arm School Program

How the Arm School Program Can Help Teachers and Learners

Computing has transformed society in innumerable exciting ways. Part of our mission is to work with teachers and educational experts like you to spark learners' interest and engagement in the subject.

Arm's technology is in billions of devices – from supercomputers, mobile phones and cars to small computers from a vast range of ecosystem partners. Many of these devices, including micro:bit, Raspberry Pi and Arduino, are popular in education. Arm's School Program works with education and technology partners to support teachers and learners in STEM & computing education. Discover our range of professional learning support for teachers, plus our teaching & learning resources, which are linked to the computer science curriculum.

If you're interested in improving your learners' engagement in Computing, we can help. Project-based learning (PBL), combined with Physical Computing, offers a way for learners to experience the thrill of innovating while also gaining and practicing the skills and knowledge they need.

If you would like to learn how to deliver PBL effectively, we offer a range of free-to-access professional development courses as well as structured teaching and learning materials, which can support you from beginner to experienced PBL practitioner:

- **Support and training for teachers** — professional development courses and communities for Computing and STEM teachers. Visit page 07 to find out more.
- **Free-to-access teaching and learning resources** on arm.com/schools, linked to the Computer Science curriculum. Visit page 08 to find out more.

What Do We Mean by “Project-Based Learning”?

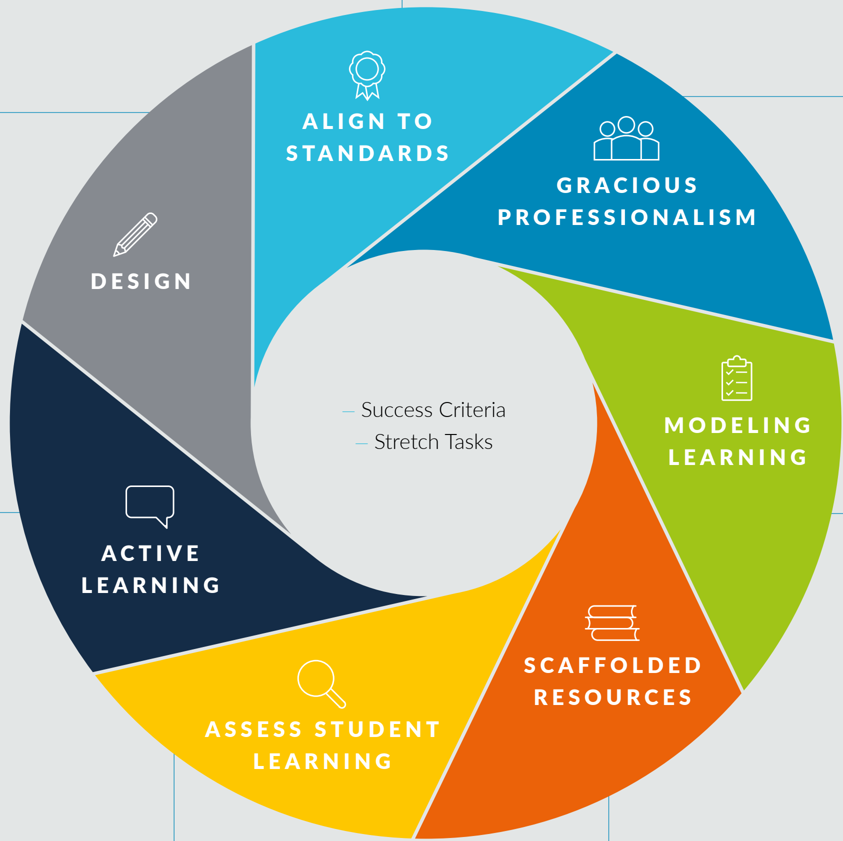
The Arm School Program’s approach to project-based learning is designed to give you the confidence and the tools you need to engage your learners in rewarding and meaningful learning experiences. It is informed by the learning theories of constructionism, cognitivism, and behaviorism.

Our teaching and learning resources are grounded in the following principles:

1. Context for Inclusion (Page 03)
2. Scaffolding for Differentiation (Page 03)
3. Computing for Real-World Problem-Solving (Page 04)
4. Curriculum Links for Teaching Relevance (Page 04)

The Arm School Program approach to PBL is carefully structured to create meaningful learning experiences that engage all learners.

Whether you do a PBL lesson once a week or every 2 or 3 weeks, this could really help shift your learners’ perception of the subject, sparking their interest in pursuing a career in tech.



