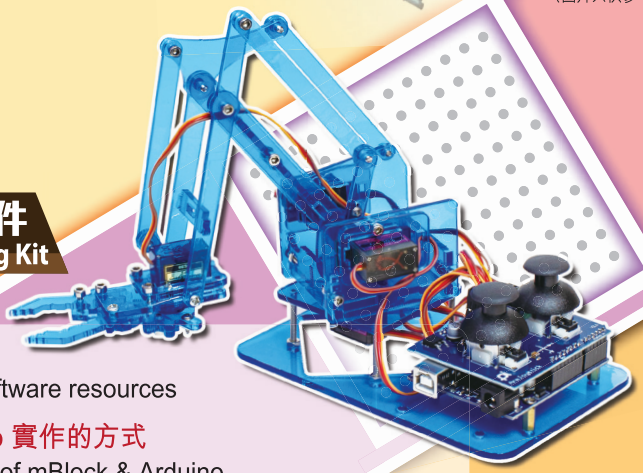
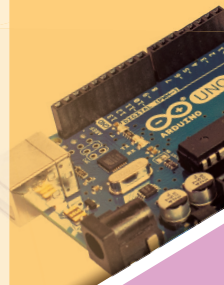
STEM
Science Technology Engineering Maths

（圖片只供參考）

# MeArm
## 機械臂教學套件
## Robotic Arm Teaching Kit



- 豐富的軟硬件資源
  Rich in hardware and software resources
- 採用 mBlock + Arduino 實作的方式
  With the implementation of mBlock & Arduino
- 深入淺出地學習各項硬件原理和編程技巧的實際應用
  Learns the principles of hardware and the practical application of programming skills easily
- 教學材料採用開放源碼軟硬件
  Teaching materials are developed with open source hardware and software
- 教師可配合設計與科技科課程自訂教學內容及STEM教學活動
  The teaching content and STEM learning activities can be customized to cater for the Design & Technology curriculum



MeArm是一款充滿趣味的袖珍型機械臂套件，本套機體用亞加力膠組件構成，可自行組裝，硬件主要包括四個SG90伺服電動機、一塊 Arduino Uno 板和專為MeArm設計的手動控制裝置——搖桿擴展板。此外，機械臂編程是利用開放源碼軟件進行。

MeArm is a popular pocket-sized robotic arm kit. The body of MeArm is made up of acrylic parts for DIY assembly. The key hardware devices of MeArm are four SG90 servo motors, an Arduino Uno board and a joystick shield which is a manual controller tailor-made for MeArm. Robotic arm programming is done with open source software.

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Arduino Uno R3 兼容主板 /
Arduino Uno R3 Compatible Board

MeArm 搖桿擴展板 /
MeArm Joystick Shield

SG90 伺服電動機 (180 度轉動 ) /
SG90 Servo Motor (180 degree Rotation)

USB 線 /
USB Cable

橡膠墊 /
Rubber feet

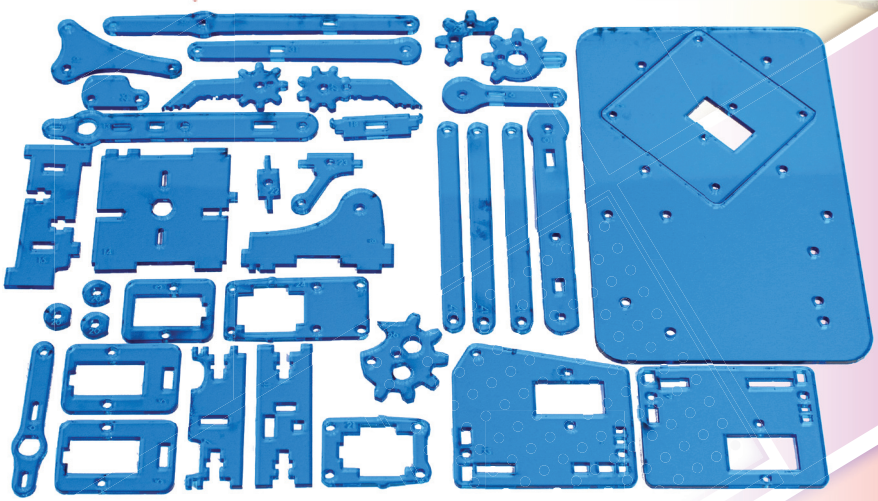
六角匙 ) /
Hex Key

六角銅柱 /
Hexagonal Copper Columns

M3 螺絲（六角頭） /
M3 Screws (Hex head)

