



4-H  
NATIONAL  
YOUTH  
SCIENCE DAY



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# DRONE

DISCOVERY

Trainer Guide

# Click2SciencePD Training Resources for NYSD 2016

## A Deeper Look: Drone Discovery

Developed by Click2SciencePD, these training resources are designed for 4-H professionals to lead with teen leaders and volunteers. The workshops focus on the skills volunteers need to help youth get the most from their Drone Discovery experience. Participants will learn about facilitating the engineering design process, reflecting and processing their learning, and guiding youth through a fun and engaging NYSD experience!

## Drone Discovery

Developed by Cornell University Cooperative Extension, this hands-on engineering design challenge explores the science behind drones and how they are being used to solve real world problems. Youth will learn everything from flight dynamics and aircraft types, to safety and regulations, to remote sensing and flight control. Challenge kits, which include everything you need to complete Drone Discovery, are available at the 4-H Mall.

## 4-H NYSD

4-H National Youth Science Day (NYSD) is the world's largest youth-led science experiment. Every year thousands of youth are taking part in the National Science Experiment focusing on important STEM topics and issues. On October 5, 2016, youth from 4-H clubs, groups, and school programs across the country will participate in Drone Discovery, the 4-H NYSD 2016 Engineering Design Challenge.



Cornell University



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## What is Click2Science?

Click2Science is an easy-to-use website full of resources designed to create more meaningful STEM learning in out-of-school time. Click2Science Professional Development helps staff deliver quality, well-facilitated STEM activities in a way that “clicks” in the minds of youth. To explore Click2Science’s training resources, or for more information on how Click2Science impacts STEM learning among youth in a positive way, visit [Click2SciencePD.org](http://Click2SciencePD.org).

# Module One: Take Off

Agenda: (50 minutes)

- Welcome (2 minutes)
- Experience the Experiment (10 minutes)
- Introduce the Skill: Reflecting and Processing STEM Experiences (2 minutes)
- Seeing the Skill in Action (8 minutes)
- Introduce Core Engineering Design Process (3 minutes)
- Brainstorming Strategies (10 minutes)
- Local Planning (12-15 minutes)

Learning goals

- Develop skills for youth and adult leaders to facilitate engineering design process
- Develop skills youth and adult leaders guide reflection and processing of the Drone Discovery experience
- Provide support so that youth and adults have fun learning together

Arrange the room so participants can talk to a partner easily. Place items on the tables.

- Post-it Notes
- Pens
- Scratch paper
- Flip Chart paper and markers

Before the training participants will need

- Use the pattern in Appendix A to create a FPG-9 glider using a foam plate. We'll be using this glider in the workshop
- 2016 NYSD Drone Discovery Challenge kit
- Drone Discover Youth or Facilitator Guide (download or from kit)

If you are not sure about Internet connection at your training, download the video prior to the training.





# TAKE OFF

## Welcome – 2 minutes

Today, we're going to learn a little about drones and how they work and work on some skills that will help us lead youth to get the most out of their Drone Discovery experience.

In Take Off, youth are introduced to drones and engineering and develop a scenario to use their drones. Just like the youth, we want to play a bit with the fun supplies that came in your Challenge kit, so if you have a kit, get it out now.

## Experience the Experiment – 10 minutes

Get a partner and find the proto-copters and FPG-9 glider you built using a foam plate. We're going to give you just a few minutes to play with these resources and experiment to see if you can change how they fly (like adjusting the elevons to make the glider go in a circle). When you come back we'll have some chat pods open for you to share what you learned. We want to know what is similar and what is different between the rotary-wing and fixed-wing aircraft.

What did you discover? What failed? We know everything isn't going to work right the first time we try it. Learning from failure is a critical part of engineering.

### Discussion

Have the participants share...

- We discovered ...
- We failed at ...

Use your flip chart to record what the group learned about rotary and fixed wing aircraft. Use these prompts as needed...