– CSTA Mapping
– UK GCSE Mapping

– Teamwork
– Collaboration
– Soft Skills
– Communication

– Activity Sheets
– Cheat Sheets

– Lesson Plans
– Slide Decks

– Formative and Summative Assessment of Computing Skills/Knowledge

– Context Driven Problems
– Engaging and Real World
– Technology Focused

– IPO
– Design Templates

1. Context for Inclusion

Your interest in PBL might start with its potential to improve learner engagement. An important step towards this goal is to choose both a context that is meaningful to your learners and a problem that motivates them.

Solving real-world problems provides learners with motivation that can lower barriers to learning. Using a PBL approach to guide learners in solving the problem encourages them to practice a range of skills along the way. These include, for example, critical thinking, teamwork, and communication skills. With a little creativity, any context can be used for a PBL project. Some contexts also offer opportunities for learners to explore societal challenges. A project that focuses on automating crop watering in developing countries is more suitable than one that involves creating robots to be used in war, for example.

SUSTAINABLE DEVELOPMENT GOALS

The UN's Sustainable Development Goals (SDGs) present a range of global issues that can be used as context for problems in PBL. Many of the resources from the Arm School Program link to the Global Goals. For example, the oil-spill cleaner-upper activity on page 05 links to Goal 14 'Life Below Water', as well as Goal 12 'Responsible Consumption and Production'.

2. Scaffolding for Differentiation

Every learner is different. When faced with a problem to solve, each learner requires a different level of support. For some, simply having a target to aim towards will be enough to get them working towards a solution. Other learners need step-by-step instructions to get them started and build their confidence. Many will fall somewhere in between—requiring occasional hints and tips to unstick them along the way. No matter what the level of ability or confidence of their learners, the teacher's goal is to keep them in the zone of proximal development by providing only enough support to ensure progression throughout the lesson. This encourages learners to be resilient, creative, collaborative, and independent. The combination of shaped learning and free expression underpins the Arm School Program methodology. It combines aspects of a formal, didactic approach with classic discovery learning.

This method of teaching is often alien to teachers who prefer to "drive" a lesson from the front. Partially letting go can be uncomfortable. The Arm School Program can help you make this shift when you teach a PBL lesson. In our resources, we provide detailed lesson plans, as well as a variety of scaffolded resources. The resources are also available in editable formats to allow you to adapt them to suit your learners.

3. Computing for Real-World Problem-Solving

As we know at Arm, computing is all about creative problem-solving. In project-based learning, the learner is not a passive recipient of knowledge, but an active participant. The combination of problem, guidance, hardware, making, and creativity can lead to highly engaging lessons.

The Arm School Program's approach combines PBL with physical computing, which means learning is expressed through physical artifacts. Developing a physical solution to a problem means that learners can see and hold the result of their learning in the shape of motors, LEDs, and more, rather than just seeing a "Hello World" in an integrated development environment (IDE).

Creating physical artifacts requires an element of planning, which is encouraged by our design sheets and input–process–output (IPO) tables. Then, there are the additional challenges of building, making, and programming the solution, as well as testing it once complete. Arm School Program lessons mirror aspects of computing in industry, encouraging learners to collaborate and communicate with their teammates as they develop and iterate solutions. The more learners engage with this style of learning, the more their resilience and confidence grow.

4. Curriculum Links for Teaching Relevance

As a teacher, you need to know how teaching and learning resources support you in covering the curriculum with your learners.

That's why all our classroom-based resources are cross-referenced with formal curriculum standards, such as the UK Computing subject content, or the US CSTA standards. The teachers and educationalists who develop Arm School Program resources refer to these standards throughout the development process. This ensures that the levelling is appropriate and that they cover as much of the curriculum as possible.

Project-Based Learning
+ Physical Computing
= Arm School Program

How Do We Structure Our Resources?

Our projects are the basis for Arm School Program resources. They apply a consistent set of headings, which allow you to provide the right level of scaffolding for each of your learners. We call this our "Project Schema." This flexible schema enables learners to engage easily with complex projects, confident in what they need to do and why they are doing it. The projects can be done in teams or on an individual basis.

Success Criteria

The success criteria are a list of SMART (specific, measurable, achievable, relevant, and time-bound) objectives for the learner, based on the context set out in the "Getting Started" section. They are essentially the learning outcomes and the deliverables for the project, presented as a checklist for the learner. Clear success criteria help ensure learners stay on task, and the teacher can use them to assess learners' progress quickly. Learners should be frequently reminded to compare their designs and solutions against these criteria. Some success criteria can be very specific, and others can be more open-ended to allow for more creative problem-solving.

