TECHNOBot AI

Teacher Guide

Lessons for Middle & High School Students | Grades 8 - 12

Technology Course

using

Scratch

Explore artificial intelligence.

In this course, students become artificial intelligence specialists. They apply a design thinking model to imagine creative solutions to real-world problems. Using Scratch, they build prototypes of their inventions. These include a drone delivery system, robot pickup service, and self-driving tour. Afterwards, they present one of their AI prototypes as an investment opportunity. Throughout the course, they reflect upon the possibilities and limitations of AI technologies.

TECHNOKids®

Table of Contents

Introduction

This section provides valuable information about teaching TechnoBot AI. It includes a description of the Teacher Guide, as well as an overview of the course. In addition, there are ideas for implementation and technology integration.

For additional guidance, open the course in TechnoHub and select *Get Started* to access preparatory steps, resource list, and scheduling timetable.

How to Use This Guide

This Teacher Guide contains the following three sections:

Getting Started: This section contains a course description, as well as ideas for implementation.

Course Instructions: The course is comprised of six sessions, each focused on a problem-solving task that aligns with the project theme. Each session includes assignments that break down the task into manageable steps. The components of each session are as follows:

- Overview – an explanation of the session's activities and their purpose.
- Materials – a list of handouts, sample files, and teacher resource materials needed to teach the session.
- Teaching Strategies – instructional methods recommended for teaching the activities.
- Lesson Plan – a detailed list of each step in the session.
- Learning Objectives – a summary of the content knowledge and technical skills taught throughout the session.
- Assignments – a session consists of assignments completed by students. Actions to be performed on the computer by the student are indicated with a triangle (▷). Background information is indicated with a dash (–).
- Review – a session review contains a list of fill-in-the-blank, multiple choice, or short-answer questions intended to review concept and technical knowledge. (answers included).
- Skill Review – an additional assignment intended to review Scratch coding skills and artificial intelligence concepts (includes completed sample).
- Extension Activity – an additional activity that relates to the skills presented in the session. Tasks show students how to enhance the document created in the session with additional, optional features.

Appendices: This section contains additional information or materials.

- Assessment Tools – a list of skills taught during this course, marking sheets, and checklists.
- Glossary – a definition of each term.
- Contact Information – how to contact TechnoKids Inc. for curriculum support.

TechnoBot AI Overview

Introduction to TechnoBot AI

In this course, students become artificial intelligence specialists. They apply a design thinking model to imagine creative solutions to real-world problems. Using Scratch, they build prototypes of their inventions. These include a drone delivery system, robot pickup service, and self-driving tour. Afterwards, they present one of their AI prototypes as an investment opportunity. Throughout the course, they reflect upon the possibilities and limitations of AI technologies.

Students complete the following:

- In session 1, students become artificial intelligence specialists. This role requires them to solve problems using AI and Scratch. The fun begins with an exploration of AI in daily lives. Next, they register for a Scratch account and discover how to use coding blocks to create a simple animation. They will apply this knowledge in upcoming sessions to program a drone delivery system, robot pickup service, and self-driving tour.
- In session 2, students develop a prototype of a drone delivery system that uses AI. It must solve a common problem at school. Using Scratch, students build a simple program that flies a sprite-drone to collect items and then return to its original start point. They will refine the code to adjust to new delivery locations and object movement. How can students improve the lives of teachers?
- In session 3, students invent a robot pickup service that kids can use to quickly get items from a smart locker. The locker could store food, books, or gym equipment. The process will be contactless. A user will receive a secret code to unlock a specific box. If the wrong code is entered, an error message will display. Students will use Scratch to build a model of their AI prototype. How can they improve the lives of kids?
- In session 4, students become computer vision specialists. They design a self-driving tour. It must meet the needs of both business owners and tourists. Using Scratch, students will build a program that drives an autonomous vehicle along a route from one exhibit to another. At each stop, a robot will share interesting facts. The tour could take place at a zoo, theme park, or city center.
- In session 5, students improve the safety of their self-driving tour. They program their autonomous vehicle to avoid obstacles along the route. Afterwards, both business owners and tourists test the design to provide feedback. Once it is ready, students invite others to take a robot guided tour and provide a customer review. How does the invention enhance the lives of others?
- In session 6, students create a presentation for potential investors. They are seeking funding for one of their AI prototypes. It could be their drone delivery system, robot pickup service, or self-driving tour. Getting straight to the point they will explain their product. Using very few words and lots of visuals they will summarize how the technology works and why it improves the lives of users. Who will invest in their invention?

Implementation and Technology Integration Ideas

In this course, students solve real world problems using artificial intelligence. They apply a design thinking model to build prototypes of their inventions using Scratch. For each programming task, they outline the decision-making process, as well as the possibilities and limitations of the technology. Upon completion students select one of their prototypes and present the AI solution to a group of potential investors.

Students complete the following design challenges:

- design a drone delivery system that automates a daily task for teachers.
- invent a robot pickup service that kids can use to quickly get items from a smart locker.
- develop a self-driving tour that shuttles tourists to exhibits.

TechnoBot AI is primarily a STEM course about artificial intelligence. However, the activities also integrate into other areas of curriculum including computer science, language arts, mathematics, science, and visual arts.

- Computer Science: The activities in TechnoBot AI use Scratch coding blocks to invent prototypes which use artificial intelligence to solve real-world problems. Students learn essential computer science concepts. They build scripts, trigger events, loop actions, control timing, debug errors, and more.
- Language Arts: The final task in TechnoBot AI targets language arts learning outcomes. Students present an AI prototype to potential investors. Their presentation must be persuasive. This task strengthens oral communication skills.
- Mathematics: TechnoBot AI can be integrated into an existing problem-solving unit in Math class. The assignments are an ideal fit because coding requires mathematical and logical thinking. For example, moving sprites across the stage requires plotting ordinal pairs, rotating objects involves knowledge of angles, and setting the size of sprites uses percentages. As well, logic is used to control when or if an action happens.
- Visual Arts: TechnoBot AI includes several digital art activities using the Scratch Paint Editor. Students illustrate a smart locker and a self-driving tour route. This is an excellent opportunity for creative expression.
- Science: TechnoBot AI could be taught as a science unit about emerging and futuristic technologies. Throughout the course, students explore the practical applications of drones, smart lockers, and self-driving vehicles. They gain an understanding of how artificial intelligence improves lives.
- Design Thinking: In TechnoBot AI students flow in and out of the five phases of design thinking. Throughout the activities they *empathize* with the user, *define* a problem, *ideate* to imagine creative solutions, mockup a *prototype,* and *test* with users.

