the tiles away in between activities or anytime you are giving instruction.
- You might also find it helpful to give students who are new to KUBO some time to free play and discover on their own so they will be more focused when receiving instruction.
- Circulate through the room and provide help as necessary. However, to encourage student-centered active learning, instruct students to follow the "ask three, then me" rule, in which they consult each other before they consult you.

CROSS-CURRICULUM CONNECTIONS

- The following cross-curriculum connections can be done as additional learning opportunities with the students and connect to different subjects.
  - Social Studies:
    - Teach students what it means to be visually impaired and how to help and get along with others who are different than themselves. Then, tell students to imagine KUBO is visually impaired and needs help crossing the street. Students must program two KUBOs to cross the street together.
  - ELA:
    - Read a book about money to students or have them read the book independently. Two great children's book examples are Lemonade in Winter by Emily Jenkins and G. Brian Karas and The Penny Pot by Stuart J. Murphy. Afterward, have students write or draw a story about KUBO working to make money and how KUBO chooses to spend or save money.
  - Math/Science:
    - Teach students about budgets. Have students create a budget for KUBO including a job for KUBO to have, how much money KUBO makes, and how much KUBO spends or saves. Have students answer word problems about the budget that involve dollar bills, cents, and dollar and cent signs (or relevant currency).

ACTIVITY 1:

KUBO Takes a Trip

OUTCOME

- Work with subroutines.
- Make two functions to complete a route and turn a function into a subroutine.

TIME

- 25 minutes

MATERIALS

- Movement TagTiles
- Blue Record and Play Function tiles
- Red Record and Play Function tiles
- Pencils
- KUBO
- Activity map

TEACHER NOTES

- Students make two functions and then combine their functions using a subroutine.
- To see how subroutines are built, watch the video on the KUBO site (*kubo.education/coding-license*).
- Students need to have KUBO memorize a new red function with a blue subroutine.
- If students' code doesn't work, they might need to debug as necessary.
- To help students keep their route in the correct order when turning it into a function or subroutine, have one student take the tiles off the route one at a time and hand them to his or her partner. The partner should put them in the correct order one at a time when making the function.

DISCUSSION QUESTIONS

- Will all groups solve the problem in the same way? Why not?
- What do you need to remember when making subroutines?
- Did KUBO go where you wanted, or do you need to debug your functions?
- How do you make KUBO execute the blue function?
- Why are subroutines useful?

ACTIVITY 1:

KUBO Takes a Trip

REFLECTION

- If you had to debug your code, what did you do to fix it?
- Why is it smart to make a subroutine? When could you use one in your life?

EXTENSION

- Create the shortest possible subroutine for KUBO to complete.
- Create the longest possible subroutine for KUBO to complete.

NOTES

ANSWER KEY

Possible route students could create for Task 1:

Possible blue function students could create for Task 1:

Possible red function students could create for Task 1:

Possible function students could create for Task 1:

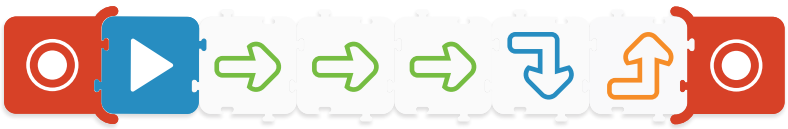
Possible route students could create for Task 2:

ANSWER KEY

Possible blue function students could create for Task 1:

Possible red function students could create for Task 1:

Possible function students could create for Task 2:



ACTIVITY 2:

Your Turn to Be a Robot

OUTCOME

- Work with subroutines.
- Use your body to execute functions and understand subroutines

TIME

- 25 minutes

MATERIALS

- Worksheet 3.2
- Pencils
- Paper
- Scissors

TEACHER NOTES

- Students cut out the red and blue functions from Worksheet 3.2 and sort them into two piles.
- Then, students choose one function from each pile and discuss how they're going to execute them.
- After they have discussed what they will do, one student executes the blue function and the other, the red.
- You might find it helpful to print out the large red and blue Play Function tiles from the appendix and place them on the floor. Then, have students execute their functions when their feet touch the Play Function tile just like KUBO executes functions when placed on the Play Function tile.
- Students then make their own functions and subroutines using pencils and paper.
- Some students might struggle drawing their own functions on blank pieces of paper. It might help to provide some kind of blank paper with a grid or lines similar to the activity map to make it easier for students to draw the functions.

