

DIVE-in Engineering from STEMscopes: An Engaging, Hands-On Engineering Curriculum for Grades 3-8

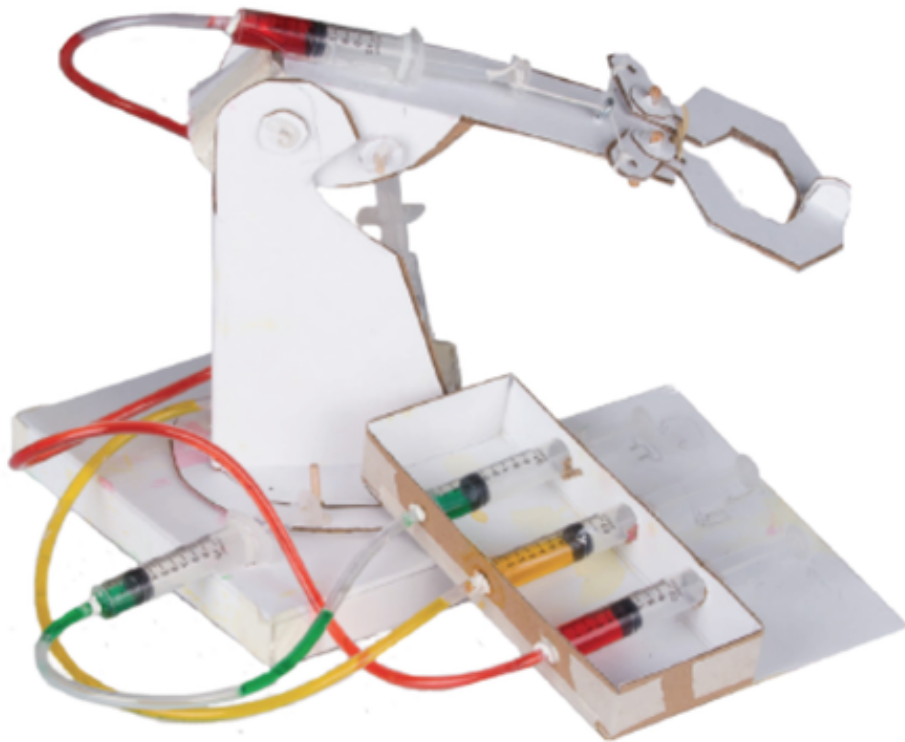
Written by Michael Karlin



DIVE-in Engineering from Accelerate Learning was built in partnership with the folks at the New York Hall of Science. It was designed to provide 3rd-8th grade students with an engaging, hands-on engineering curriculum that can help turn your classroom into a structured, scaffolded

Makerspace. The curriculum provides students with practical, inquiry-based educational experiences that encourage exploration and inspire ingenuity.

The idea behind STEMscopes DIVE-in Engineering (DIVE-in) is to offer a structured and scaffolded step between the traditional classroom and the wide-open spaces of a Makerspace. In general, Makerspace activities and movements have centered around discovery-based learning, where students can create things and solve problems all on their own. However, for many K-12 students (and teachers), this type of unstructured activity may lead to frustration and difficulty. Not that those are bad things (and neither is the failure and troubleshooting that is inherent within Makerspaces), but they can be detrimental if they lead to students no longer wanting to learn or participate. Therefore, the idea with DIVE-in is to provide more structure and scaffolding so that by the completion of the activities within the curriculum, students will have practice using their creativity and also the foundational knowledge they need about things like circuitry, gears, hydraulics, etc. to be let loose in a Makerspace.



Robot Arm: Students design a hydraulic arm with an articulating neck and pincer grip and then Vary their design to solve real-world problems.

To accomplish this, the DIVE-in lessons are structured around the “DIVE” method, which encourages students to think like engineers, and is a somewhat similar approach to design-based thinking. The DIVE method is built around four steps, each of which the students work through during the course of a lesson/activity:

Deconstruct: Working the way engineers do, students begin by taking apart a working prototype. By recording measurements, making diagrams, and taking notes, the students prepare for the next step.

Imitate: Now students are ready to reverse engineer the prototype, making their own version based on what they learned during the deconstruct phase.

