


Unit Title	Teaching it forward with MOSS
Grades/Ages	Suggested Age Range: 8-13 (3rd through - 8th grade)
Hello!	<p>This Teach It Forward activity has been developed as part of the initial exploration of MOSS robotics by students who are new to MOSS. It can serve as the foundation for a very meaningful cross-curricular unit of study incorporating all STEM-related subjects as well as literacy and the arts. There are several enrichment activities provided to serve as extensions into these areas. Teachers’ application of these enrichment extensions are meant to be used flexibly according to the needs of students.</p> <p>Teach it Forward can be taught as a whole class lesson as this activity plan describes or it can be implemented as a small group enrichment unit. The following video was taken during my initial development and planning of the Teach It Forward activities in my classroom.</p>  <p>Here, you will see two teams of third grade students who are working together for the first time, while the rest of the class is working on other projects. With our third graders here, I began by working the day before with the four students who are the “teachers”. They had never seen or worked with MOSS before our first lesson (in which they were asked to reverse engineer an assembled MOSS Crazy Nocturnal Backpacker). In this video, these students are now beginning to teach the construction of the Crazy Nocturnal Backpacker forward to the rest of the group. This is the first time that the “students,” the recipients of Teaching it Forward, in the group have ever worked with MOSS. The worksheets that they are using in the video are the first version of what went on to become the actual worksheet in the reverse engineering lesson.</p>

	<p>You will notice that while the children are beginning their Teach It Forward work, I play an active role as their guide and facilitator. There are times when I interject to point out that a student has a point that contributes to their learning that should be heard. This activity offers a meaningful team building experience while at the same time fosters deep individual learning. While roles can be assigned, there are spontaneous observations that take place outside of roles and students gain the opportunity to learn and apply the skill set of how to share, listen and support each other as they experience such meaningful and rich learning. When it is the students' first time teaching a lesson forward, it is helpful for the teacher to play an active role to guide them. As the students become more experienced in subsequent experiences, the teacher can begin to lessen his or her role and allow the students to teach more independently.</p> <p>In this video you will see that the students are all actively engaged and have the chance to experience a real life application of the "Improve" step of the Engineering Design Process. They experienced an error in the build of their robot during their rebuild stage and work together as a team to find a solution to this problem. It can be difficult for some to realize that the expectation should not be that they always get the build "right" the first time and that some of the most meaningful and memorable learning takes place during the "Improve" step. This clearly becomes evident to the students at the end of the video as they celebrate their success.</p> <p>Your Teacher Friend, Beth.</p> <div data-bbox="987 993 1356 1173" style="border: 1px solid black; padding: 5px; text-align: center;"> <p>I have tried 99 times and have failed, but on the 100th time came success.</p> <p>- Albert Einstein</p> </div>
<p>An Add-on for your students</p>	<p>Music : I have also included a thematic song list that can serve as background music to the activities. I almost always have music playing in the classroom during hands-on work time. There are definitely times when a quiet classroom serves a very important purpose, however when students are actively working and engaged, simply putting music on changes the energy in the room into a celebration!</p> <p>The music playlist I have comprised for this lesson follows the theme of paying it forward and teaching it forward, but please feel free to play music of your choice to make the atmosphere even more of a celebration!</p> <p>Here is an interesting excerpt reprinted by the Johns Hopkins School of Education from the book <i>Music and Learning</i> by Chris Brewer, 1995 about the positive effect of music in the classroom.</p>