This is a preview of the teacher guide.
Pages have been omitted.

Session 2
Flying Machines at School

In this session, students develop a prototype of a drone delivery system that uses AI. It must solve a common problem at school. Using Scratch, students build a simple program that flies a sprite-drone to collect items and then return to its original start point. They will refine the code to adjust to new delivery locations and object movement. How can students improve the lives of teachers?

Assignment 4: Artificial Intelligence and Drones

Assignment 5: Get to Know the Design Thinking Model

Assignment 6: Plan a Drone Delivery System

Assignment 7: Invent a Drone Delivery Prototype

Reflection: Your Drone in the Real World

Session 2 Review: AI Terminology and Scratch Blocks

Session 2 Skill Review: Search and Rescue Drone

Session 2 Extension Activity: Learn About Drones and AI

Session 2 Getting Started

Overview

In this session, students develop a prototype of a drone delivery system that uses AI. It must solve a common problem at school. Using Scratch, students build a simple program that flies a sprite-drone to collect items and then return to its original start point. They will refine the code to adjust to new delivery locations and object movement. How can students improve the lives of teachers?

Materials

- Scratch: https://scratch.mit.edu/
- Scratch Flashcards: Events, Motion, Looks (optional)
- Assignments 4 – 7
- Design Thinking presentation (replaces Assignment 5)
- *drone.sb3* sample (optional)
- Reflection: Your Drone in the Real World
- Session 2 Review: AI Terminology and Scratch Blocks (optional)
- Session 2 Skill Review: Search and Rescue Drone (optional)
  - *rescue.sb3* sample
- Session 2 Extension Activity: Learn About Drones and AI (optional)
- Drone Delivery System Marking Sheet

Teacher Preparation

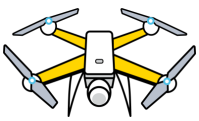
(Refer to the Preparing to Teach section of this guide for instructions)

- (Optional) Gather the flashcards listed in the materials list for this session.
- (Optional) Open *drone.sb3* in Scratch. Study the scripts students will be building.
- Review assessment tools. A customizable *Drone Delivery System* marking sheet is available in the Assessment folder.

Teaching Strategy

In this session, students invent a drone delivery prototype that simplifies a school task for the teacher. Explain session scenario:

> *In this session, you invent a drone delivery system. It will replace a manual task done by the teacher. For example, the flying machine might collect student work, distribute art supplies, or hand out laptops. You will use a design thinking model to develop a creative solution. Using Scratch, you will build a prototype to demonstrate how the technology will work. How can you improve the workday for teachers?*



Assignment 4: Artificial Intelligence and Drones

In this assignment, students read about drones. They learn practical applications for this technology and how artificial intelligence improves their operation. Afterwards, students answer questions. This task can be done independently or as a group.

To increase understanding you might want to show a video by Intel about AI and drones: https://youtu.be/--pp-_xtm_U.

Before you begin, introduce the following terms:

- *drone:* small flying machine that follows a person's commands or software instructions to move.
- *GPS:* global position system that uses satellite signals to pinpoint a location.
- *lidar:* technology that scans an area to determine the position of objects by measuring the time it takes light pulses to bounce back into a receiver.
- *autonomous*: act independently with no control from others.
- *machine perception:* technology that gives machines the ability to see, hear, and touch so that they can understand what is happening around them.
- *computer vision*: technology that allows a machine to see and identify objects.
- *machine learning*: technology that gives a machine specific data to train it to do a simple task such as recognize an object.
- *deep learning*: technology that gives a machine a large amount of data to do a complex task such as make a prediction using many networked connections.

Session 2 Extension Activity: Learn About Drones and AI

To help students learn about drones and artificial intelligence, complete the Session 2 extension activity. It has several short YouTube videos that demonstrate the technology.

Assignment 5: Get to Know the Design Thinking Model

In this assignment, students are introduced to design thinking, which is an approach to creative problem solving. It is commonly used in the workplace to develop unique solutions that meet end-users' needs. To learn more visit: https://designthinking.ideo.com/.

A design thinking model will be used throughout the course to develop AI prototypes. In this assignment, students read about the steps and then answer questions. Skip this assignment if they are already familiar with design thinking.

You may wish to use the *Design Thinking* presentation instead of the assignment sheet.

Before you begin, introduce the following term:

- *design thinking:* five-step model for creative problem solving that includes empathize, define, ideate, prototype, and test.

Assignment 6: Plan a Drone Delivery System

In this assignment students become design thinkers. Their task is to develop a drone delivery system that automates a task for the teacher. The planning sheet includes a section for each step in the model. You may have students work independently or in small design teams.

Below are some suggestions:

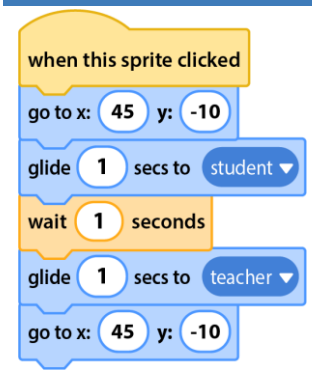
- Step 1 *Empathize*: To help students empathize with the end-user they are given interview questions. As a class, you may have students take turns posing questions to you. Alternatively, you may divide students into teams and have them interview other teachers in the school to discover their unique needs.
- Step 2 *Define*: Students are given a fill-in-the blank sentence to write a problem statement. You may wish to provide a word list of emotions to help identify feelings associated with the issue.
- Step 3 *Ideate*: As a class or in teams have students list tasks that a delivery drone can do for teachers. Have students think about the school day, subject areas, or special events to focus their thinking. Wild ideas are welcome!
- Step 4 *Prototype*: Each student can pick their own idea for the drone delivery system from Step 3. They quickly draw how it will work. The sketch should be very simple.
- Step 5 *Test*: In the test step of design thinking the end-user determines if the solution meets their needs. Have students submit their assignment sheet. Or, have a one-on-one meeting to verify that the idea will work. To determine if the drone delivery system is viable, view the *drone* project in Scratch to gain an understanding of the task.

