Explore Components Design Worksheet: Rocket-Powered Lander

Pick one TechRise experiment idea and plan your design.

Explore Components Design Activity Procedure

1. Now that you've brainstormed experiment ideas and understand the electrical components needed to build an experiment, choose one idea for your group, and plan the experiment's design.

2. Review the hardware component menu (below) and use the following questions as a guide to plan your experiment.

Choose one person in your group to record the answers to the following questions.

1. What is your experiment idea?

2. What data do you want to collect from your experiment?

3. How will you capture data? What will this data tell you?

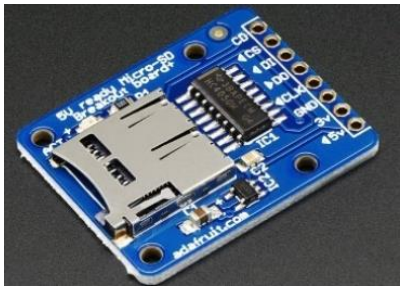
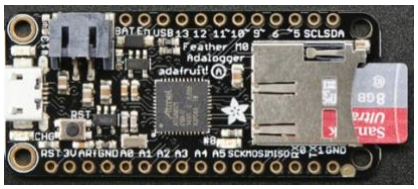
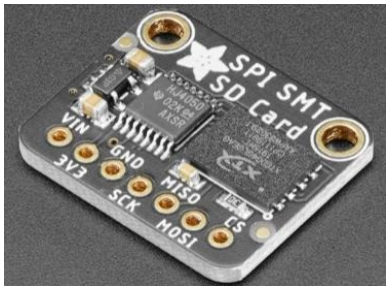
4. What main components/hardware will you need to build your experiment? Use the hardware component menu below to help plan out the design for your experiment. Keep in mind you are welcome to use other components that you know of in the design and are not limited to only ones that you see in the list.

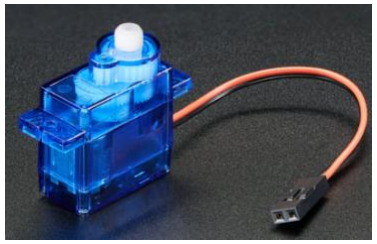
5. Sketch a drawing or diagram of your experiment plan (optional).

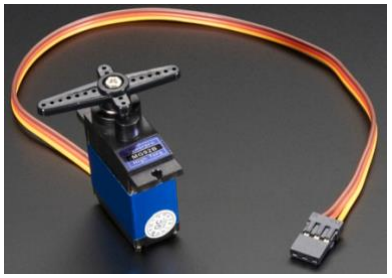
HARDWARE/COMPONENT MENU

This menu is meant to serve as a guide for what hardware types can be used for a TechRise Experiment. Teams are welcome to use other components not listed on this menu. If you have any questions about the hardware components listed, please do not hesitate to reach out to Future Engineers at support@futureengineers.org.

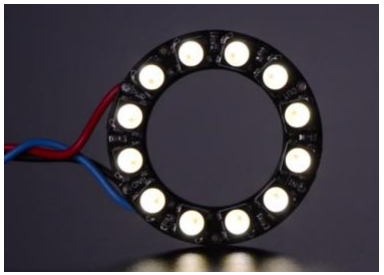
Component	Description	Reference Image	Possible Sources
Microcontroller	Microcontrollers are programmable chips that can be used as the "brains" of an experiment to automate simple tasks by receiving data (input) and sending data (output). You can think of a microcontroller almost like a mini computer. They perform repetitive functions and can be programmed to interact with the components below to build out your experiment. (A simple example could be a microcontroller programmed to receive data from a temperature sensor and to tell a fan motor to turn on if the temperature goes above a certain value.)	 Adafruit Metro M4  Arduino Uno	Metro M4 Source 1 Metro M4 Source 2 Metro M4 Source 3 Arduino Uno Source 1 Arduino Uno Source 2 Arduino Uno Source 3

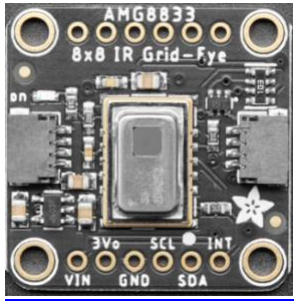
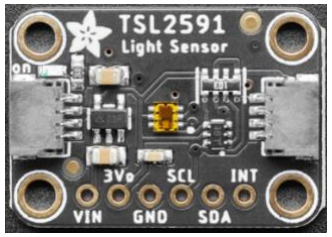
Data Capture	Experiments that are designed to collect data will require an additional device to store, or log, information as text so it can be retrieved and analyzed following a successful flight. SD and MicroSD card readers are well suited for this task. These external storage devices connect to a microcontroller allowing the controller to write data as text to files stored on the removable SD cards. Some development microcontrollers have built-in card readers but most will need a second board, or “shield” dedicated to data storage**.**	 Adafruit MicroSD Card Breakout Board  Adafruit Feather M0 Adalogger  Adafruit SPI Flash SD Card	MicroSD Board Source 1 MicroSD Board Source 2 MicroSD Board Source 3 Adalogger Source 1 Adalogger Source 2 Adalogger Source 3 SPI Flash SD Card Source 1 SPI Flash SD Card Source 2 SPI Flash SD Card Source 3
Motion Components			