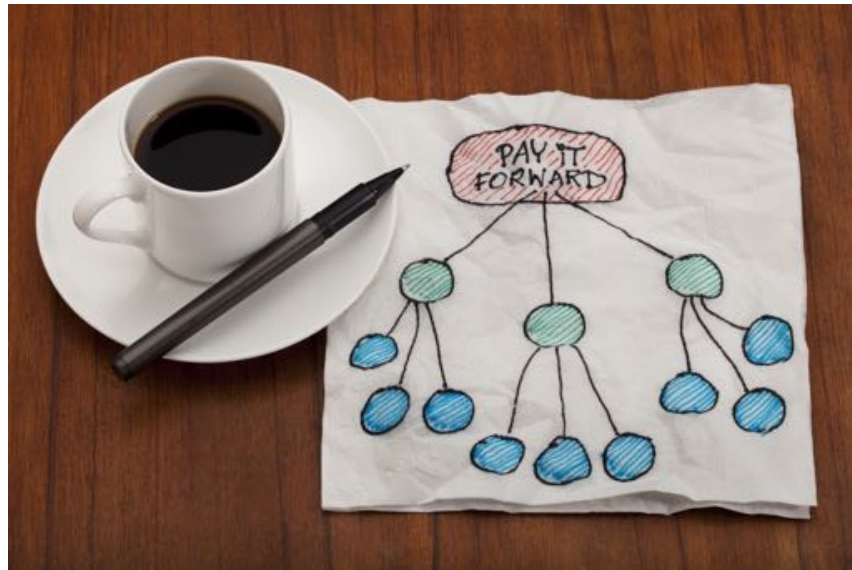
Share your ideas and students work with us on social media:

Facebook, Twitter and Instagram [#mossteachitforward](#)

Activity 1: Pay It Forward

Estimated Time: 45 Minutes

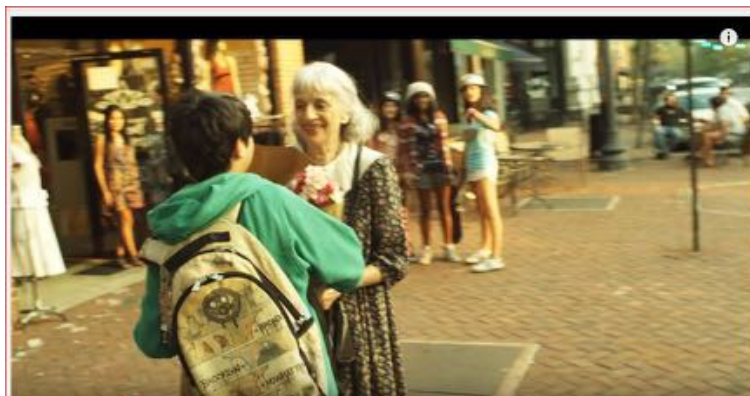
Materials: **Idiom Match Up** worksheet; poster paper; pencils; markers; and colored pencils or crayons; teacher prop; scissors; screen and projector for video; document camera; or overhead projector; Pay It Forward pictures.



FOCUS: Paying it Forward is a chain reaction of kindness and giving to make the recipient happy, without expecting anything in return.

Pay It Forward: Examples

First introduce the idea of “Paying it Forward” with an example. Teacher can use an anecdote and/or the [Kindness Boomerang Video](#) to illustrate the concept.



The following is an anecdote that I use with my students. Use this one or to share one of your own. If you have a story that you find to be successful with your students in these activities, share it with all of us! Using **#mossteachitforward** tell us your story on our Facebook page, via Twitter or Instagram.

Example Story of Paying it Forward

"This morning on my way to school, I made a stop at the coffee shop to pick up a super-duper mochafrappacino latte . I was feeling a little grumpy as I waited a bit longer than usual. When it was finally my turn at the drive-through window, I reached out to pay for the coffee and was stopped by the employee who said it would not be necessary. I was very confused. She went on to tell me that the customer in the car ahead of mine had paid for my drink. He said that he had just moved to town and was feeling kind of homesick the other day when he went through the drive-through and someone just to be kind and wanting to make someone else's day brighter paid for his drink. He said it completely changed the way he was feeling and made him realize that one simple kind act can make another person's day-- and maybe even their lives-- more joyful.

So he decided that he wanted to 'pay it forward'. He wanted to spread kindness and smiles to others and so he asked to do the same for me that the other man had done for him. I put my money away feeling very happy and surprised. It made me stop and think about how there is beauty and kindness in the world, which inspired me to go and continue spreading the kindness of this chain reaction. The man started the chain reaction and I was the link to keep it going. His kindness inspired me to keep it going but it also made me realize that I have the same power to impact another person through the little things that I can do. It showed me that it does not take a great big gift or thing to brighten a person's day but even in the simplest form you can change someone's day or even their life for the better.