Now your learners can begin developing their ideas. It's important to encourage learners to consider the feasibility of their ideas: can they build their project in the time given and with the resources they have access to?

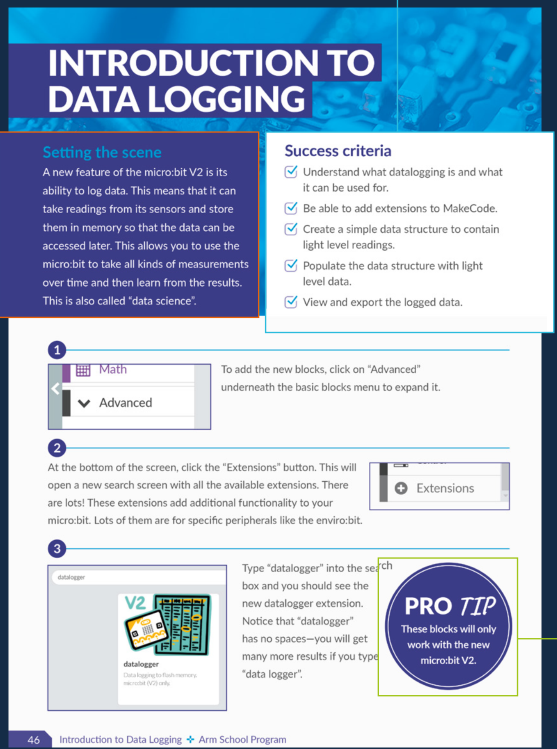
This project was designed for middle-school learners (11–14-year-olds), and we provide some scaffolding to get them thinking about the inputs, processes, and outputs (the IPO model). This model helps learners to make the link between the code and the real world. It neatly shows how the physical computing elements provide inputs, processing, and outputs, and how they all need to work together to meet the success criteria.

Getting Started

In "Getting Started," the project is introduced and the context is explained to ensure that learners have a good understanding of the problem they need to solve. Read "Contexts for Inclusion" on page 03 for more on our approach.

In this section, we also start to introduce project constraints. These are vital to ensure both that the project is achievable and that the learners focus on a well-defined problem. The problems are designed to be solvable by students in the age range and to use computational techniques with which learners should be familiar.

It's important to introduce the challenge in an interesting and engaging way to stimulate the learners' imagination and enthusiasm.



Pro-Tips

Pro-tips can be tips, examples, or common tripping-up points that you may wish to highlight for your learners. We write them when the projects are being tested.

In this example, the learner is provided with some guidance on how to build the solution, and also how to wire the micro:bit with the motors. This type of scaffolding for the elements of physically building the project is often needed. Typically, learners do not learn about basic electronics until later in their education, and they may disengage from the project if they don't know how to wire the components together.

A pro-tip might also guide learners through any coding that is needed. It could provide some starter code or blocks. The learner is then expected to complete the rest independently. This is an important point of differentiation. Some learners won't need any support in coding; others will need lots of guidance. In our example, we provide just the first few steps of the algorithm, and then learners can extrapolate this to solve the full problem.

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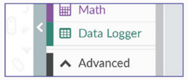
You will now see the Data Logger blocks at the bottom of the basic blocks menu.



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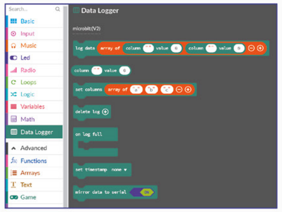
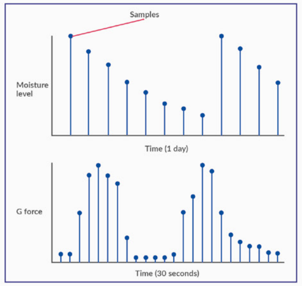


These are all the blocks in the datalogger extension. You now have all the extra blocks you need, but let's quickly look at what datalogging is and how it works.

6

Datalogging is where you record data over a given amount of time. That data can be anything the micro:bit can take as an input, for example, temperature or light levels. This data can be sampled quickly or slowly. For example, if you wanted to log the Gs your scooter gets on a halfpipe then you would sample a lot of data over a short time. If you were measuring light and moisture levels for a plant in a greenhouse, you would sample much more slowly for a longer period, like every hour. This sampling rate is also referred to as "automatic logging".

You can already take inputs and process them, but these blocks allow you to store this data and then do something with it later on. This is really useful if you want to analyze data. You can even start to explore the world of data science by applying statistical techniques to analyze your data in clever ways. This is advanced stuff, which we will explore later, but let's start with the basics.