- Rotary-wing and fixed-wing aircraft are similar
- Rotary-wing and fixed-wing aircraft are different
- We found that moving the rudder made the glider
- We found that moving the elevons made the glider

## Introduce the Skill: Reflecting and Processing STEM Experiences – 2 minutes

We know that as you work through the Drone Discovery experience with youth, there will be a lot on your mind. You'll be making sure you don't lose any children and hoping nothing gets broken. But you'll also be thinking a lot about how to make this fun and help them learn as much as possible.

One of the skills you will be using through all the activities is helping youth reflect and process their learning experience. You will help youth make connections to their own experiences – by saying things like, What do you know about...? You'll ask questions that get them to think – like “Why didn't that work?”

I have a short video that I want to share with you where you'll see youth at a Maker Guild building parachutes to put in a wind tunnel. They are actually using a lot of the same concepts about flight, lift and drag that the youth you work with will be learning, just in a different type of challenge. We'll use the video as a starting place to develop some strategies you can use to help youth Reflect and Process their Drone Discovery experience.

As you watch the video, jot down questions and strategies the facilitator uses to help youth reflect and process the experience.

## Seeing the Skill in Action – 8 minutes

Click2SciencePD Learning Module: Making Meaning from STEM Learning  
<http://www.click2sciencepd.org/learning-modules/making-meaning-from-stem-learning>

### Discussion

Have the participants share what they noticed in the video.

- I noticed ...
  - They used the plussing strategy to give feedback to each other. The facilitator asked, "Does anyone have a plus for..." It seems like a good strategy, but I think it takes some practice for youth to get good at giving each other feedback.

Use your flip chart to record strategies that the group thought were effective.

- Questions or strategies I thought worked well
  - The facilitators asked "What do you know about..." to get youth thinking about the topic.
  - I thought "What made you want to change it?" Was a good open question that got them thinking.
  - I thought "Why did that not work?" Was a really good question that helped the youth process and learn from failure. I think it is really important to support youth in understanding that they can fail, learn from it, and it can help them succeed in the end.
- I want to know more about ....

## Introduce Core Engineering Design Process – 3 minutes

You may have already noticed that the Engineering Design Process is central to the Drone Discovery experience. So, what will you need to know to guide youth through this process? We want youth to understand that engineering is about designing solutions that solve problems. We want to help them be the problem solvers of our future.

In the guide, we introduce the Core Engineering Design Process in this way - To succeed in this challenge, you'll need to think like an engineer as you design, build and test drones. There are many different kinds of engineers and different ways to approach a challenge. The engineering design process has three basic steps: define, design and optimize.

We're going to look at each of these steps, then we'll develop strategies you can use as you lead youth through the Take Off activity.

## Defining Engineering Problems

The engineering design process starts by defining the problem. In their guide, there is a list of challenges. Each team will select a challenge to work on. Different teams will see even the same challenge differently. As they define the problem, they need to consider constraints and limits (like time and resources). It is also really important for each team to define their criteria for success. You can expect each team to define their problem a bit differently. Encourage them record specific ideas as they reflect on their challenge on page 5 of the youth guide. They will come back and work on solving this challenge in the Foam Drone activity.

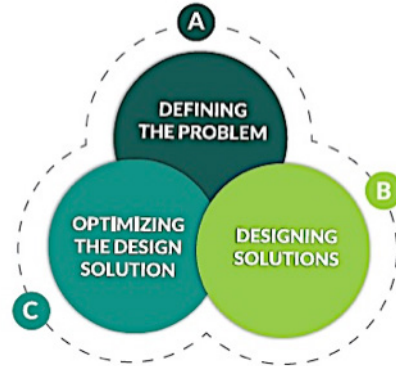
## Designing Solutions

Designing solutions starts with brainstorming - one good idea is rarely enough. Starting with lots of ideas, makes engineering fun, and helps engineers develop innovative ideas. The fun part is starting with an idea, trying it out and seeing what happens.

## Optimizing the Design Solution

Then the idea is tested, refined and improved. This is optimizing. Sometimes ideas send you back to the drawing board - why it is good to start with lots of good ideas. This is where complex ideas become simpler, more focused - simple is good.