Sample Pay it Forward class discussion

My coffee Pay It Forward experience involved people buying something for somebody else but it is important to realize that Paying It Forward does not mean money or the purchase of items and/or experiences must be involved. The Kindness Boomerang video demonstrates several examples of people Paying It Forward that are acts of kindness not involving the exchange of money. They are simply a continuation of kindness and generosity without expecting anything in return."

The idea of Pay It Forward/Teach It Forward can be done on the scale that best suits the teachers', students' and community's needs. The next steps could be to have your students simply commit to one deed to begin a Pay It Forward chain. If doing this, there is a Pay It Forward card available here that is a great way to help students to get their message across. The teacher may choose to expand upon the idea and organize a Pay It Forward day to work on in conjunction with the Teach It Forward unit. A Pay It Forward school kit is available [here](#).

SAMPLE CLASS DISCUSSION ON IDIOMS

"The term 'Pay it Forward' is an example of an idiom. What is an idiom?"

"An idiom is a phrase that figuratively means something different than what the words literally denote. Let's take a look at some fun examples of idioms."

- Teacher shows idiom illustrations from **"Teach It Forward - Defining Idioms"** work pages and then as a class students will name the idiom and come up with its meaning.


Activity: Idioms

Suggested time: 45 minutes

- Each group will then be assigned one of the idioms to define and illustrate in a Teach It Forward poster which will continue the learning chain for other students. Students work to match, write and define idioms.

"Next we are going to do some brainstorming about idioms within our teams. Each team has a set of paper strips, some have idioms on them and others have their meanings. Your team will match each idiom with its meaning. You will also notice there are two blank strips. On one blank strip you will write a new idiom that your team comes up with and you will write the meaning of it on the other blank strip. When you are finished writing your own team idiom, I will collect it to share."

EXAMPLE

Picture	Literal Translation	Idiom	Meaning
	Man sitting on top of earth, happy!	"I'm on top of the world!"	Everything is going my way; excited, happy

What we can take away:

Now we know that an idiom does not mean what it literally says - we know that paying it forward does not mean to pay someone with money but to figuratively spread happiness to others.

Resource Books About Idioms

<ol style="list-style-type: none"> 1. Parish, Peggy, Siebel Thomas, Barbara (Illustrator), Thank You, Amelia Bedelia, Harper Collins, Publishers; 1964, 0-0-6-022979-9 K. 2. Porter, Daniel, Reynolds, Donna (Illustrator), Cat Got your Tongue: The Real Meaning Behind Everyday Sayings, Troll Assoc.; March 1999, 0816749183 H. 	<ol style="list-style-type: none"> 3. Terban, Marvin, The Scholastic Dictionary of Idioms, Scholastic, Inc.; 1998, 0590381571 4. Terban, Marvin, Maestro, Giulio (Illustrator), Mad as a Wet Hen: And Other Funny Idioms, Houghton Mifflin Co.; Oct. 1987, 0899194796 I. 5. Terban, Marvin, Maestro, Giulio (Illustrator), In a Pickle: And Other Funny Idioms, Houghton Mifflin Co.; April 1983, 089919649 J.
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Activity 2: Robot Recipes - Build It

Estimated Time: 45 Minutes

Materials: MOSS Robot Construction Kit, 2 assembled Crazy Nocturnal Backpacker robots (one should have an error in its build), **Teach It Forward Planning Page** and **Teach It Forward Notes**, projector and screen to display Robot Recipes.

Students will be working in Engineering teams of three to four and should be seated together as a team. If you have worked on the **Sphere Keeper Challenge** and **Reverse Engineering of the Crazy Nocturnal Backpacker**, it is suggested that your students continue to work with the same teams as they have in the previous activities. By working with the same team members they have the chance to establish a set of collaborative skills that will benefit them in their problem solving efforts. Of course there may be instances where teams experience conflict or collaborative challenges and in those cases teacher support with assigned roles can be helpful.