Assignment 7: Invent a Drone Delivery Prototype

In this assignment, students build a working prototype of their drone delivery system to demonstrate how it will work. They will use Scratch. You may wish to show the sample *drone.sb3* to explain the code.

Before you begin, introduce the following term:

- *object tracking:* a type of computer vision that can identify and follow a moving object.

BLOCKS	CATEGORY	PURPOSE
	Events	Run the script when the drone is clicked.
	Motion	Set the location of the drone's launch pad.
	Motion	Move the drone to the student's location.
	Control	Pause the drone to adjust the timing of its flight.
	Motion	Move the drone to the teacher's location.
	Motion	Set the location of the drone's landing pad.

Reflection: Your Drone in the Real World

- identify strengths and limitations of drone delivery and AI technology
- compare a sprite-drone prototype to a real drone

Lesson Plan

Assignment 4: Artificial Intelligence and Drones

- Read about drones and the tasks they perform.
- Answer questions about AI and drones.

Assignment 5: Get to Know the Design Thinking Model

- Read about the steps in a design thinking model.
- Answer questions about design thinking.

Assignment 6: Plan a Drone Delivery System

- Step 1 Empathize: Interview teachers to discover their needs.
- Step 2 Define: Complete a sentence to write a problem statement.
- Step 3 Ideate: Generate tasks a delivery drone might do for a teacher. Select a task.
- Step 4 Prototype: Sketch how the delivery drone system will work.
- Step 5 Test: Share sketch with teacher to determine if it will meet user's needs.

Assignment 7: Invent a Drone Delivery Protype

- Open Scratch. Create a new Scratch project.
- Insert sprites for the teacher, student, and drone.
- Place the sprites on the stage and adjust their size.
- Set the launch pad for the drone.
- Program the drone to fly from one place to another to complete a task.
- Test object tracking. Improve the program.
- Explain the drone delivery system.
- Take the drone AI challenge.
- Save changes and close Scratch.

Session 2 Skill Review: Search and Rescue Drone

To extend learning about drones in the real world complete the Session 2 Skill Review. Students watch a video of a Search and Rescue drone to discover how it works. Afterwards, they apply their knowledge to build a Scratch project of a rescue mission.

https://www.youtube.com/watch?v=GkIJ2NJQHys

Learning Objectives

Applied Technology

- design a delivery drone system using design thinking to solve a school-related problem

Content Knowledge

- define drone and AI terminology
- identify tasks completed using drone and AI technologies
- recommend places a drone should and should not fly and defend your opinion
- identify strengths and limitations of drone delivery and AI technology
- compare a sprite-drone prototype to a real drone

Design Thinking

- recognize the steps in a design thinking model
- understand how the design thinking model focuses on the end-user's needs
- develop a plan using design thinking to solve a real-world problem
- emphasize with users by conducting an interview with the teacher
- define one key school-related problem a drone can solve
- ideate to generate a list of tasks a drone can do for a teacher
- sketch a prototype to illustrate idea for a drone delivery system
- show sketch to teacher to test if idea meets a need

Computer Science | Coding

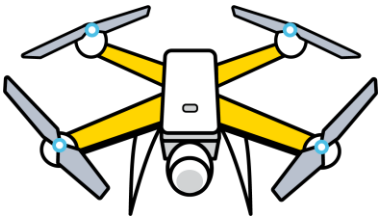
- apply computational thinking to solve problems
- code a program using Scratch that models a delivery drone system
- run a script or program
- debug the code

Scratch Block-Based Coding

- create a new Scratch project and name the file
- select a sprite from a Library
- set the exact size of a sprite using a percentage
- trigger a script to run when a sprite is clicked, or the Go button is pressed
- move a sprite to a specific spot to act as a launch and landing pad
- move a sprite to a specific sprite to demonstrate a drone delivery system
- reposition a sprite on the stage to test a drone's object tracking
- wait for an amount of time to allow a person time to interact with a drone
- explain the drone delivery system using the *say* block

Assignment 4 Artificial Intelligence and Drones

In this assignment you learn how drones use artificial intelligence to complete tasks. Read about how this technology can improve lives. Afterwards, answer the questions.



What Is a Drone?

A drone is a small flying machine that follows a person's commands or software instructions to move. It is used to learn, work, or play. A drone can have:

- many propellers to stabilize their flight.
- battery to power the unit.
- GPS to report location.
- sensors to track speed, altitude, motor rotation, and more.
- cameras to take photos, record video, or live stream.
- LIDAR to create 3D images of an area.
- gadgets to carry a load or complete a specific task.

Why Do People Use Drones?

There are many reasons people use drones. For example, drones can:

1. fly places that people cannot go.
2. act as an "eye" in the sky to show people a new viewpoint.
3. collect data to make decisions or assess risk.
4. provide a status report of an area or equipment.
5. transport items.

WHAT TASKS CAN DRONES DO?	
inspect equipment	track progress of building projects
search and rescue	transport aid after a disaster
map an archaeological site	patrol an area to keep it secure
count animals	detect crop health
record footage for film or tv	live stream an outdoor event
locate wildfires	deliver seedlings to restore forests
explore a planet	take aerial photos of a property for sale

Artificial Intelligence and Drones

Today, many drones are *autonomous*. This means they can direct their own actions and fly with no control from humans. Artificial intelligence helps the machine to see, hear, touch, and think. Using AI hardware and software, drones can:

- scan an area to pick a route
- identify objects
- track movement
- detect obstacles
- avoid collisions
- adjust a path

Drones collect lots of data. Often too much for people! One way to control the information is to use artificial intelligence to automate some tasks.