## Core Engineering Design Process



- A** **Defining engineering problems** involves stating the problem to be solved as clearly as possible in terms of criteria for success, and constraints or limits.
- B** **Designing solutions to engineering problems** begins with generating a number of different possible solutions, then evaluating potential solutions to see which ones best meet the criteria and constraints of the problem.
- C** **Optimizing the design solution** involves a process in which solutions are systematically tested and refined, and the final design is improved by trading off less important features for those that are more important.

## Brainstorming Strategies - 10 minutes

We've covered a lot, and we have (Minutes left). I want to take a moment to review where we've been and think about how you can apply all this as you lead the Drone Discovery experience.

Our goals for this training module are (1) to prepare you to introduce the Core Engineering Design Process and support youth in applying it throughout their Drone Discovery experience. And (2) to develop strategies you can use to help youth get more out of the experience by being intentional about reflecting and processing along the way. We want you to be prepared to provide opportunities for youth to talk about what they are doing, and to listen to what others are learning. You can do this by incorporate reflection throughout the experience, not just at the end.

For Foam Drone, you will need teams of 5, so I recommend you establish those teams in this activity, since the next activity will give them a chance to solve the challenge they select in this activity.

Now let's create some concrete strategies you can use. Open up your guide and grab some post-it notes. We are going to brainstorm strategies together, and I want you to pick out the best ideas and actually write them in your book, or on post-it notes that you place in the book so you have them in front of you as you lead the activity.





#### Trainer Note

I recommend using the youth guide because I find it easier to follow when I am in front of the group – I use the facilitator guide as I am preparing, but not as I'm leading the activity. That's why I put my notes in the youth guide, but I want you to put your notes in the guide you will use to lead the experiment.

One tip for Take Off is to create couple of foam or cardboard patterns for the FPG-9 glider so youth can trace it easily onto their foam plate – or if you need to save time, prepare the gliders ahead of team (see page 10 in the facilitator guide for tips on making gliders).

#### Discussion

Have the participants share...

- Prompts or questions to help youth define their engineering challenge (page 5 in Youth Guide, page 8 in Facilitator Guide) In the short version of this activity, youth will spend 5 minutes defining their challenge, and then move on to Foam Drone.
- In the 25 minutes version of the activity, they will have time to explore rotary and fixed wing flight. What prompts or questions could you use to help youth refine and optimize their solution for controlling the FPG-9 glider (page 6 in Youth Guide, page 10 in Facilitator Guide) How will you support youth to learn from their failure if the aircraft doesn't do what they expect?
  - Pause after they have had some time to explore and have each partner go talk to someone from another group and share what they have learned.
  - A failed flight – describe exactly what happened – do you know anything you could change to make it fly differently (i.e. more force, less force, adjustments to the FPG-9 glider.
- How will you wrap up this experience and prepare them for the Foam Drone challenge? (page 6 in Youth Guide, page 10 in Facilitator Guide)

Use your flip chart to record ideas about helping youth reflect on what they've learned.

- Prompts or questions to help youth reflect on what they learned as they tried out the rotary-wing and fixed-wing aircraft (page 6 in Youth Guide, page 10 in Facilitator Guide)
  - Drones use both rotary and fixed wing aircraft platforms. Rotary aircraft are better at precision flying, especially if they need to stay in one place, like to take a picture. Fixed-wing aircraft can carry heavier loads and travel longer distances.
  - What do you remember from what you discovered as your explored the different types of aircraft? (pull up pods if needed)

### Local Planning – 12-15 minutes



#### Trainer Note

It will be really helpful to the volunteers and teen leaders you are training to think about the logistics and details of the actual event they will be involved in. If you have not already covered this with the group, reserve 12-15 minutes to review logistics and address any specific concerns.

Ask the group...

- Do you feel ready to lead the Drone Discovery experience at...?
- What do you need to feel ready?

If the details are familiar, a quick review may be all that is necessary.

Let's talk about how the event will be set up.

- Location and time
- Audience (families, afterschool program, school, club, etc.) How many are you expecting? Will everyone arrive at one time? Will people be coming and going?
- How will the space be set up?
- What supplies will be provided? What do volunteers need to bring?
- Any ideas how we can advertise the event to get more people there?
- Be sure to address concerns mentioned.