Robot Recipes



"Today you will be taking the next very exciting steps in robot construction. I introduce to you... Robot Recipes!" (Teacher shows Robot Recipes web page found [here](#)).

Analogy:

"If you've ever baked a cake before, you know that you must carefully select and measure your ingredients in order for it to turn out properly. If your cake is missing a key ingredient or if the ingredients are not combined as they should be, or if you use incorrect tools, your cake will not turn out as planned. One time when I was baking what was supposed to be a fluffy chocolate birthday cake it turned out more like a sad looking huge chocolate pancake. I realized it was because I had used more baking soda than the recipe called for. Baking a cake is a science. When a cake bakes, the baking soda forms a chemical reaction and creates bubbles in the batter which cause the cake to rise. Too much baking soda causes the bubbles to get too large and run into

one another. So my cake rose way up and then, splat! Sunk down and became heavy and flat.

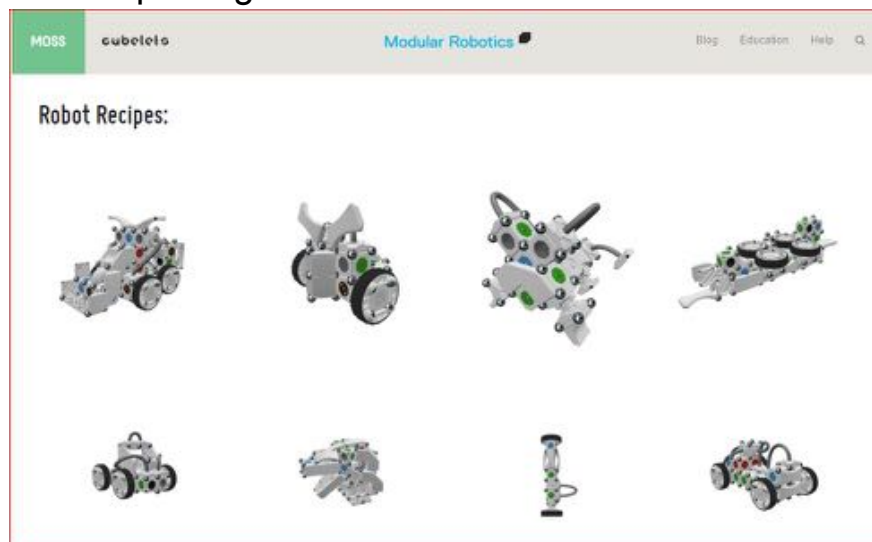
Building a robot is the same way! If you don't follow the instructions correctly--like missing an 'ingredient'-- your robot may not work the way you want it to!"



"The MOSS Robot Recipes section on the Modular Robotics website is set up in a similar way to a cooking or baking recipe. Let's take a look at a Robot Recipe for a build that will be familiar to you."

- Teacher demonstrates process of finding a Robot Recipe by scrolling down page to the image of the Crazy Nocturnal Backpacker. The teacher then has the cursor hover over the image to demonstrate how the name for the image shows up when you do so. The teacher then clicks on the image to bring up the Robot Recipe for the Crazy Nocturnal Backpacker.

Tour of Robot Recipe Page



The teacher should have set up ahead of time a **Sphere Keeper** and a **MOSS robot construction**

kit ready to use. In this part of the activity, the teacher will demonstrate to the students how a Robot Recipe is used to complete a build.

“As you can see, some of the recipes include a video to demonstrate how your MOSS robot is expected to behave once it has been built (Teacher plays video clip). There is also a link to bring us back to the main recipe page.”

- The teacher demonstrates by clicking on that link. The teacher might then choose to discuss other aspects of the page such as the robot’s description, tags and Community Score.