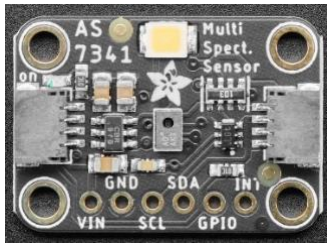
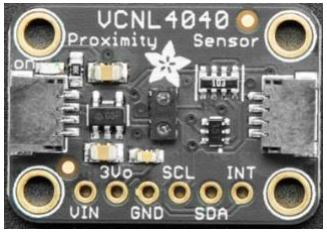
DC Motors	Component that converts electricity into rotational mechanical energy. Motors can be selected to automate tasks using a certain speed or torque. Some motors need to be geared to provide higher torque at lower speeds. It is recommended that any DC motors be wired into a motor driver (see Electronic Hardware) rather than directly into the microcontroller to protect your microcontroller from current overdraw or backflow.	 DC Motor  DC Motor in Servo Body  High Torque Motor with Gearbox	DC Motor Source 1 DC Motor Source 2 DC Motor Source 3 DC Motor in Servo Body Source 1 DC Motor in Servo Body Source 2 DC Motor in Servo Body Source 3 High Torque Motor Source 1 High Torque Motor Source 2 High Torque Motor Source 3

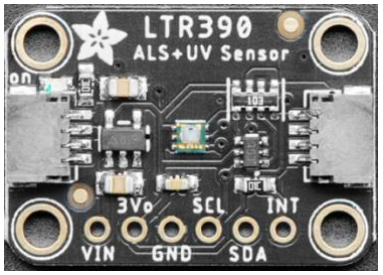
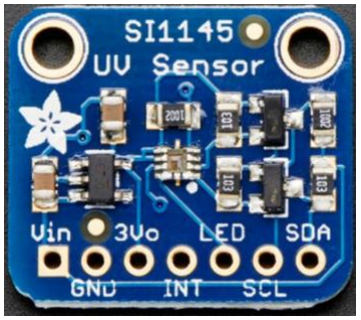
Servomotor (Servo)	A motor that can provide position control. The motor shaft can be moved to a specific angle or position swiftly and precisely. For example, you can program a servo to move from 0 degrees to 90 degrees at a specific moment during your experiment. Most servomotors cannot apply much force and are limited to a 180° range of motion, but they can be utilized as fast release mechanisms or lightweight actuators. Servomotors do not require a motor driver.	 Micro Servo High Powered  Continuous Rotation Micro Servo	Micro Servo High Powered Source 1 Micro Servo High Powered Source 2 Micro Servo High Powered Source 3 Continuous Rotation Servo Source 1 Continuous Rotation Servo Source 2 Continuous Rotation Servo Source 3
Stepper Motors	Similar to a servo, a stepper is a type of motor that allows for precise control of rotation. Steppers are typically heavier than servos and require a motor driver to control, however all steppers are capable of continuous rotation and usually have higher torque than servos. Steppers are commonly used in combination with screw gears to create linear motion.	 Mini Stepper Motor - NEMA-8	Mini Stepper Motor Source 1 Mini Stepper Motor Source 2 Mini Stepper Motor Source 3 Unipolar Stepper Source 1 Unipolar Stepper Source 2

		 Unipolar Stepper Motor	
Solenoid	An electromagnetic device that can “push out” or “pull in.” Solenoids are an on-or-off mechanism that can operate very quickly to actuate linear movement. For example, solenoids are used in pinball machines to shoot away a ball quickly when it touches the bumper.	 Solenoid	Solenoid Source 1 Solenoid Source 2 Solenoid Source 3
Imaging			
Lights	Lights are recommended if you plan to take photos or videos of your experiment. Ambient lighting during the flight may fluctuate and image quality strongly relies on adequate lighting. Lighting an LED is a common first lesson in electronics. A 150 Ohm resistor is recommended on the positive (longer) lead of the LED, however you may calculate the minimum necessary resistance if you would like the LED to be brighter. Neopixels do not require a resistor,	 LEDs	White LEDs Source 1 White LEDs Source 2 White LEDs Source 3 Neopixel Ring Source 1