## Summarize

In this workshop, we focused on applying the engineering design process and helping youth reflect and process their learning throughout their experience on Take Off, the first part of the 2016 National Youth Science Day challenge. In the next workshop, we'll focus on the Foam Drone activity.





# Module Two: Foam Drone & Landing

Agenda: (50 minutes)

- Welcome (2 minutes)
- Experience the Experiment (10 minutes)
- The Engineering Design Process – What you will be doing (3 minutes)
- Seeing the Skill in Action (8 minutes)
- Brainstorming Strategies (10 minutes)
- Brainstorming Strategies for Landing (5 minutes)
- Local Planning (12-15 minutes)

Learning goals

- Develop skills for youth and adult leaders to facilitate engineering design process
- Develop skills youth and adult leaders guide reflection and processing of the Drone Discovery experience
- Provide support so that youth and adults have fun learning together

Arrange the room so participants can talk to a partner easily. Place items on the tables.

- Post-it Notes
- Pens
- Scratch paper
- Flip Chart paper and markers

Before the training participants will need

- 2016 NYSD Drone Discovery Challenge kit
- Drone Discover Youth or Facilitator Guide (download or from kit)

If you are not sure about Internet connection at your training, download the video prior to the training.





# FOAM DRONE

## Welcome - 2 minutes

This is the second in our series of three workshops designed to support teen leaders and volunteers as they prepare themselves to help youth to get the most out of their Drone Discovery experience. This workshop focuses on the Foam Drone Challenge and building community connections through Landing: Taking Action.

In Foam Drone, youth learn about remote sensing by designing and using a model drone, then sharing data in a video film festival. They will have opportunities to try out different roles on an engineering team and use the Core Engineering Design Process as they design and optimize the platform they will attach to the drone. In Landing: Taking Action youth will have the opportunity to apply what they've learned.

## Experience the Experiment - 10 minutes

We want you to experience the experiment, so get a partner and find the foam airplane in your kit. We're going to give you just a few minutes to play with the glider and see if you change how it flies. See if you can make it go in a circle. When you come back at (Time) we'll discuss what you learned.

### Discussion

Have participants share...

- We discovered...
- We were able to get our glider to...

## The Engineering Design Process - What you will be doing - 3 minutes

The engineering design process is central to the Drone Discovery experience. To succeed in this challenge, youth will need to think like an engineer as they design, build and test their drones.

Your role as you facilitate the engineering design process isn't to help them solve the problems that come up along the way - but to help them think through the process to find their own solutions. In this activity, youth will be working in a team of five, which means you will probably have one foam drone for two teams

### Defining Engineering Problems

In Foam Drone, the teams will have a chance to use the foam airplane in the kit to solve the challenge they defined in Take Off. As the teams focus in on their problem, you can help them think about what makes a good solution, encourage lots of ideas and open-ended thinking. Don't expect each team to come to the same solution. They may choose different places to mount the camera, or different strategies to get the information they need.

## Designing Solutions

Encourage fun and innovation as teams design their solutions. When they get stuck, encourage them to tell you what isn't working, and what they could do differently. Try not to offer your own solutions. The fun part is starting with an idea, trying it out and seeing what happens.

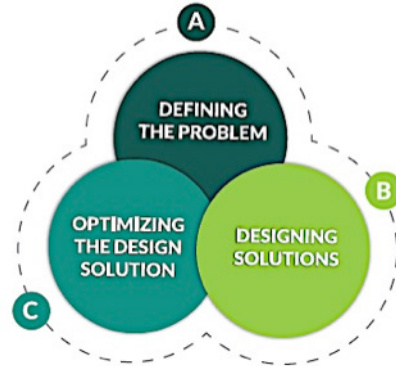
## Optimizing the Design Solution

At this point, the teams will be able to view the first video they recorded and think about how to redesign their drone to get a better video -

- Did they mount the camera upside down?
- Was the drone moving too fast or too slow to get the best video?
- Would it help to add elevons to the drone? How you do that?

Once their ideas are tested, refined, encourage optimization. A good idea can get better, and you want to keep everyone busy. This is also where complex ideas become simpler, more focused - simple is good.