M3 螺絲（平頭） /
M3 Screws (Flat head)

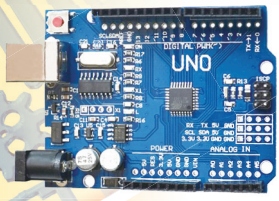
M3 螺母 /
M3 Nuts



MeArm 亞加力組件 / MeArm Acrylic Parts

# 重要零件介紹 Introduction to Major Parts

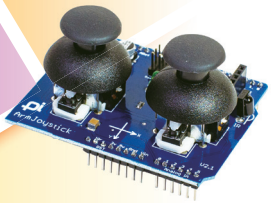
## Arduino Uno R3 兼容主板
## Arduino Uno R3 Compatible Board




Arduino Uno R3 是 Arduino Uno 的第三代改進版，是一款易用型開放源碼微控制器開發板。其運作原理主要是運用按鈕、感應器或手機等等把訊息輸入 UNO 板，透過執行所燒載的程式而作出反應，輸出的零部件可以是直流電動機、伺服電動機、LED 等等。

Arduino Uno R3 is the third revision of Arduino Uno, a user-friendly microcontroller board which operates by receiving input signals through buttons, sensors, mobile phones, etc. and responding through executing the loaded program. The output devices can be DC motors, servo motors, LEDs, etc.

## MeArm 搖桿擴展板
## MeArm Joystick Shield



MeArm 搖桿擴展板是為 MeArm 機械臂設計的一款 Arduino Uno 擴展板，可以直接疊插到 Arduino Uno 板上，提供 4 個伺服電動機接口、一個藍牙模組的接口和一個內置的紅外線接收器。搖桿擴展板上的兩個搖桿根據 X/Y 位置輸出四個二軸類比訊號，用來控制 MeArm 四個伺服電動機轉動，從而操縱 MeArm 的上下移動、左右轉動、前後移動和夾爪開關。

MeArm Joystick Shield, an Arduino Uno shield tailor made for the MeArm robotic arm, can be plugged onto an Arduino board and offers four servo ports, a Bluetooth module port with an built-in infrared receiver. Each of the two joysticks on the shield outputs two-axis analog signals according to its X/Y position. Together they serve as motion controllers for the four MeArm servo motors by manipulating MeArm's upward/downward, leftward/rightward and forward/backward movements as well as the open/close actions of its gripper.

## SG90 伺服電動機
## SG90 Servo motor

伺服電動機是一種旋轉驅動器，提供準確的角度位置控制。SG90 伺服電動機是一個可提供高輸出功率、可安裝在窄小位置的小型輕巧（9 克）的伺服電動機，能大約旋轉 180 度（左右各 90 度）。它包含一個反饋式電動機控制器和齒輪箱。每個伺服電動機都備有伺服臂和螺絲配件。

A servo motor is a rotary actuator that allows for precise control of angular position. SG90 is a tiny and lightweight (9g) servo motor that offers high power output and fits in small places. It can rotate by about 180 degrees (left/right: 90 degrees). It is a motor controller with feedback and a gear box. Each servo motor comes with an accessory pack of servo arms and screws.

## 編程語言 Coding Language

Scratch 程式語言是由 MIT 開發的免費教學用程式語言，特別為中小學生而設計。Scratch 使用圖形化的積木編程界面，簡單易用。

**參考書目：① PA01s Scratch 初階；② PA02s Scratch 進階**

Scratch is a free educational coding language developed by MIT and geared towards kids aged 8 to 16. Scratch's drag-and-drop programming blocks can fit into one another like jigsaw puzzle pieces.

**Reference Books: ① PA01s Scratch: Basic Skills；② PA02s Scratch: Advance Skills**


## Arduino 板連接與程式上載
## Arduino Board Connection and Program Upload

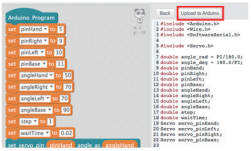
1. 把 MeArm 搖桿擴展板疊插在 Arduino 板上。
   Plug the MeArm Joystick Shield onto the Arduino board.