- To limit data, drones can use sensors to see objects. This is a type of *machine perception*. It allows drones to scan an area and then highlight things that are important.
- To label data, drones can look at features in an image. This is a type of *computer vision*. It allows drones to identify objects.
- To analyze new data, drones can learn from past tasks. This is a type of *machine learning*. It allows drones to use data to become better at classifying images.
- To make decisions, computers can analyze data from drones to look for patterns. This is a type of *deep learning*. AI organizes large amounts of information on its own.

Questions About AI and Drones

1. How can AI technology be used by a drone?
   a. map a route to fly
   b. avoid obstacles by picking a new flight path
   c. identify objects
   d. all of the above

To see drones at work, complete the Session 2 Extension activity.

It has short videos that are fun to watch.

2. How can a researcher use AI and drones to study endangered species?
   Finish the sentence with a task.
   a. Map **an area.**
   b. Track **a herd.**
   c. Identify **an animal.**

3. Companies want to use drones to deliver items. Where should drones be allowed to fly?

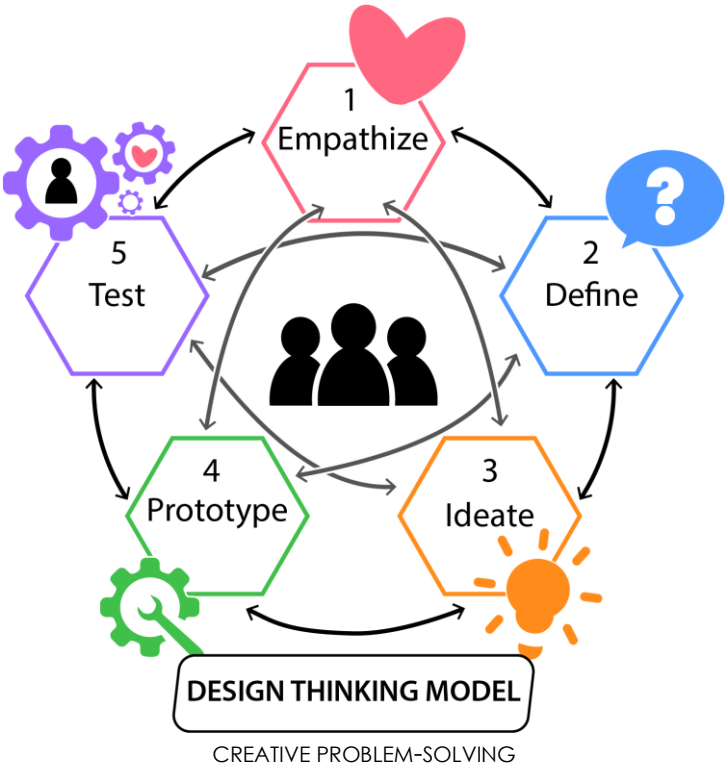
Around the school playground.	☐ yes	☐ no
Above your backyard.	☐ yes	☐ no
On top of a highway.	☐ yes	☐ no
Near an airport.	☐ yes	☐ no
Over a forest.	☐ yes	☐ no

Chat with a friend.
What places should be no-fly zones?

Assignment 5 Get to Know the Design Thinking Model

In this assignment you learn about the Design Thinking Model. You will apply this model to design artificial intelligence prototypes throughout this course. It will help you develop ideas for a drone delivery system, robot pickup service, and self-driving tour.

Read the information about the model and then answer the questions.



What Is Design Thinking?

Design thinking is a five-step model for creative problem solving. It focuses on understanding people's needs to develop products and services that improve lives. The model is non-linear. This means, a person does not solve a problem by progressing from step 1 to step 5. Instead, when design thinking, there is a flow back and forth through the steps to find the best solution.

Five Steps in Design Thinking

Design thinking has five steps:

1. *empathize*: understand a person's feelings, values, desires, and needs.
2. *define*: identify one main problem to solve that will help users.
3. *ideate*: imagine solutions to the problem.
4. *prototype*: create a simple model of a solution.
5. *test*: share the prototype with users to gain feedback to improve the solution.

Why Use Design Thinking?

Design thinkers are everywhere! They are architects, engineers, business owners, graphic designers, game developers, animators, programmers, and more! Many workplaces use a design thinking model because it focuses attention on the end-users' needs.

People working in the field of artificial intelligence use design thinking to guide the development of new products and services. The goal is to make people's lives better. Instead of thinking "let's do it because we can" there is a shift to "let's do it because we should".

Here are some of the ways design thinking is used in the workplace:

- recognize the problems people face.
- understand why people need solutions.
- invent new products or services that meet people's needs.
- determine if an idea is worth pursuing.
- find and fix design flaws.
- keep improving a solution until it meets the needs of users.
- gain approval from a user to know that the solution works.
- demonstrate a prototype to raise money to fund development.

Questions About Design Thinking

1. What are the five steps in a design thinking model?

   a. understand, define, ideate, share, prototype

   b. empathize, design, brainstorm, test, invent

   c. empathize, define, ideate, prototype, test

2. In a design thinking model, you can move back and forth between steps.

   a. true

   b. false

3. Empathize is the most important step because it focuses on understanding the end-user. What does a design thinker need to understand about a person?

   a. feelings

   b. values

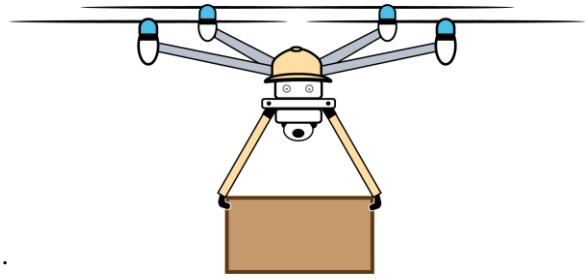
   c. desires

   d. needs

   e. all of the above

Assignment 6 Plan a Drone Delivery System

Become a design thinker!