## Core Engineering Design Process



- A** **Defining engineering problems** involves stating the problem to be solved as clearly as possible in terms of criteria for success, and constraints or limits.
- B** **Designing solutions to engineering problems** begins with generating a number of different possible solutions, then evaluating potential solutions to see which ones best meet the criteria and constraints of the problem.
- C** **Optimizing the design solution** involves a process in which solutions are systematically tested and refined, and the final design is improved by trading off less important features for those that are more important.

## Seeing the Skill in Action – 8 minutes

We're going to watch a video so you can see this the Engineering Design Process in Action and how different team members are different roles.

Click2SciencePD Learning Module: I can do STEM skill video (2:51)  
<http://www.click2sciencepd.org/learning-modules/i-can-do-stem>

As you watch the video, jot down questions and strategies the facilitator uses to help youth understand more about applying the engineering design process and the different roles they will have on the team.

## Discussion

Have participants share...

- I noticed ....
  - The facilitator really latched onto the idea of making a plan and came back to that several times.
- Questions or strategies I thought worked well
  - "What do engineers do?" was a really effective, open question.
  - I loved the comment she makes "you don't fail in engineering - you just keep redesigning" - What can we do to help youth be comfortable learning from designs that fail?

- I want to know more about ....
  - I'm trying to figure out how to make the most of having five on a team and making meaningful roles for everyone. I like the idea of letting youth select their role - hopefully that will make it more meaningful to each individual.

Use your flip chart to record strategies the team might want to use as they lead the Drone Discover experience.

- Are there any strategies you saw in the video that you would like to use?

## Brainstorming Strategies - 15 minutes

Now it is time to think about how you will actually apply this as you lead the Drone Discovery experience. Some tips for making this activity run smoothly

- You'll need at least one computer to download videos on
- Practice with the camera ahead of time so you know how it works and can download the videos
- Be sure the camera is charged before you start the activity
- Set up your target for the drones to record before you start the activity

Open up a copy of the Drone Discovery guide you'll be using and grab some post-it notes. We are going to brainstorm strategies together, and I want you to pick out the best ideas and actually write them in your book, or on post-it notes that you place in the book so you have them in front of you as you lead the activity.

The Foam Drone challenge starts on page 7 in the Youth Guide and page 12 in the Facilitator Guide with a list of roles. We saw in the video how different team members had different roles. Did you think this was helpful? How can you use this strategy when you lead the activity? Make some notes in this section about how you want to handle who is doing what. Will you let youth select their own roles? Will you get extra foam airplanes so teams don't have to share?

Now let's use some of our strategies for helping youth through the Engineering Design Process. In this challenge, each team using the foam airplane as a drone platform to attach their sensor (camera). How will you help them think about trade-off like weight and drag? How will you help them define what success looks like? Make some notes for Define the Engineering Problem on page 8 in the Youth Guide and page 13 in the Facilitator Guide about questions you might use to help the teams think about these issues.

Next Comes Design a Solution on page 8 in the Youth Guide and page 14 in the Facilitator Guide. The most important thing to remember is to not to offer your own solutions. The fun part is starting with an idea, trying it out and seeing what happens. Encourage experimentation and testing with the drone and with the camera. As you discuss trade-offs of their design - encourage you the think about what is not working, or could work better. Make some notes about questions you might ask to help the teams think about these issues.

You will probably find that some teams spend a lot of time designing and testing their drone while others quickly move on to Optimize Your Solution. Here your role is to keep everyone engaged and be prepared to challenge teams that feel like they've solved the problem to make their solutions better – simpler, prettier, more accurate. Brainstorm some ideas about how you will encourage optimization. You may also want to encourage these teams to edit their video – How long does the video need to be? What are the most informative five seconds of their video? What parts of the video are not helpful? Have them work on a presentation (see page 16 in the Facilitator Guide).

How will you share their videos? Social media? At a special event or celebration? With parents at the end of the activity? Take time to think about how they will Communicate Your Results see page 9 in the Youth Guide and page 16 in the Facilitator Guide.