Stretch tasks

- Modify the program to take in more than one type of reading. Other readings could include temperature, direction, acceleration, or anything else that the micro:bit can measure.
- Think of a project where measuring something over time would be useful. How could the data help you?
- Download the data as a .csv file and then open it in a spreadsheet application. Create a chart to visualize the data. Choose which chart to use carefully!

Final thoughts

Being able to store data and analyze it later is a very powerful tool. The data you record can help you improve what you are measuring. For example, a farm could measure soil moisture and light levels, see how these affect the crop yield, and consequently improve its profitability. Data can also be used to spot patterns, and you can create programs that do this for you—this is known as machine learning. In our farm example, a form of machine learning could be used in which the machine learns from the data which light and water levels get the highest crop yield. This can be used to automate watering and light levels to maximize the yield. Data science and machine learning can be applied to almost anything and are rapidly changing the world we live in.

The Arm School Program Project Schema

Engaging context	Getting started	Lesson plan
CT problem	Success criteria	Slide deck
Making elements	Pro-tips	Worksheets
PBL	Stretch tasks	Cheat sheets
Flipped resources	Final thoughts	Teacher solutions
Fomal lessons	Collapsed days	Extra curricula

Stretch Tasks

Stretch tasks are an extension of the base-level success criteria, so they are more challenging. They provide differentiation for confident learners by adding more challenge and complexity to the project.

Final Thoughts

The "Final Thoughts" section reflects on the project and how it relates to the wider world. It draws together learners' experiences throughout the project, as well as asking more open-ended, humanities-style questions for learners to reflect on. They can be used as final thoughts by the teacher at the end of the lesson, or even as homework questions.

What Support Does the Arm School Program Offer Teachers?

1. Free-to-Access Online Professional Development (PD) Courses

Whether you're new to teaching Computing, you're a specialist Computer Science teacher, or you just want to learn more about physical computing, this program will set you on the path to becoming an expert with practical computing, and help you understand the importance of project-based learning. Each course is about 10–12 hours of learning, which you can do over a few days, a week, or 10 weeks—whatever works best for you. The courses also work independently of each other, so you can pick and choose the courses that best suit your needs.

Introduction to Project-Based Learning

This course gives an overview of physical computing, including devices from Arduino, Raspberry Pi and micro:bit. It then explores the learning theories and teaching approaches relevant to project-based learning (PBL).

Practical Application and Classroom Strategies for PBL

Project-based learning (PBL) is a useful tool for teachers of Computer Science (and other subjects!). This course focuses on equipping you with the knowledge and resources you need to begin teaching Computing through PBL with confidence.

Effective Assessment of Project-Based Learning

Assessment is an area of Project-Based Learning that teachers often struggle with. Many teachers think PBL just can't be done effectively, and so they can't see a place for it in their teaching, except perhaps for end-of-term or end-of-semester activities. In fact, PBL **can** be done effectively, and this course shows you how.

Soft Skills, Teamwork and the Wider Curriculum

This course is focused on STEM skills and attributes, including gracious professionalism, teamwork, communication, and collaboration. It shows you how you can structure PBL lessons and events to give all your learners the opportunity to practice and develop these skills. To save you time, we provide resources and guidance—all free to download.

2. Further PD Support

The Arm School Program offers a series of six professional development videos, which explore key themes addressed in the online courses described above. Visit our website school.arm.com to view them.

Additionally, if you are a teacher trainer, the Arm School Program can support you with training and presentational materials to enable you to run your own professional development sessions on teaching Computing through project-based learning and physical computing. Contact us at school@arm.com.

Teachers can also join one of our communities of practice to join online events and network with peers to discuss the challenges of teaching and expand their knowledge and understanding. Visit our website school.arm.com to find out more.