You must plan a drone delivery system for your teacher. It should automate a task using AI.

The drone might collect student work, hand out laptops, or drop off art supplies.

Interview your teacher to understand their needs. Answer the questions to pick an idea.

Step 1 - Empathize with Your Teacher

1. The first step in design thinking is to *empathize*. Ask your teacher the questions below to understand their workday.

   a. What is your first reaction when you feel like class time is being wasted?

   b. Why do you react that way?

   c. Can you describe how you feel when a task such as collecting tests takes a long time?

   d. What things will you do when teaching to avoid wasting class time?

   e. What do you think about having a drone in the classroom to help do some tasks?

   f. Which tasks do you think a drone can do to save class time?

   g. Which tasks do you think a drone cannot do to help you when teaching?

Step 2 – Define the Problem

2. The second step in design thinking is to *define*. In this step, a design thinker takes the information from the *empathize* step and uses it to identify one main problem to solve.

   Write a problem statement. It should focus on how people feel about the situation.

   Teachers feel _____ when common tasks take too long and waste class time.
   emotion

Step 3 – Ideate to Brainstorm Solutions

3. The third step in design thinking is to *ideate*. Ideate means to imagine. In this step, a design thinker will think of many ways to solve the problem. Often this is done as a group.

   a. List tasks that a **delivery drone** might be able to do for a teacher:

   - *collect student work*
   - *hand out laptops*
   - *drop off art supplies*
   -
   -
   -
   -

   b. From the list, pick a delivery drone idea that you think is the best solution for teachers. Put a star beside it.

Step 4 – Sketch a Prototype

4. The fourth step in design thinking is to create a *prototype*. A prototype is a model that demonstrates how an idea will work.

   Draw a sketch that shows how the drone will do a task. Use symbols, arrows, and shapes for the teacher, drone, students, and other objects.

Step 5 – Test the Prototype

5. The fifth step in design thinking is to *test* the prototype. The user should be the tester and decide if the solution meets their needs.

   Explain your sketch to the teacher. Have them complete the checklist.

   a. Will the solution help teachers? ☐ yes ☐ no

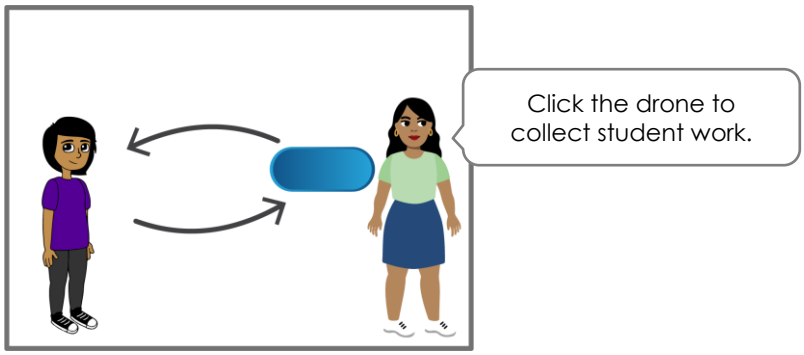
   b. Can a model of the delivery system be built in Scratch? ☐ yes ☐ no

If yes, go to the next assignment. You will program a drone delivery prototype using Scratch.
If no, go back to step 3 or 4 to improve the solution.

Assignment 7 Invent a Drone Delivery Prototype

In this assignment, you build a drone delivery prototype using Scratch. It will automate a task for a teacher.

When clicked, the drone will move to the student and then return to the teacher.



EXAMPLE DRONE DELIVERY SYSTEM

How will the program work?

When clicked, the drone will move to a specific location. After a short time, it will return to its original spot. Once the drone is working, you will test the design. It should track an object and then adjust its flight path. You will use these Scratch blocks to build the program:

BLOCK	CATEGORY	PURPOSE
when this sprite clicked	Events	Run the script when the drone is clicked.
go to x: 0 y: 0	Motion	Set the location of the drone's launch and landing pad.
glide 1 secs to Sprite	Motion	Move the drone to the student's or teacher's location.
wait 1 seconds	Control	Pause the drone to adjust the timing of its flight.

Create a New Scratch Project

1. ▷ Sign into Scratch.

   ▷ Click *Create*.

   ▷ Name the file **drone**.

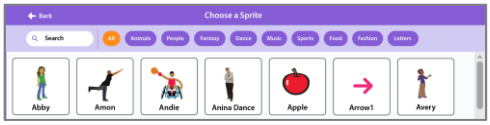
Insert Sprites for the Teacher, Student, and Drone

2. ▷ In the Sprites List remove the cat.

   ▷ Click *Choose a Sprite*.

   ▷ Pick a sprite for the *teacher*.

   ▷ Pick more sprites for the *student* and *drone*.

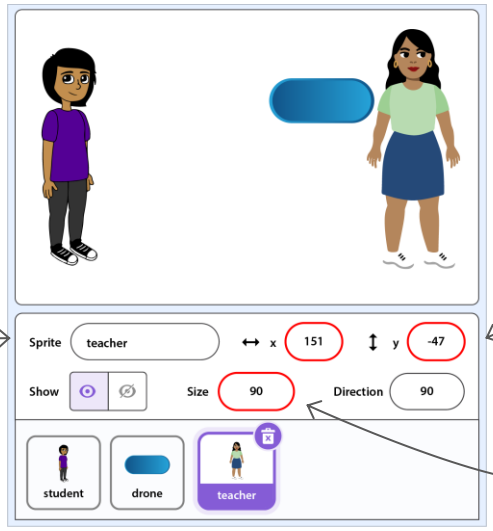


TIP: *Characters 1*, *Characters 2*, and *Dani* have many styles of people.

Place the Sprites and Set Their Size

3. ▷ Drag the sprites on the stage to place them.
   Notice the x and y values change to show the sprite's location.

   ▷ Type a **size** for the sprite. Use a number less than 100 to make it smaller.