DISCUSSION QUESTIONS

- How did you execute subroutines using your own bodies?

REFLECTION

- What tricks or tools help you remember how subroutines work?
- When would you not use a subroutine?

ACTIVITY 2:

Your Turn to Be a Robot

EXTENSION

- Choose two different functions from each pile. Decide how to execute them.
- Use another group's subroutine and try it out. Can you predict where you will end up?

NOTES

ACTIVITY 3:

KUBO Goes to the Baker

OUTCOME

- Work with subroutines.
- Create stories to match the actions you program KUBO to do on the activity map. You must use at least one subroutine.

TIME

- 25 minutes

MATERIALS

- Movement TagTiles
- Blue Record and Play Function tiles
- Red Record and Play Function tiles
- KUBO
- Activity map
- Worksheet 3.3
- Pencils

TEACHER NOTES

- Students need to split their story into two sections; each student will be responsible for building the function for one section.
- Students put the two functions together so one becomes a subroutine.
- Students also need to identify and debug any mistakes.
- Students then turn their story into a comic and draw it on Worksheet 3.3. They must draw their functions as well.
- Students may come up with more stories and repeat this activity until they are comfortable with the concept of subroutines.

DISCUSSION QUESTIONS

- After KUBO has purchased the cake, how will you help KUBO get back to school again?
- What is a subroutine? How do you make one?
- Can you come up with a short story in which KUBO starts at one spot, move to a second, and then moves on to a third?
- Did KUBO go where you wanted?

ACTIVITY 3:

KUBO Goes to the Baker

REFLECTION

- What does it mean to debug your work?
- Explain the importance of debugging your work.

EXTENSION

- Show your comics to the class and explain how you used subroutines in your stories.
- Take one of your functions and make KUBO execute the subroutine twice. Can you predict where KUBO will end up?

NOTES

ACTIVITY 4:

KUBO Leaves the Baker

OUTCOME

- Work with subroutines.
- Create stories to match the actions you program KUBO to do on the activity map. You must start at the baker.

TIME

- 25 minutes

MATERIALS

- Movement TagTiles
- Blue Record and Play Function tiles
- Red Record and Play Function tiles
- KUBO
- Activity map
- Pencils
- Paper

TEACHER NOTES

- Students must create a story that makes KUBO move to six different spots on the activity map. KUBO must start at the baker.
- Students need to split their story into two sections; each student will be responsible for building the function for one section.
- Students put the two functions together so one becomes a subroutine.
- Students also need to identify and debug any mistakes.
- Students may come up with more stories and repeat this activity until they are comfortable with the concept of subroutines.

DISCUSSION QUESTIONS

- After KUBO has purchased the cake, where will KUBO go next?
- Can you come up with a story where KUBO starts at the baker and goes to six different spots on the activity map?
- Did you have any mistakes you had to debug? If so, what did you do wrong?
- What new story and subroutines can you come up with for KUBO?

ACTIVITY 4:

KUBO Leaves the Baker

REFLECTION

- When you're making subroutines, what helps make it easier for you?
- When do you think is the best time to use subroutines?

EXTENSION

- Create the shortest possible function with a subroutine for KUBO to leave the baker.
- Take one of your functions and make KUBO execute the subroutine three times. Can you predict where KUBO will end up?