2. 把四個伺服電動機接駁到擴展板上如下圖：
   Connect the four servo motors to the shield as shown in the figure below:


3. 用 USB 線把 Arduino 板與電腦連接起來。
   Connect the Arduino board to the computer via the USB cable.

4. 在電腦啟動 mBlock 3 程式，在程式界面上方的連接（Connect）選單中點選序列埠（Serial Port），再點選已連接了 Arduino 板的 COM 埠。
   Run the mBlock 3 application on the computer. On the top of the interface, from the Connect menu, click Serial Port and select the COM port already connected to the Arduino port.

5. 在程式中開啟伺服電動機校正程式，在編輯（Edit）選單中點選 Arduino 模式（Arduino mode），然後在右方出現的 Arduino 程式語言區的上方按上傳到 Arduino（Upload to Arduino）鈕上載程式到 Arduino 板。
   In the application, open the servo calibration program. From the Edit menu, click Arduino mode. In the Arduino code pane which opens on the right, click the Upload to Arduino button to upload the program to the Arduino board.




6. 上載程序完畢時，可聽見機械的聲音，代表所有伺服電動機的角度位置已重設。
   Upon completing the upload action, mechanical sound can be heard, which means the positions of all the servos are set.

## 產品特色 Product Features

### 1. 詳盡自學教程 Detailed Self-Learning Tutorial

- 教學內容詳盡，鼓勵同學自學。
  Detailed teaching and learning materials are provided to facilitate students' self-learning.
- 充足及清晰指引以提升學生學習效率。
  Adequate and clear instructions are given to enhance students' learning efficiency.
- 教程支援電腦、平板及智能手機，方便易用。
  Tutorial supports different devices including computers, tablets and smartphones.

### 2. Scratch 語言教學 Scratch Programming Language

- 採用流行、簡易並免費的 Scratch 程式語言來進行教學，學與教更簡便。
  Scratch, a popular, simple and free programming languages is used, which makes learning and teaching easy.
- 特別加入與硬件相關的編程技巧。
  Hardware-related programming skills are covered.

### 3. 開放源碼的軟硬件 Open-Source Software & Hardware

- Arduino 和 mBlock 都是開放源碼的，教師可以按校本需要調整內容。
  Arduino and mBlock are open-source. Teachers can adjust the teaching content according to school needs.

# 教材和學材 Teaching and Learning Materials

## 1. 基礎知識 Basic Knowledge

- 附多本基礎知識教程，即使完全不懂 mBlock 和組裝機械，也能輕鬆學習。
  Basic knowledge tutorials of mBlock and robot assembly are provided for beginners.

## 2. 自學教材 Self-Learning Guide

- 每個專案都有詳盡的自學教材，鼓勵自主學習。
  Each project contains detailed self-study materials in order to encourage self-study.

## 3. 資源檔案及建議答案 Resource Files & Suggested Answers

- 全部與編程有關的作業均配備相關的資源檔案及建議答案。
  All assignments related to programming are provided with relevant resource files and suggested answers.

## 4. 工作紙 Worksheets

- 提供與專案相關的工作紙，附計分指引和答案，方便鞏固知識和評核。
  Project-related worksheets are provided with marking scheme and answers to facilitate knowledge consolidation and assessment.

## 5. 互動光碟及專用網站 Interactive CD-ROM & Companion Website

- 光碟和網站均提供完整的教材和學材，方便備課、教學或自學。
  A CD-ROM and a website with full teaching and learning materials are provided. ( 網址 Website：http://www.apricot.com.hk/stemkit/)

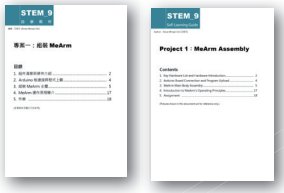
# 專案一：組裝 MeArm
# Project I: MeArm Assembly

同學可以根據組裝步驟來組裝 MeArm 主體，然後透過 Arduino 板連接所有組件及電腦 mBlock 3 程式。同學會學習到 MeArm 操作的四個原理：夾爪開關、左右轉動、前後移動和上下移動。

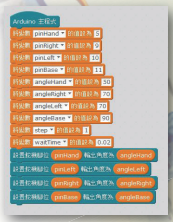
Students can follow the assembly procedure to assemble MeArm's main body, connect all hardware devices and upload the mBlock program to the Arduino board. Students will learn the four dimensions to MeArm's operation, namely, jaws opening/closing, leftward/rightward rotation, forward/backward motion and upward/downward motion.