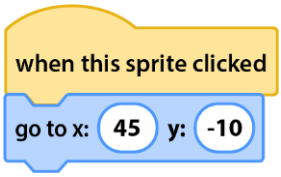


TIP: From the Looks blocks, click *next costume* to switch the style of the sprite.

Set the Launch Pad for the Drone

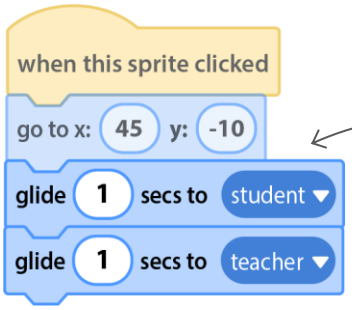
4. ▷ Place the *drone* sprite where you want it to take off.

   ▷ Build a script that sets its start point:



Program the Drone to Fly from One Place to Another

5. ▷ Add blocks to move the drone from one sprite to another when clicked:



TIP: Pick *glide to random position*. Then use the arrow to pick the sprite.

   ▷ Test it! Click the drone to see it fly.

Test Object Tracking

6. An AI drone should adjust the flight path on its own.

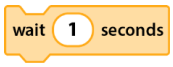
   ▷ Move the student or teacher on the stage. Test the program again.

TIP: If the drone moves to the back of the stage, from the Looks blocks, click *go to front layer*.

Improve the Program

7. Does the teacher or student have enough time to do a task such as hand in work? If not, add a *wait* block to the script.

   ▷ Set the number of seconds.

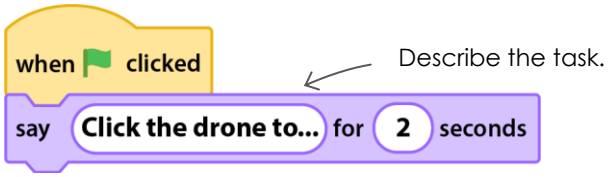


8. Have the drone return to the launch pad. Add another *go to* block.

   ▷ Set the x and y values.

Explain the Drone Delivery System

9. Select the teacher sprite. Build a script to describe the drone delivery system:



Take the Drone AI Challenge

10. Pick a challenge to improve the prototype or come up with your own idea!

- ☐ Add another student. Edit the drone's code to move from one student to another.
- ☐ Build a new script to move a student from one spot to another. Can the drone find the student?
- ☐ Your own idea:

Save the Changes and Close Scratch

Reflection: Your Drone in the Real World

Think about the design of your AI drone delivery system. How would it work in the real world? Consider the strengths and weaknesses of this technology.

1. Give your delivery drone prototype a name:

/1

2. What task does your drone do for teachers?

/1

3. How does your drone improve the workday for teachers?

/1

4. Drones use *GPS* to navigate. In Scratch, the sprite-drone uses x and y values to find the location of objects. What locations use x and y values in your coding?

X and Y values were used to set the location of the sprite-drone launch and landing pad.

/2

5. Drones use *object tracking* to adjust the flight path. This is a type of *computer vision*. Will your sprite-drone automatically change its route if the teacher moves to a new spot in the classroom. Why or why not?

Yes. The sprite-drone will detect the new location using the x and y values of the teacher.

/2

6. Drones are trained to identify objects correctly using *machine learning*. The sprite-drone knows the identity of the student. If a new student was added to the class would your sprite-drone automatically fly to the person? Why or why not?

No. The sprite-drone follows instructions. It needs a command to be able to identify a new student so it can be included in the flight path.

/2

7. Drones with AI technology can scan an area and then adjust its flight path to daily changes. Imagine that your drone could edit its code to fly only to students in attendance that day. How would AI technology improve the drone's operation?

The sprite-drone would not waste time looking for a student that is not present that day.

/2

8. Drones have safety concerns. What are some problems with your drone at school?

- **student might throw something at drone**
- **hit items hanging from the ceiling**
- **propeller could hit a student; crash if the load is too heavy**

/3

TOTAL /14

Session 2 Review: AI Terminology and Scratch Blocks

Complete each sentence with the correct term.

drone	GPS	computer vision	machine learning

1. A **drone** is a small flying machine that follows instructions to move.
2. A self-flying drone uses **GPS** to detect its location.
3. **Computer vision** allows a machine to see and identify objects.
4. **Machine learning** uses data to learn how to classify images.

/4

Artificial intelligence can be used by drones. Label the statements as *true* or *false*?

5. A drone can explore another planet in space. ☐ **true** ☐ false
6. A drone can transport items from one place to another. ☐ **true** ☐ false
7. A drone can only fly if a person tells it the exact route to go. ☐ true ☐ **false**
8. A drone is used to fly places people cannot safely go. ☐ **true** ☐ false
9. A drone cannot identify objects. ☐ true ☐ **false**

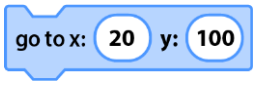
/5

Pick the correct answer.

10. Design thinking has five steps. They are:
    a. empathize, define, ideate, prototype, test
    b. empathize, design, build, prototype, test
    c. brainstorm, design, ideate, test, share

/1

What does the Scratch block do?

11. 

a. Have a sprite show in the center of the stage.

b. Move a sprite to a specific spot on the stage.

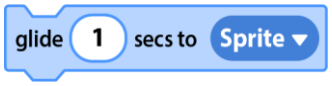
c. Move a sprite 20 steps up and 100 steps down.

12. 

a. Run a script when the sprite is clicked.

b. Run all the scripts when a sprite is clicked.

c. Stop a program from running.

13. 

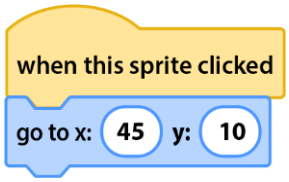
a. Wait one second before doing an action.

b. Move a sprite smoothly one step.

c. Move a sprite smoothly to the location of another sprite.

/2

What does this script do?



14. a. When a sprite is clicked move it up 45 steps and across 10 steps.

b. When the Go button is pressed move a sprite to a specific spot on the stage.

c. When a sprite is clicked move it to a specific spot on the stage.