### Brainstorming Strategies for Landing – 5 minutes

We're going to spend just a little time thinking about what comes after the Drone Discovery experience. Through their National Youth Science Day experience, participants have learned a lot about drones and the potential they have to solve problems. We want to give them the opportunity to apply this knowledge in their community.

Open up a copy of the youth guide to Landing, it starts on page 16 in the Youth Guide and page 24 in the Facilitator Guide. What are some ideas you have about how youth can apply what they've learned in your community? Are there problems they could solve? Are there businesses using drones that they could visit or learn more about?



#### Trainer Note

Use your flip chart to record ideas about connections in the community. If you have ideas about possible businesses or other resources they could connect with, add them to the list as well.

#### Resources to Share:

- Click2Science resources for starting a Project Based Learning experience.
- Resources from NYSD
- Career Exploration online resources

## Local Planning - 12-15 minutes



### Trainer Note

It will be really helpful to the volunteers and teen leaders you are training to think about the logistics and details of the actual event they will be involved in. If you have not already covered this with the group, reserve 12-15 minutes to review logistics and address any specific concerns. If the details are familiar, a quick review may be all that you need to do.

Ask the group...

- Do you feel ready to lead the Drone Discovery experience at...?
- What do you need to feel ready?

Let's talk about how the event will be set up.

- Location and time
- Audience (families, afterschool program, school, club, etc.) How many are you expecting? Will everyone arrive at one time? Will people be coming and going?
- How will the space be set up?
- What supplies will be provided? What do volunteers need to bring?
- Any ideas how we can advertise the event to get more people there?
- Be sure to address concerns mentioned.

## Summarize

In this workshop, we focused on applying the engineering design process, encouraging youth to develop their own solutions and making it fun for everyone throughout the Foam Drone activity from the 2016 National Youth Science Day challenge. We also talked about to make connections within your own community for Landing: Taking Action. We want to provide opportunities for youth to apply what they've learned in their own community. In the next workshop, we'll focus on the Code Copters activity and making career connections as part of Landing: Taking Action.





# Module Three: Code Copters

## Module Four: Landing

### Agenda (50 minutes)

- Welcome (2 minutes)
- Experience the Experiment (10 minutes)
- Reflecting and Processing STEM Experiences (3 minutes)
- Seeing the Skill in Action (8 minutes)
- Brainstorming Strategies for Code Copters (10 minutes)
- Brainstorming Strategies for Landing (5 minutes)
- Local Planning (12-15 minutes)

### Learning Goals

- Develop skills for youth and adult leaders to facilitate engineering design process
- Develop skills youth and adult leaders guide reflection and processing of the Drone Discovery experience
- Provide support so that youth and adults have fun learning together

Arrange the room so participants can talk to a partner easily. Place items on the tables.

- Post-it Notes
- Pens
- Scratch paper
- Flip Chart paper and markers

Before the training participants will need

- 2016 NYSD Drone Discovery Challenge kit
- Drone Discover Youth or Facilitator Guide (download or from kit)
- A printed copy of page 13 of the Youth Guide for each participant

If you are not sure about Internet connection at your training, download the video prior to the training.





# CODE COPTERS



# LANDING: TAKE ACTION

## Welcome – 2 minutes

This is the last in our series of three workshops designed to help teen leaders and volunteers prepare themselves to help youth to get the most out of their Drone Discovery experience. We'll be focusing on Code Copters and Landing.

In Code Copters, youth explore coding concepts through a game then code a simulated drone using Scratch. Then in Landing, youth apply what they've learned as they take action through citizen science, career exploration, or civic engagement. You don't need to be an expert to lead either of these activities. We'll talk about how to facilitate the activity even if you know little to nothing about coding.

## Experience the Experiment – 10 minutes

We do want you to experience Code Copter and understand what your role as facilitator will be. We're going to program a drone. Look over the commands on page 13 of the Youth Guide. The first command is used to begin and end your program. What will you say to begin the program? What will you say at the end? Some of the other eight commands are very helpful. Some are not. Remember your role is to support youth in devising their own solution. Don't tell them which commands are most useful. Instead, encourage teams to create their own solution and discover which commands are most useful as they try them out. It is really important that you don't give them the solution – let it be their own, but be ready to help them out as they try to learn from what doesn't work.