Vary: In the next step, students analyze what they have created and brainstorm ways to make it different. Can they make it bigger? Smaller? Can they replace or remove parts?

Explore: The knowledge and skills gained by the students in the previous steps have prepared them for the final exploration, in which they solve the original problem in a new way, or apply their solution to a totally new problem.

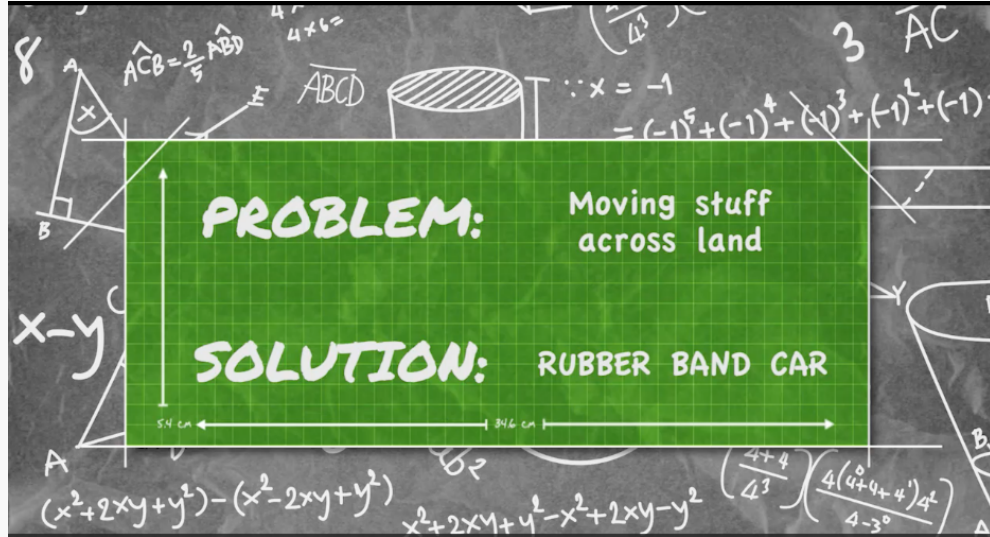
In each grade band (3-5 and 6-8), students explore nine different engineering solutions, across three different units: On the Move, Around the House, and Eyes, Ears & Hands. Here's an example of the introductory video teachers could use for the Eyes, Ears & Hands unit to give you an idea of what these lessons are all about:

When delivering lessons, teachers are provided with everything they need to structure and scaffold the lesson. They receive online lesson plans, step-by-step guides, discussion prompts and ideas, kits including enough supplies to build 13 prototypes, 1 for the teacher and enough for 12 groups of 2 to complete the activity, and work journals for their students to keep track of their progress and reflections. That being said, while the teachers are provided with everything they need, the idea is that the students would work through the lesson in more of a traditional engineering-fashion, following the DIVE methodology.

The screenshot shows the 'Balloon Boat' module page. At the top, there's a green icon of a person and the title 'Balloon Boat'. Below the title, it says 'Topic On the Move' and 'Grade DIVE in 3rd-5th'. A 'Bookmark Scope' button is in the top right. A navigation bar includes 'OVERVIEW', 'DECONSTRUCT', 'IMITATE', 'VARY', and 'EXPLORE'. The main content area has a question 'How can something be moved across water?' with a gear icon. Below it, a video player is shown with a 'Play Video' button and a play icon. The video player has a 'DIVE-in Engineering' logo at the bottom, which includes 'STEMSCOPES' and 'in partnership with New York Hall of Science'. On the right side, there's an 'Essentials' section with links to 'Our Guiding Philosophy', 'Project Reflection', 'The DIVE In Methodology', and 'Student Engineering Notebook', each with a 'T' icon. An 'Edit Scope' button is at the bottom of this section.

In other words, students aren't given the step-by-step directions to build a robotic claw, or a stomp rocket.

Instead, they begin by **deconstructing** a prototype in an attempt to see all the components, and how they're put together. During this step they create sketches, compile a list of parts, and so on. The goal being that during the **Imitate** phase, they're able to essentially reverse engineer the creation. The gold standard here would be having students completely reconstruct the prototype without having to look at an example of one, and only relying on their own notes and sketches.