/2

TOTAL: /15

Session 2 Skill Review: Search and Rescue Drone

Drones can fly where people cannot safely go. For example, they can reach the top of a snowy mountain or scan a dense rainforest. This makes them helpful for search and rescue.

In a search and rescue mission drones can:

- reach a location faster than a person.
- map a search zone to pinpoint places where a person might be trapped.
- shine a spotlight on an area.
- carry a loudspeaker to broadcast a message.
- identify a person using a thermal camera and other sensors.

Use Scratch to program a drone to find a lost sprite. You will use these blocks:

BLOCK	CATEGORY	PURPOSE
when this sprite clicked	Events	Run the script when the drone is clicked.
go to x: y:	Motion	Set the launch and landing pad location.
glide 1 secs to Sprite	Motion	Fly to the missing sprite.

---

1. Watch a video about Search and Rescue drones: https://youtu.be/GkIJ2NJQHys.
2. Create a new Scratch project. Name the file **rescue**.
3. Insert a backdrop of a dangerous area.

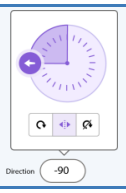
---

4. Insert sprites for the **drone** and **lost sprite**.
   a. In the Sprites List click *Delete* to remove the cat.
   b. Click *Choose a Sprite*.
   c. Pick a sprite for the *drone*. Repeat to add a *lost sprite*.

EXAMPLE RESCUE MISSION

TIPS:

- Resize the sprites to fit the scene.
- Change the direction to flip a sprite.



5. Use your skills to build a script. It must do the following:
    - Run when the drone is clicked.
    - Start at a specific spot, which is the launch pad.
    - Fly to the lost sprite.
    - Return to the landing pad.

---

6. Pick a challenge to add interest:

☐ Pause when the drone reaches the missing sprite. 

☐ Say a message to the lost sprite. 

☐ Have the lost sprite yell for help when the Go button is pressed.

Answer Questions about Your Search and Rescue Mission

1. Why is the location you chose for the Scratch project dangerous for people?

2. What items could the drone carry to help the lost sprite?

    light, food, tools, medical supplies, phone

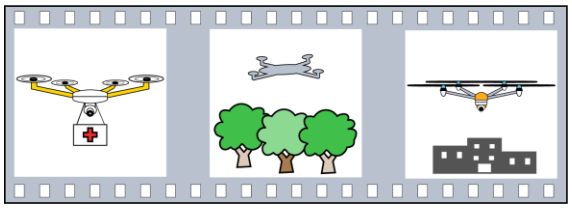
3. Drones can use artificial intelligence to identify a person in distress from other living things. This is a type of *computer vision*. Why is this useful in a rescue mission?

    do not waste time looking at animals or healthy people

4. Use the Internet to find a search and rescue drone. Which model do you think is the best? Why?

Session 2 Extension Activity: Learn About Drones and AI

Artificial intelligence is making drones smarter. Find out how!
Watch the videos and then answer the questions.



1. **Drones Getting Smarter with AI | Intel** (1:32)

   https://youtu.be/--pp-_xtm_U

   How is AI and computer vision tech making drones easier to fly, safer, and more capable?
   List two ways:

   - **autonomous navigation, collision avoidance, recognize user**
   - **recognize where people are, interact with drone using hands, land or take off from palm**

2. **Build the Future with Us at Prime Air | Amazon** (2:01)

   https://youtu.be/o8Ef_AqceMw

   Who does Prime Air want to hire to help create a future that doesn't yet exist?
   List two types of experts:

   - **engineers, scientists, aerospace experts, product developers, software programmers,**
   - **aviation experts, innovators**

3. **Tree-Planting Drones | WWF-Australia** (2:20)

   https://youtu.be/7C7-uvmSG6Y

   List two different tasks the tree-planting drone can do:

   - **deliver seed pods, plant seeds**
   - **monitor plantings, identify species that are successful**

4. **PwC Combines Drones and AI to Help Clients with Complex Infrastructure Projects** (2:22)

   https://youtu.be/5ROVWsnGBmM

   List two ways artificial intelligence is used to manage sites:

   - **monitor sites, notice details people cannot, identify people, machinery, and materials,**
   - **automate image processing, explore and monitor data in real time, identify problems**

Critical Thinking about Drones and AI

Watch the videos. Afterwards, apply your knowledge of drones and AI to think about the technology's strengths and weaknesses.

5. **Search and Rescue Drones that Create Their Own Networks | Harvard Magazine** (0:53)

   https://youtu.be/CCacvXwLNnA

   The future of drones and AI technology is being explored by researchers. Students at Harvard School of Engineering and Applied Sciences create prototypes to test their ideas to see how they would work in the real world.

   a. What does the search and rescue prototype do?

      assess situation

      locate target

      use WIFI to alert robots to go to location

      if WIFI is not available robots can create their own networks

   b. How do you think this idea can help search and rescue teams?
      List two ways:

      - **find person in a remote area, provide Internet access to communicate**
      - **tell robots best way to reach target, robots do rescue without risking human life, robots can carry emergency supplies**

   c. What limitation or problem do you think this idea must overcome before it can be used in the real world?

      drones and robots must be able to travel in inclement weather

      ground robots may have difficulty getting to location

      machines must have long battery life

      drone requires technology to see in extreme conditions

6. **How Drones are Used in All Your Favorite Movies | Time** (3:15)

   https://youtu.be/bLZRG4d3iUk

   This video shows you many ways that drones are used to capture action in a movie. The video was made in 2018. Since then, AI has been added to drones.

   How do you think AI technology could help a filmmaker use a self-flying drone?

   automatically follow an actor, avoid obstacles on the film set, self-adjust filming path

   respond to hand gestures from a camera operator, instantly react to actor's movements

   film different points of view at the same time, decide when to record

   determine if a shot is blurry or clear, automatically edit a blurry shot

This is a preview of the teacher guide.
Pages have been omitted.