NOTES

Appendix

PRINTABLE PAGES

- Student worksheets
  - In order by lesson plan and then activity
  - Printable large images of the TagTiles on paper, which will allow younger students to more easily do Task 1 in Lesson Plan 1 and also Task 2 in Lesson Plan 3.
- Coding certificate diploma
- Activity map
- Blank activity map

All printable material can be downloaded from *kubo.education/coding-license*

Standards Addressed

US ISTE CURRICULUM STANDARDS

	KUBO CODING				KUBO CODING+		
Learning Outcome	**LP 1: Routes**	**LP 2: Functions**	**LP 3: Subroutines**	**LP 4: Loops**	**LP 1: Refresher course**	**LP 2: Advancing programming**	**LP 3: Challenge master**
1a Students articulate and set personal learning goals, develop strategies leveraging technology to achieve them and reflect on the learning process itself to improve learning outcomes.	•	•	•	•	•	•	•
1b Students build networks and customize their learning environments in ways that support the learning process.	•	•	•	•	•	•	•
1c Students use technology to seek feedback that informs and improves their practice and to demonstrate their learning in a variety of ways.	•	•	•	•	•	•	•
1d Students 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.	•	•	•	•	•	•	•
2a Students cultivate and manage their digital identity and reputation and are aware of the permanence of their actions in the digital world.							
2b Students engage in positive, safe, legal, and ethical behavior when using technology, including social interactions online or when using networked devices.							
2c Students demonstrate an understanding of and respect for the rights and obligations of using and sharing intellectual property.							
2d Students manage their personal data to maintain digital privacy and security and are aware of data-collection technology used to track their navigation online.							
3a Students plan and employ effective research strategies to locate information and other resources for their intellectual or creative pursuits.							
3b Students evaluate the accuracy, perspective, credibility, and relevance of information, media, data, or other resources.							
3c Students curate information from digital resources using a variety of tools and methods to create collections of artifacts that demonstrate meaningful connections or conclusions.							
3d Students build knowledge by actively exploring real-world issues and problems, developing ideas and theories, and pursuing answers and solutions.					•	•	•
4a Students know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.	•	•	•	•	•	•	•
4b Students select and use digital tools to plan and manage a design process that considers design constraints and calculated risks.	•	•	•	•	•	•	•

Standards Addressed

US ISTE CURRICULUM STANDARDS

	KUBO CODING				KUBO CODING+		
Learning Outcome	LP 1: Routes	LP 2: Functions	LP 3: Subroutines	LP 4: Loops	LP 1: Refresher course	LP 2: Advancing programming	LP 3: Challenge master
4c Students develop, test and refine prototypes as part of a cyclical design process.	•	•	•	•	•	•	•
4d Students exhibit a tolerance for ambiguity, perseverance and the capacity to work with open-ended problems.	•	•	•	•	•	•	•
5a Students formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models and algorithmic thinking in exploring and finding solutions.	•	•	•	•	•	•	•
5b Students collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.	•	•	•	•	•	•	•
5c Students break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.	•	•	•	•	•	•	•
5d Students understand how automation works and use algorithmic thinking to develop a sequence of steps to create and test automated solutions.	•	•	•	•	•	•	•
6a Students choose the appropriate platforms and tools for meeting the desired objectives of their creation or communication.	•	•	•	•	•	•	•
6b Students create original works or responsibly repurpose or remix digital resources into new creations.	•	•	•	•	•	•	•
6c Students communicate complex ideas clearly and effectively by creating or using a variety of digital objects such as visualizations, models or simulations.	•	•	•	•	•	•	•
6d Students publish or present content that customizes the message and medium for their intended audiences.	•	•	•	•	•	•	•
7a Students use digital tools to connect with learners from a variety of backgrounds and cultures, engaging with them in ways that broaden mutual understanding and learning.							
7b Students use collaborative technologies to work with others, including peers, experts, or community members, to examine issues and problems from multiple viewpoints.							
7c Students contribute constructively to project teams, assuming various roles and responsibilities to work effectively toward a common goal.					•	•	•
7d Students explore local and global issues and use collaborative technologies to work with others to investigate solutions.							•