3. Innovation Days

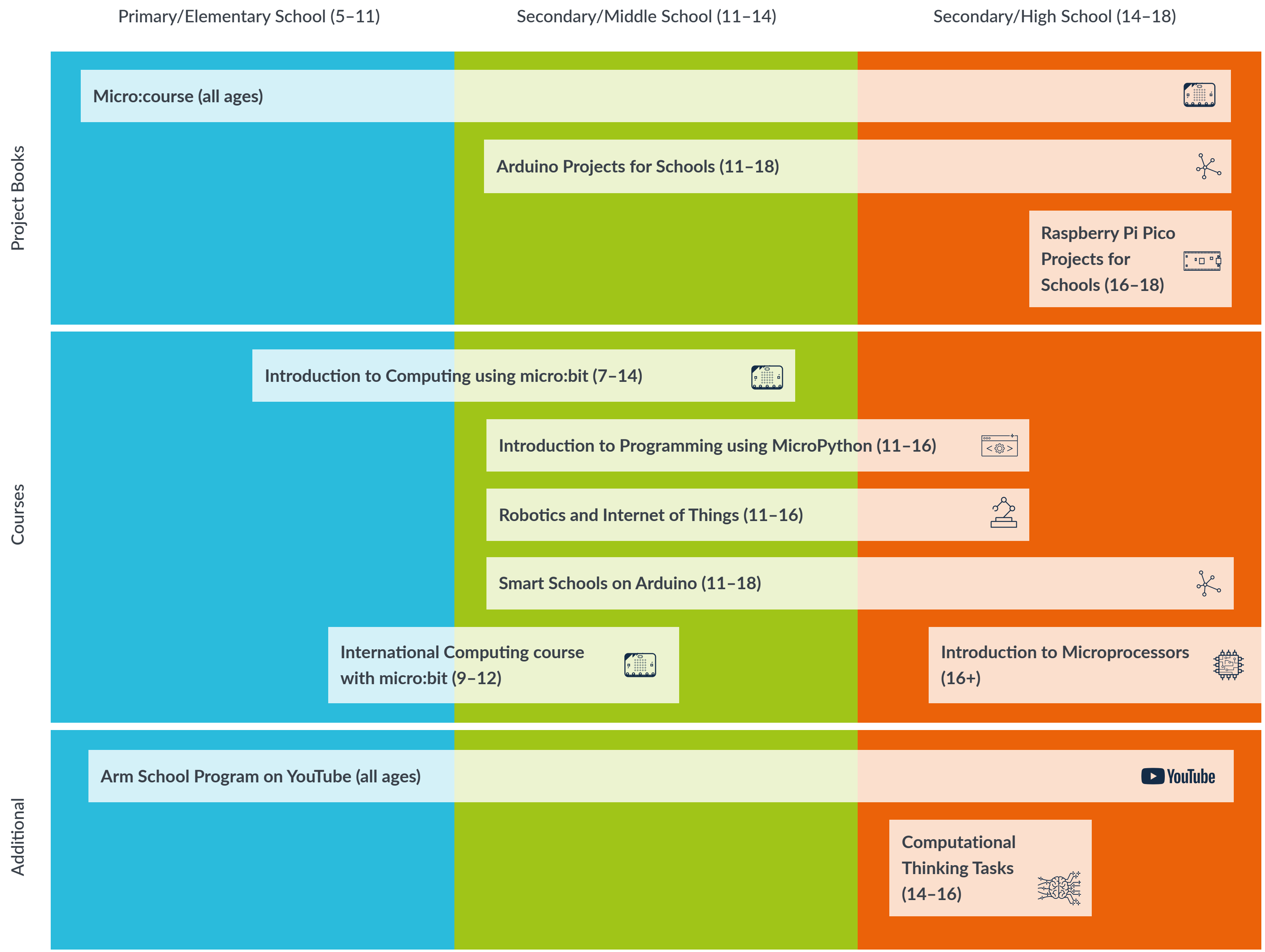
An Innovation Day is a competition where teams of learners design, program and build solutions to a real-world problem using physical computing. It's an engaging, motivating and fun day, which demonstrates to students that working in Computing can be a creative and social experience, where teamwork and resilience go hand-in-hand with putting your subject knowledge into practice.

Visit our website at school.arm.com to access all the resources and support you need to run your own Innovation Day.

Free-to-Access Teaching and Learning Resources

The Arm School Program has a range of project-based teaching and learning resources all freely available at arm.com/schools. All our resources apply a project-based learning pedagogy. You can learn more about this approach and how we structure our resources on page 05.

Select the link on each resource to visit our website and learn more about it.



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Micro:course (all ages)

Arduino Projects for Schools (11–18)

Raspberry Pi Pico Projects for Schools (16–18)

Introduction to Computing using micro:bit (7–14)

Smart Schools on Arduino (11–18)

International Computing course with micro:bit (9–12)

Introduction to Programming using MicroPython (11–16)

Robotics and Internet of Things (11–16)

Arm School Program on YouTube (all ages)

Computational Thinking Tasks (14–16)

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110 Fulbourn Road, Cambridge, CB1 9NJ, UK