Once the students have reconstructed the prototype, the next two steps are where student creativity really comes into play.

During the **Vary** phase, students are asked to change elements of the prototype, like using different materials, reversing components, changing the size of components, and so on. This is an incredibly beneficial brainstorming step that lets students explore different possibilities outside what was already constructed, but in a way that is still scaffolded around the prototype.

Finally, students are asked to **Explore**. During this phase, students solve the problem that was being solved by the prototype in a new or different way, or they use the device to solve a different problem than it was intended for.

Explore

In the final step, the student engineers are challenged to produce something completely new, exploring the possibilities of what they have learned. Once again, we suggest that after students have brainstormed individually in their journals, the facilitator run a whole-group brainstorming session to help student engineers generate ideas about how to take what they have learned so far to the next level of innovation. There are at least two ways to do Explore.

- **Adapt this solution to another problem:** The rubber band made the car move. Can you create something new that uses a rubber band do a different job?
- **Try to find another solution to the same problem:** A rubber band car is one way to move stuff across the land. Can you invent another way to do this?

Brainstorm

Student engineers will first brainstorm ideas for Explore in their journals. Next, the facilitator will run a whole-group brainstorming session to collect the ideas of individuals and generate more ideas. Once again, student engineers can join the group that will work on the project in which they are most interested.

A Note on Materials

As with the variations, it is impossible to anticipate what student engineers will choose to do for their new Explore solution. Once again, the facilitator may wish to create a budget if it makes sense. Otherwise, student work groups should be allowed to use what they want of the extra materials, within reason. For this step we recommend that time be given for students to gather materials from home or around the school.

Uncut extra dowel is provided so student engineers can cut the dowel to the required length, should a new Explore solution require dowels of a different length.

Overall, I absolutely love the methodology behind DIVE-in. I think it does a wonderful job of scaffolding students through the engineering process and helping lead them to a point where they can begin using their creativity and ingenuity to create new solutions to problems, or use existing solutions to solve problems in new types of ways.

In terms of pricing and content, the DIVE-in curriculum includes everything teachers need to launch the curriculum in their own classroom. Each bundle includes the 9 lessons for the grade bands, as well as student journals, teacher access to the online support resources, 12 kits for student groups, and 1 kit for the teacher to build the prototype. You can also purchase a “teacher toolkit” which includes things like extra cardboard, glue guns, etc. if you are in need of those types of extra supplies.

3-5th Grade Bundles				\$2,125.00
On the Move Kit	Balloon Boat	Rubber Band Car	Stomp Rocket	
Around the House Kit	Lock Box	Light Switch	Rotary Fan	
Eyes, Ears, and Hands Kit	Claw Hand	Stringed Instrument	Telescope	
6-8th Grade Bundles				\$2,600.00
On the Move Kit	Motor Boat	Motor Car	Hovercraft	
Around the House Kit	3-way Switch	Door Knob	Air Conditioner	
Eyes, Ears, and Hands Kit	Robot Arm	Slide Projector	Speaker	
Teacher Toolkit (1 per Teacher)				\$245.00

In the end, I'm a huge fan of what DIVE-in is offering. By providing teachers with all the scaffolding and support they might need, DIVE-in is incredibly approachable, even for teachers who have never tried problem or project-based learning in their classroom. Plus, DIVE-In does an excellent job of providing enough scaffolding for students, without giving them linear, step-by-step directions that they have to follow precisely. I strongly believe that after working through this curriculum, students will have a strong, foundational engineering understanding that would allow them to be more successful in a Makerspace environment. Additionally, the skills and lessons learned throughout the DIVE-in curriculum are just beneficial, 21st century skills that our students need to develop anyway. Plus, all the lessons are aligned with the NGSS Engineering, Technology and the Application of Science (ETS) standards, to help teachers make curricular connections as well.

Overall, the STEMscopes DIVE-in curriculum is an excellent opportunity for teachers to bring real-world problem-solving activities into their classroom in an engaging and hands-on way. If you're a 3-5 or 6-8 grade teacher looking to implement this type of learning in your classroom, I absolutely recommend checking out DIVE-in.



*The opinions expressed in this review are my own.
I was not compensated for writing this review.*