“Now let’s take a look at the bottom of the Recipe page. Here we are at the ingredients! These are the modules we must have in order to build this particular robot. What exactly do we need to create the Crazy Nocturnal Backpacker? Let’s see.” Teacher then demonstrates how hovering over the image of each module will bring up the name of each module. Teacher selects corresponding modules from the kit and lays them out on a table to prepare to build with them. After all modules are laid out, the teacher says *“Here we have all of the modules needed to build our Backpacker. Are we missing anything?”* Teacher gives students the opportunity to compare the Robot Recipe to the modules that have been taken from the MOSS robot construction kit. Students should then be guided to recognize that spheres need to be included as well. *“Yes, we also must have spheres. Why do we need to have these spheres?”* Students should respond that they are used to connect the modules to one another. *“Are the spheres magnets?”* The students should recall that they are not magnets but that there are magnets embedded within the modules that enable them to connect.

- Next the teacher scrolls up the page to the Interactive Directions.

“When we reverse engineered the Crazy Nocturnal Backpacker, I had assembled them ahead of time using this Robot Recipe. The Interactive Instructions are a lot of fun to use and teach us a great deal about how the modules work together as a system. In this activity we will assemble the robot and begin to become familiar with their functions. We are continuing to explore and use our problem solving skills. We will get to the point in our robot builds where you will be expected to understand the specific functions of the modules and their color coded faces because each does have a very specific function, however not just yet. For now, this is about creative exploration and getting acquainted with MOSS.”

Let’s take a look at the Interactive Instructions as I demonstrate how I was able to build the Crazy Nocturnal Backpacker.”

- The teacher then takes students through the build step by step. Begin by pointing out how to **drag, zoom and pan** as it says at the beginning of the instructions. Bring the instructions to full screen so that students can see how this is done. In **Step 1**, click on the **question mark** to show how the initial directions can be brought up as a reminder. In **Step 2**, demonstrate how the 3D model can be manipulated in order to see all angles and faces of the modules. Once your robot is built, click on “X-RAY” on the lower left-hand corner of your screen and explain the function and purpose of this element of the instructions. Rotate the robot to show them the path of the flow of data and power. Take a few moments to discuss the meaning of and the advantages of having X-RAY as part

of the instructions.

"Now that I have my robot built, how do I test if it works? That's right I need to slide the switch." Teacher calls on a student to slide the switch and turn it on. Students then observe the behavior of the completed robot. After a moment or so, the teacher stops the robot. Teacher has another example robot which the students have not yet seen. This robot has one error in the way that it was built. Teacher takes second robot out to be seen by students. *"But what if at the end of my build I found that my robot does not work as expected? How can I solve this problem?"* Teacher guides students to conclude that they can go back and review steps and reverse engineer their robot in order to solve the problem. Teacher can demonstrate this with second robot if time allows.

*"So now, engineers, it's your turn. In our last activity, we discussed idioms and in particular we talked about 'paying it forward.' I shared with you my Pay It Forward Experience and this week you will have the chance to create your own wave of good deeds. We will begin doing so with our next activity: **Teach It Forward**.*

In Teach It Forward you will begin a wave of sharing with others the exciting and collaborative learning that you are about to experience here today. This will create a chain reaction of teaching, learning and sharing. Sound interesting? Here's how it works. Today we are going to construct two types of robots in our class using the Robot Recipes for each one. When we get started in a few minutes, each team will be assigned either the Plasmaspinner2000 or the Illuminati Tower to build together as a team. You will only build the one that your team is assigned. In our class we have ___ (insert appropriate number) engineering teams (team members should be seated together). So ___ teams will create the Plasmaspinner2000 and ___ teams will create the Illuminati Tower. For the rest of our time today, you will have the chance to build your robot as a team following the Robot Recipe. The next time we meet to work on our Teach It Forward activities, you will be doing some planning because next time, you will be the teachers, teaching your buddy team about your robot." Students build and test robots as previously discussed using the Robot Recipes. If a team finishes before time is up, they can go back and follow the recipe to build the Crazy Nocturnal Backpacker as a team.