## 專案資源 Project Resources

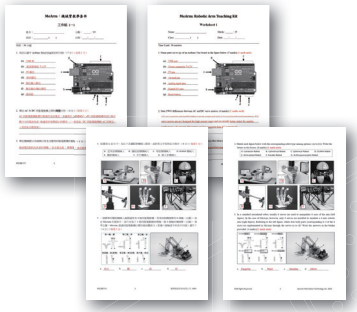
### 自學教材
### Self-Learning Guide



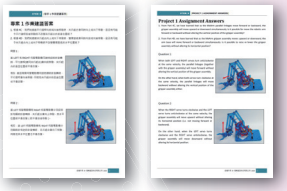

### 資源檔案
### Resource Files


### 工作紙
### Worksheets



### 建議答案
### Suggested Answers



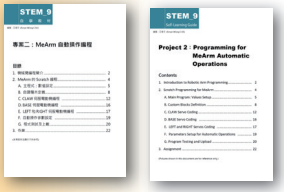
# 專案二：MeArm 自動操作編程
# Project II: Programming for MeArm Automatic Operations

同學會學習編寫一個簡單的 Scratch 程式指示 MeArm 機械臂自動重複地拾起和放下一塊 2cm x 2cm x 2cm 的正方積木。

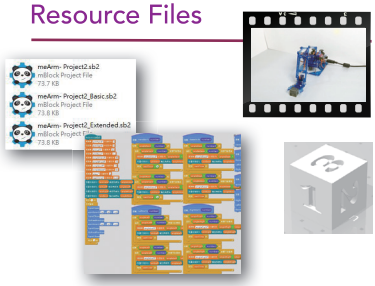
Students will learn to write a simple Scratch program to instruct the MeArm to automatically pick up and put down a 2cm x 2cm x 2cm block repeatedly.

## 專案資源 Project Resources

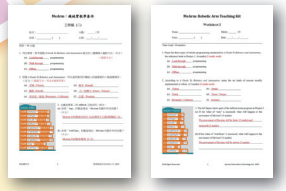
### 自學教材 Self-Learning Guide



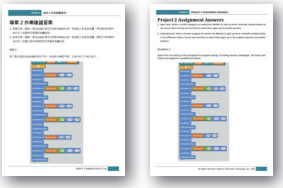

### 資源檔案 Resource Files




### 工作紙 Worksheets



### 建議答案 Suggested Answers



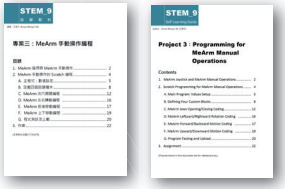
# 專案三：MeArm 手動操作編程
# Project III: Programming for MeArm Manual Operations

同學會學習為手動操作 MeArm 搖桿控制 MeArm 活動編程。

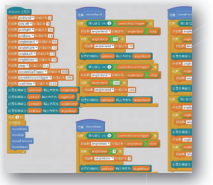
Student will learn to write programs for manual control of MeArm motions through MeArm joysticks.

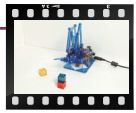
## 專案資源 Project Resources

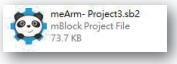
### 自學教材
### Self-Learning Guide




### 資源檔案
### Resource Files








### 工作紙
### Worksheets

本教學套件為配合教育局推行的STEM教學而設計，適合中小學生使用，學與教材料齊備，方便作課堂教學、專題研習或自主學習之用。

## 產品特色 Product Features

- 開放源碼的軟硬件 Open-Source Software & Hardware
- 詳盡自學教程 Detailed Self-Learning Tutorial
- 採用Scratch語言教學 Scratch Programming Language for Teaching
- 提供活動相關的基礎知識 Related Basic Knowledge Provided
- 資源檔案及建議答案 Resource Files & Suggested Answers
- 工作紙 Worksheets
- 互動光碟及專用網站 Interactive CD-ROM & Companion Website

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