If you can, work with a partner and have them try out your code. When you come back at (Time) we'll discuss what you learned. You may also want to look at this activity in the Facilitator Guide. It starts on page 19.

### Discussion

Have the participants share...

- We discovered...
  - Some of the commands, like move \_\_ steps are really not very clear
  - Glide to X:\_\_, Y:\_\_\_\_\_ is a useful command
  - Change x or Change y by \_\_\_\_\_ are useful commands
- How does this activity use the engineering design process? Youth do not build a drone in this activity. Are they using engineering at all? How?
  - EDP is applied to the process of creating their program. Especially as they test and redesign the program.
  - Teams will define their problem as they think about what the program needs to accomplish- then they design a solution and optimize their solution as they make improvements to their program.

## Reflecting and Processing – 3 minutes

Have you ever led an activity with youth where they understood it better than you? Often in 4-H we tend to volunteer in areas where we have expertise. Most often when I talk to volunteers that are working outside their comfort zone – say building and programming robots – it is because they have a child that is passionate about robots and they are willing to take a risk to provide that opportunity to their child.

In this experiment, you will be part of a national effort providing the opportunity for thousands of youth to explore the idea of designing and programming a drone. That is really exciting. And you don't have to be an expert to make this happen. Remember you're going to use a lot of open questions that you don't need to know the answer to. Your questions will help you reflect on what they are doing and solve the problem for themselves.

- What do you want the program to do? What is it actually doing?
- What does this command do? (You can go through a whole program having them explain each command)

Often as you use these questions, you'll get a response like, "Oh, I know what I need to do now." You may have no idea what they need to do next, but just step back and let them do it. Another strategy to keep in mind is to notice who in your group is an expert. Ask them to help teams that are struggling. This benefits both the expert and the team they are helping.

Now we're going to watch a video of expert coming into an afterschool program to help youth learn to build and code robots. You'll see him using strategies that you can apply to the Code Copters. In this case, he is an expert and understand the programming well. Notice how he uses his expertise.

As you watch the video, jot down questions and strategies the facilitator uses to help youth reflect and process the experience.

- What strategies does he use to encourage youth to solve their problems without giving them the solution?
- How does he use questions to encourage youth to reflection and process their experience as they are coding?
  - Loved the example from the Navy as a lesson about why to not program the robot to go forever.

## Seeing the Skill in Action – 8 minutes

Click2SciencePD Learning Module: Real-World Application of Skills (3:17)

<http://www.click2sciencepd.org/learning-modules/real-world-application-of-skills>

### Discussion

Have the participants share..

- I noticed ....
- Questions or strategies I thought worked well
- I want to know more about ....

Use the flip chart to record strategies the team might want to use for the Drone Discovery experience.

- Are there any strategies or questions you saw in the video that you would like to use?

## Brainstorming Strategies for Code Copters – 10 minutes

Now it is time to think about how you will actually apply this as you lead the Code Copters challenge. Here are some tips for making this activity run smoothly.

If you are doing the Code Copters IRL,

- Use masking tape to create a 4x4 grid that you can move around in easily – you will be the drone for this activity.
- If you choose to use the command cards (page 27 Facilitator Guide), make copies in advance and cut out the cards.

If you doing the Code Copter simulation,

- You'll need at least one computer with Internet access for each pair of youth, if you have access to enough computers, you can let each person work on their own.
- You'll need to go to <http://www.scratch.mit.edu> to set up a username and login for your group before you start this activity.
- You may want to play around with scratch yourself, or you may decide to learn along side the youth you are working with

The Code Copters challenge starts on page 11 in the Youth Guide and page 18 in the Facilitator Guide. Who's doing what? Remember for this activity you will have smaller groups, one or two people working at a computer. Help partners decide what their roles will be. This is important – only one person can program on the computer. How will the other person on the team be involved? Will you have team member switch roles so everyone gets to sit at the computer and do some programming? Make some notes about how you want to use the roles.