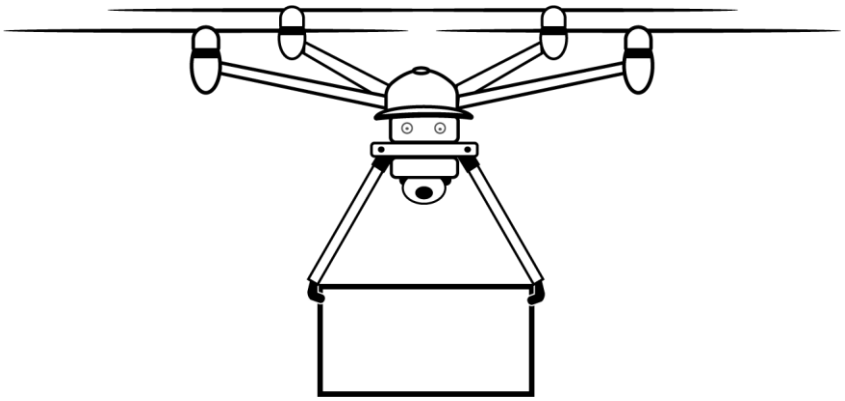
Appendices

Refer to the appendices for additional resources:

This is a preview of the teacher guide.
Pages have been omitted.

Drone Delivery System Marking Sheet

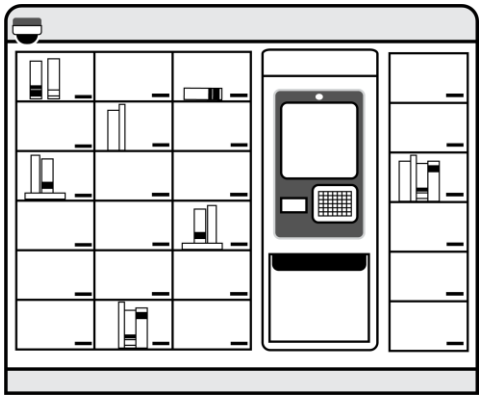
Design a delivery drone system using design thinking that solves a school-related problem. It should automate a task for a teacher.



Code | Drone Operation	
drone starts at a launch pad	/1
drone moves to the student and then to the teacher	/2
drone returns to landing pad	/1
teacher and students have enough time to complete a task	/2
teacher describes the drone delivery system	/2
Creativity	
drone has unique features (e.g., moves to multiple students, detects moving student)	/2
TOTAL:	/10

Robot Pickup Service Marking Sheet

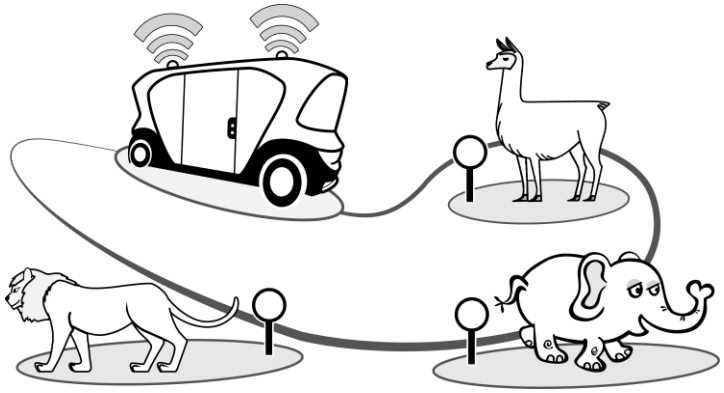
Invent a smart locker using design thinking to create a Robot Pickup Service for kids.



Code | Smart Locker Operation	
order is placed into a locker unit	/1
a secure code for the order is randomly generated	/2
user is prompted to enter in their code	/1
locker verifies if the code is correct, which allows the user to get their item	/2
locker shows an error message if the code is incorrect	/2
Creativity	
smart locker has an original painted design	/2
smart locker has additional code (e.g., hide order once picked up, new user)	/2
smart locker instructions are creative and clearly explain how to use the service	/3
TOTAL:	/15

Self-Driving Tour Marking Sheet

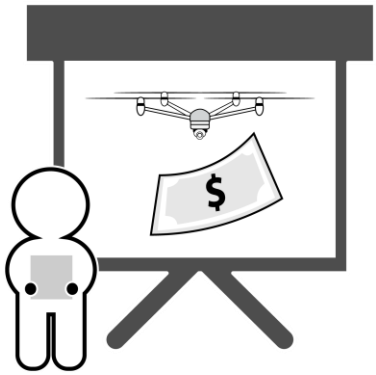
Develop a self-driving tour using design thinking that meets the needs of business owners and tourists. Use Scratch to build a simulation of an autonomous vehicle that follows a route, stops at each exhibit, and shares interesting facts. Improve safety by coding an object detection system.



Code | Tour Route	
tour includes three exhibits and an autonomous vehicle	/2
vehicle drives along a route and stops at each exhibit	/3
tourists have enough time to look at each exhibit	/2
vehicle senses color of sign and then shares a fact about the exhibit	/3
Code | Object Detection	
person moves across tour route	/2
vehicle senses person and stops if they touch	/2
Creativity	
painted colored signs identify each exhibit	/1
tour has unique features (e.g., vehicle speed, exhibit design, additional obstacles)	/2
tour instructions are creative and clearly explain the safety features	/3
TOTAL:	/20

Investment Opportunity Marking Sheet

Create a presentation that convinces investors to fund an AI prototype. Describe the invention and how it meets users' needs. Explain how the code works, design limitations, and next steps.



Content	
describes the invention and how it meets users' needs	/2
demonstrates the prototype with a link to the Scratch project	/2
highlights an important part of the code with an explanation that is easy to understand	/2
explains how artificial intelligence improves the product	/2
discloses a problem with the invention and offers a reasonable solution	/2
convinces the investor the AI prototype will make money	/2
Design	
slide design looks professional	/2
images convey information about the AI prototype	/2
graphic organizer clearly summarizes a problem with the AI prototype	/2
Creativity	
additional features or information attract investor attention	/2
TOTAL:	/20