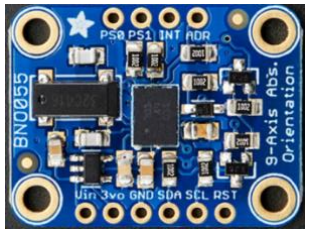
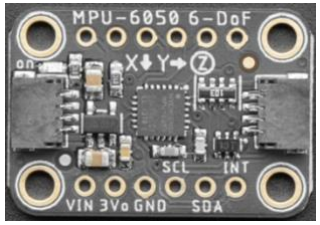
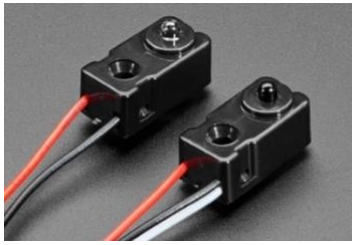
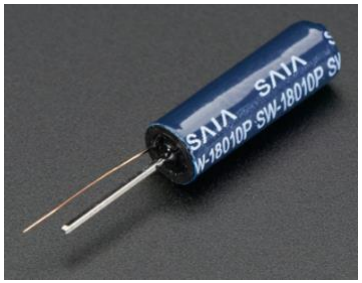
	and instead can be wired directly into the microcontroller.	 Neopixel Ring	Neopixel Ring Source 2 Neopixel Ring Source 3
Camera	A camera that takes photos or videos. Camera boards without an integrated microSD card slot (such as the Arducam) will require an external one and will occupy your microcontroller's processor while taking a video, rendering it incapable of any other actions. You can select an additional, smaller microcontroller dedicated to camera processing if necessary.	 Dash Cam  Arducam Mini Camera	Dash Cam Source 1 Dash Cam Source 2 Arducam Mini Camera Source 1 Arducam Mini Camera Source 2 Arducam Mini Camera Source 3

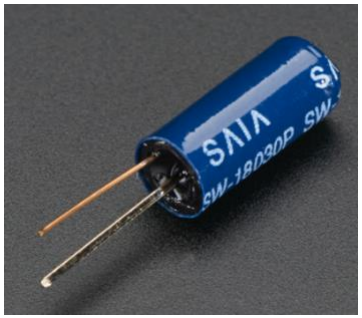
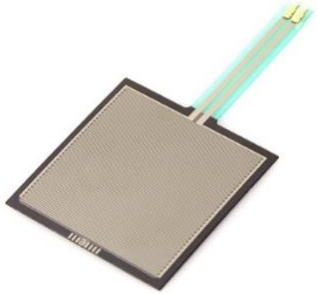
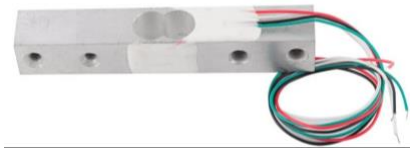
IR/Thermal Camera	An infrared camera that detects thermal (heat) energy. It senses an object's heat signature and creates an image of varying colors depending on how cold or hot an object is.	 Adafruit IR Thermal Camera Breakout  IR Thermal Camera Breakout	Adafruit IR Camera 55 Deg Source 1 Adafruit IR Camera 55 Deg Source 2 Adafruit IR Camera 55 Deg Source 3 IR Thermal Camera Source 1 IR Thermal Camera Source 2 IR Thermal Camera Source 3
Light Sensors			
Visible Light Sensor	A sensor that detects light in the visible spectrum. Some are equipped with additional capabilities such as RGB value measurement or proximity readings.	 Light Sensor	TSL 2591 Source 1 TSL 2591 Source 2 TSL 2591 Source 3 AS 7341 Source 1 AS 7341 Source 2

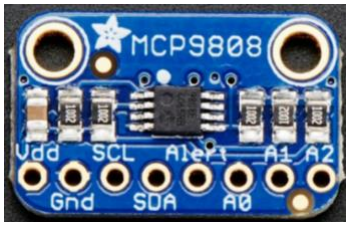
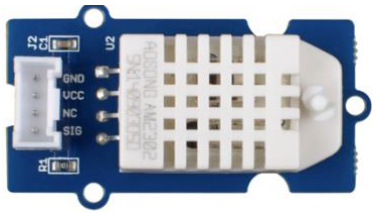
		 Light Spectrum Analyzer  Proximity, Light, RGB and Gesture Sensor  Proximity and Lux Sensor	AS 7341 Source 3 APDS 9960 Source 1 APDS 9960 Source 2 APDS 9960 Source 3 VCNL4040 Source 1 VCNL4040 Source 2 VCNL4040 Source 3