For Code Copters IRL, you get to be the drone moving around the grid you set up on the floor. Look over the instructions on page 20 of the Facilitator Guide. It explains how you should respond to each of the commands. You also need to decide if you want to use the Command Cards that are on page 27 of the Facilitator Guide. Make a note to remind yourself that you need to prepare these ahead of time if you are using them. Any other tips you can share with the group for this activity?

Code Copters starts on page 21 of the Facilitator Guide and 14 in the Youth Guide. This is where your teams get to go online and actually program a drone to fly over a landscape. Remember to set up a username and login for your group ahead of time. There are lots of resources on the NYSD site to help with the programming – but you do not need to be an expert to lead this. Your role is to use your questions to encourage the teams to solve problems for themselves. What are some good questions to use when they are programming? How will you encourage problem solving? Make some notes in your guide about how you want to do this.

## Brainstorming Strategies for Landing – 5 minutes

We're going to spend just a little time thinking about what comes after the Drone Discovery experience. Through their National Youth Science Day experience, participants have learned a lot about drones and the potential they have to solve problems. We want to give them the opportunity to apply this knowledge in their community.

Open up a copy of the youth guide to Landing, it starts on page 16 in the Youth Guide and page 24 in the Facilitator Guide. In the last workshop, we discussed connecting to resources in your local community. Today we'll focus on Career Exploration and Citizen Science.

What could you do to help youth explore careers related to their Drone Discovery experience?

### Resources to Share

- Career Clusters - help students discover their interests and their passions, and empowers them to choose the educational pathway that can lead to success in high school, college and career <https://careertech.org/career-clusters>
- Discover Engineering – great resources to help youth explore a wide range of engineering career and how to be successful in the field they choose <http://www.discovere.org/discover-engineering>
- The College board has a career exploration site called Big Future – it lets youth learn about a wide variety of careers and has questions to help them discover a career that interests them <https://bigfuture.collegeboard.org/explore-careers>

How about Citizen Science? Have you ever participated in a citizen science project? Citizen science projects give anyone the opportunity to work with large research projects, often collecting data, or in some cases, helping analyze large data sets. There are some great resources in Landing: Take Action to help you get started in this area. Remember that service is a crucial part of the 4-H experience and being able to apply what they have learned in the Drone Discovery experience through a project like Fossil Finder is a great opportunity to serve in a new way.

### Resources to Share

- Click2Science resources for Developing a STEM Project <http://www.click2sciencepd.org/learning-modules/developing-a-stem-project>
- The Nature Conservatory project – Yard Map lets youth learn about creating habitat for animals in their own backyard and be part of a community <http://www.yardmap.org>
- The Fossil Finder project lets youth help interpret data collected by drones – more eyes, more information, more discoveries is their theme <http://www.fossilfinder.org>
- SciStarter is a site where you can find lots of citizen science projects and can select one that is of interest to your group <http://scistarter.com>

## Local Planning - 12-15 minutes



### Trainer Note

It will be really helpful to the volunteers and teen leaders you are training to think about the logistics and details of the actual event they will be involved in. If you have not already covered this with the group, reserve 12-15 minutes to review logistics and address any specific concerns. If the details are familiar, a quick review may be all that you need to do.

Ask the group

- Do you feel ready to lead the Drone Discovery experience at...?
- What do you need to feel ready?

Let's talk about how the event will be set up.

- Location and time
- Audience (families, afterschool program, school, club, etc.) How many are you expecting? Will everyone arrive at one time? Will people be coming and going?
- How will the space be set up?
- What supplies will be provided? What do volunteers need to bring?
- Any ideas how we can advertise the event to get more people there?
- Be sure to address concerns mentioned.



## Summarize

In this training, we focused on using reflection and open questions to support youth in developing their own solutions and helping them find answers to their questions, even if you don't know the answer. Code Copters is a great activity where youth get to learn about programming and actually simulate controlling their own drone. Have fun with it. We also shared resources for making connections to careers and being part of a citizen science project for Landing: Taking Action. We want to provide opportunities for youth to apply what they've learned and serve others.

Do you feel ready to go with Drone Discovery? Do you have any questions that we have not addressed?