[Video of students working on first build with Robot Recipes](#)

Activity 3 - Robot Rebuild and Plan

Estimated Time: 45 Minutes

Materials: MOSS Robot Construction Kits, computers for Robot Recipes, Teach It Forward Planning Page, Teach It Forward Notes, chart paper, graph paper (optional)



"In our last activity we learned about the MOSS Robot Recipes on the Modular Robotics website and you had the chance to do your first independent build following the Interactive Instructions on the website. It was very exciting to see the results when you matched up the color-coded faces and intentionally connected MOSS modules. Were there some things that surprised you as you built your robot? Did you learn something that you think would be helpful for someone to know if they are new to building that robot?"

- Students share responses. Teacher records responses on a chart for all to see.

*"I would like you to keep these thoughts in mind as we go into our next activity, the **Robot Rebuild and Plan**. Today is the day that you will be the teachers in our classroom! Something that all teachers do before teaching a lesson is create a plan. We will begin by having each team build its assigned robot now for a second time. Yesterday when you did your first build, our focus was on getting to know the Robot Recipes and how the Interactive Instructions work. Today you have some experience with the Robot Recipes build and you will see that your build will move more quickly and independently. Each team has a copy of the **Teach It Forward Planning Page**. This page will serve as your plan when it is your turn to teach your buddy team about your robot build."*

- The teacher now reviews the planning page and vocabulary with the students. This step will be differentiated according to students' needs. The teacher can have students begin to write out their plans before the rebuild to get down basic points and then elaborate more while doing their rebuild. It is not necessary to have all sections contain writing, some may have a sketch or diagram as an engineer's plans would have. Students could be provided with graph paper as an additional planning resource. The graph paper can be used to complete design sketches with notes as an engineer would make.

*"Let's take a look at the Teach It Forward Planning Page together. Your team will complete this page when you have finished your robot build, however, you might choose to add to it as you go along. Team members can rotate jobs take turns with the role of recorder in order to complete the page. On the back of this page you have the **Teach It Forward Notes**. This is your workspace to jot down ideas before you fill out the Teach It Forward Page. It's your troubleshooting brainstorming page."*

Once rebuild planning pages are complete, Plasmaspinner2000 teams will each pair up with an Illuminati Tower team. Each team will complete a Teach It Forward lesson with their buddy team. The two teams will decide together which will demonstrate first. This serves can serve as another team building experience where two teams coming together now have the chance to work collaboratively. The teacher may decide to choose which team presents first in order to support students in the process. If this is the case, the Plasmaspinner2000 team would be a good choice to begin with. With the Plasmaspinner2000 we do not have a sensor as we do with the Illuminati Tower and starting off more basically without it and then moving on to a build that includes a sensor is a concrete way for students new to MOSS to easily see the function of the sensor. What is included in this lesson is determined by each team based upon what stood out to them as being important in the build and understanding of their robot. Some teams may choose to start out with their robot assembled and have their buddy team reverse engineer it. Others may prefer to have their buddy team do the build. This flexible approach brings some unexpected and exciting learning to the Teach It Forward experience.

[Teaching It Forward - Teamwork Video](#)





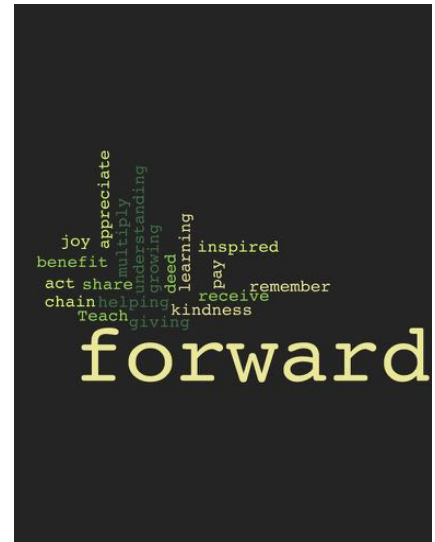
Ideas for Additional Enrichment

The concept behind Teach It Forward can be applied to all kinds of learning beyond this particular group of activities. I have used this approach in building a variety of robots as well as in other areas of the curriculum. I am including some additional suggestions for enrichment here that teachers may choose to use with their classes in order to extend the learning. Here are some ideas:

- The teacher teaches a robot build forward to a building colleague who does not typically teach, such as the principal, a custodian or an office administrator and invites that person to come into class as a teach it forward support teacher for first lesson. This can also be done ahead of time with parents of students. Another possibility is for the teacher to teach it forward to a special area teacher like the art, music or physical education teacher and then for them to brainstorm together a follow up lesson that integrates the area of specialization into the teach it forward lesson, hence broadening the reach and deepening the meaning.
- Robot buddies class: Teacher arranges a Robot Buddies class with a teacher in a younger grade. the next step of teach it forward is for the students to do a demo build of each of the three types of robots to the younger students*
- Variation on theme: Teacher directly teaches one group of four in an initial build. Children reverse engineer, complete worksheet, rebuild. Then this group teaches a new group of four. Then process repeated throughout the class until all have learned the build.

- **Vocabulary Word Cloud**

Students can go to [this site](#) to create their own Teach It Forward word cloud. Word clouds are a creative literacy component to inspire students to make connections with and reflect upon content related vocabulary.



Vocabulary

idiom, chain reaction, homesick, Pay It Forward, Sphere Keeper, recipe, drag, zoom, pan, x-ray



Idiom: _____

Meaning: _____



Idiom: _____

Meaning: _____



Idiom: _____

Meaning: _____



Idiom: _____

Meaning: _____

Idiom Match Up

Students are divided into teams of 3-4. Teacher cuts apart one page per team ahead of time. Teams then match the idioms to their literal meanings. On the blank strips at the bottom of the page, teams will come up with an idiom that is not already listed. The teacher will check and collect student written idioms in a hat and as a they are matched up as a class. Upon completion of idiom matching each team will choose one of the idioms and its meaning to illustrate on a poster that can teach the idea forward by teaching others what the meaning of the idiom is.

"A Piece of Cake"	A task that can be accomplished very easily
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"A Leopard Can't Change His Spots"	You cannot change who you are
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"Bend Over Backwards"	Do whatever it takes to help. Willing to do anything
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"Cry Over Spilt Milk"	When you complain about a loss from the past
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Planning Page

In the spaces provided you will write bullet pointed lists, key ideas or sketch. Writing does not need to be in complete sentences. The purpose of this page is to guide you in your Teach It Forward step of the activity.

<p>Objective (this is what the group will learn): Example: "Our Teach It Forward Group will learn the steps that were taken to assemble the Crazy Nocturnal Backpacker"</p>	<p>Connecting the learning to what they already know about the subject: Example: When we reverse engineered the Crazy Nocturnal Backpacker there was a module that gave power to our robot..."</p>
<p>Direct Instruction: Explain to your buddy team the steps you followed in order to build the robot. Share with them any tricky parts you encountered and suggestions you have.</p>	<p>Guided Practice: Your buddy team reverse engineers to explore the whole robot to better understand its parts.</p>
<p>Closure: Wrap up what you have taught forward. Explain their next steps.</p>	<p>Independent Practice: Your students will now take the information you shared with them as a starting point to build the robot themselves using the Robot Recipe.</p>

Pay It Forward Action: I let someone go ahead of me in line at the grocery store checkout because I wanted to make their day a little happier.

Pay It Forward Reaction: The person said, "Thank you so much! I'm running late for work and that means a lot to me!" They got their groceries with a big smile, which made me smile, too!

Students will write what action they took to Pay It Forward and the reaction it caused. This can be done on 3x11 inch strips of paper. The strips can then be made into links and joined to form a Pay It Forward paper chain of kind and giving actions. The above is an example of how this might be done.

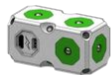
Teach It Forward - Robot Anatomy

Illuminati Tower

Using the MOSS **Instruction Manual**, the Modular Robotics **Robot Recipes**

<http://www.modrobotics.com/moss/robots/> and/or

<http://www.modrobotics.com/moss/moss-getting-started/> label each robot module and face and give its purpose.



















Additional Observations/Notes:	

Teach It Forward - Robot Anatomy
Plasmaspinner2000

Using the MOSS **Instruction Manual**, the Modular Robotics **Robot Recipes**
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