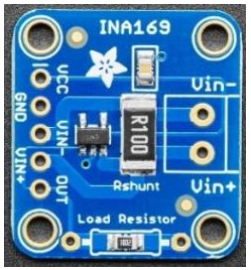
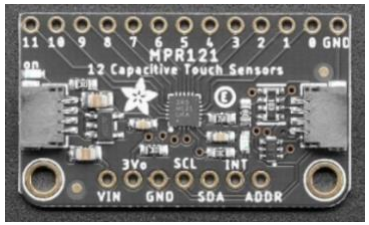
UV Sensor	Sensor that measures ultraviolet rays.	 UV Light Sensor  UV Sensor  UV Sensor	UV Light Sensor Source 1 UV Light Sensor Source 2 UV Sensor Source 1 UV Sensor Source 2 UV Sensor Source 3 UV Sensor Source 1 UV Sensor Source 2

Distance Sensors			
TOF Distance Sensor	A time-of-flight sensor is a device that measures distances using light. It sends out a quick burst of infrared light (aka a laser beam) towards an object. When the light hits the object, it bounces back like an echo. The sensor then calculates how long it took for the light to make the round trip. Since we know that light travels at a constant speed, the sensor can figure out how far away the object is based on the time it took for the light to return.	 LIDAR Distance Sensor  Long range IR Distance Sensor  Long-Distance IR Sensor	Garmin LIDAR-Lite Optical Distance Sensor Source 1 Garmin LIDAR-Lite Optical Distance Sensor Source 2 Long range IR Distance Sensor TF03 Long-Distance LiDAR Module (100m)
Motion and Force Sensors			

IMU, Orientation Sensor and Gyro	The inertial measurement unit can sense speed, direction, acceleration, force, angular velocity and more. The Orientation Sensor and Gyro Sensor measures the rotation of an object in three axes (x,y,z).	 IMU  Gyro & Acceleration Sensor	IMU Source 1 IMU Source 2 IMU Source 3 Gyro Source 1 Gyro Source 2 Gyro Source 3
IR Beam Break Sensor Set	Infrared emitter and receiver set detects when the beam is broken. This set can be used as a “gate” to detect when something has crossed the invisible line produced by the emitter and receiver.	 IR Beam Break Set	IR Beam Break Set Source 1 IR Beam Break Set Source 2
Vibration Sensor	Sensor that detects non-directional vibrations.		Fast Vibration Sensor Source 1 Fast Vibration Sensor Source 2 Fast Vibration Sensor Source 3

		Fast Vibration Sensor  Slow Vibration Sensor	Slow Vibration Sensor Source 1 Slow Vibration Sensor Source 2 Slow Vibration Sensor Source 3
Force Sensors	Two common methods of force sensing are Force Sensitive Resistors (FSR) and Strain Gauges. FSRs are an inexpensive and easy option but are fairly inaccurate. They are best used to detect changes in force but aren't recommended to measure exact weights. Strain gauges can measure weight accurately, however they are larger and more complicated to use. They require calibration and an Analog to Digital Converter, like this one.	 Force Sensitive Resistor  Strain Gauge	Force Sensitive Resistor Source 1 Force Sensitive Resistor Source 2 Force Sensitive Resistor Source 3 Strain Gauge Source 1 Strain Gauge Source 2 Strain Gauge Source 3
Environmental Sensors			

Temperature Sensor	Sensor that measures temperature.	 Temperature Sensor  Temperature-Humidity Sensor	Temperature Sensor Source 1 Temperature Sensor Source 2 Temperature Sensor Source 3 Temp & Humidity Sensor Source 1 Temp & Humidity Sensor Source 2
Radiation and Magnetism			
Radiation Sensor	Sensor that detects ionizing radiation.	 Pocket Geiger Radiation Sensor	Pocket Geiger Radiation Sensor
Magnetometer	Sensor that detects magnetic fields in 3 axes.	 Magnetometer	Magnetometer Source 1 Magnetometer Source 2 Accel/ Magnetometer Source 1

		 Accelerometer Magnetometer	Accel/Magnetometer Source 2 Accel/Magnetometer Source 3
Miscellaneous			
Current Sensor	Measures current flow through the sensor board.		Current Sensor Source 1 Current Sensor Source 2
Microphone	Records audio.		Microphone Source 1 Microphone Source 2
Capacitive Touch Sensor	Detects the presence of electrically conductive materials.		Capacitive Touch Sensor Source 1 Capacitive Touch Sensor Source 2
Other Useful Hardware			
Electronic Hardware		Prototyping(solderless) Breadboard Perma-proto(solderable) Breadboard Jumper Wires	

	Slip Ring I2C Multiplexer Motor Driver Resistors MicroSD Card & Reader Soldering Iron
Mechanical Hardware	Prototyping Mounting Hole Plates Springs Gears Angle Brackets Pulleys 3D Printer