Standards Addressed

UK NATIONAL CURRICULUM COMPUTER SCIENCE STANDARDS

			KUBO CODING				KUBO CODING+		
	Learning Outcome	Curriculum Aspect	LP 1: Routes	LP 2: Functions	LP 3: Subroutines	LP 4: Loops	LP 1: Refresher course	LP 2: Advancing programming	LP 3: Challenge master
AIMS	**The national curriculum for computing aims to ensure that all pupils:**								
	can understand and apply the fundamental principles and concepts of computer science, including abstraction, logic, algorithms and data representation	CS	•	•	•	•	•	•	•
	can analyse problems in computational terms, and have repeated practical experience of writing computer programs in order to solve such problems	CS	•	•	•	•	•	•	•
	can evaluate and apply information technology, including new or unfamiliar technologies, analytically to solve problems	IT	•	•	•	•	•	•	•
	are responsible, competent, confident and creative users of information and communication technology	DL	•	•	•	•	•	•	•
KEY STAGE 1	Understand what algorithms are	CS	•	•			•	•	•
	Understand that algorithms are implemented as programs on digital devices	CS	•	•				•	•
	Understand that programs execute by following precise and unambiguous instructions	CS	•	•			•	•	•
	Create simple programs	CS	•	•			•	•	•
	Debug simple programs	CS	•	•			•	•	•
	Use logical reasoning	CS	•	•			•	•	•
	Predict the behaviour of simple programs	CS	•	•			•	•	•
	Use technology purposefully to create, organise, store, manipulate and retrieve digital content	IT	•	•			•	•	•
	Recognise common uses of information technology beyond school	DL							

Standards Addressed

UK NATIONAL CURRICULUM COMPUTER SCIENCE STANDARDS

			KUBO CODING				KUBO CODING+		
	Learning Outcome	Curriculum Aspect	LP 1: Routes	LP 2: Functions	LP 3: Subroutines	LP 4: Loops	LP 1: Refresher course	LP 2: Advancing programming	LP 3: Challenge master
KEY STAGE 1	Use technology safely and respectfully	DL	•	•			•	•	•
	Keep personal information private	DL							
	Identify where to go for help and support when they have concerns about content or contact on the internet or other online technologies.	DL							
KEY STAGE 2	Design programs that accomplish specific goals	CS	•	•	•	•	•	•	•
	Write programs that accomplish specific goals	CS	•	•	•	•	•	•	•
	Debug programs that accomplish specific goals	CS	•	•	•	•	•	•	•
	Control or simulate physical systems	CS	•	•	•	•	•	•	•
	Solve problems by decomposing them into smaller parts	CS			•	•	•	•	•
	Use sequence in programs	CS	•	•	•	•	•	•	•
	Use selection in programs	CS							
	Use repetition in programs	CS				•	•	•	•
	Work with variables	CS							
	Work with inputs	CS	•	•	•	•	•	•	•

Standards Addressed

UK NATIONAL CURRICULUM COMPUTER SCIENCE STANDARDS

			KUBO CODING				KUBO CODING+		
	Learning Outcome	Curriculum Aspect	LP 1: Routes	LP 2: Functions	LP 3: Subroutines	LP 4: Loops	LP 1: Refresher course	LP 2: Advancing programming	LP 3: Challenge master
KEY STAGE 2	Work with outputs	CS	•	•	•	•	•	•	•
	Use logical reasoning to explain how some simple algorithms work	CS	•	•	•	•	•	•	•
	Use logical reasoning to detect and correct errors in algorithms and programs	CS	•	•	•	•	•	•	•
	Understand computer networks including the internet	CS							
	Understand they can provide multiple services, such as the world wide web	CS							
	Understand the opportunities they offer for communication and collaboration	DL							
	Use search technologies effectively	IT							
	Appreciate how results are selected and ranked	CS	•	•	•	•	•	•	•
	Be descerning in evaluating digital content	DL							
	Select, use and combine a variety of software (including internet services) on a range of digital devices to design and create a range of programs, systems and content that accomplish given goals, including collecting, analysing, evaluating and presenting data and information	IT							
	Use technology safely, respectfully and responsibly	DL	•	•	•	•	•	•	•
	Recognise acceptable/unacceptable behaviour	DL							
	Identify a range of ways to report concerns about content and contact	DL							