Jockey Club STEAM Education Resources Sharing Scheme

# WE Speak Louder

Teachers' Guide



First Edition June 2020

School of Science and Technology
Hong Kong Metropolitan University

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# Contents

***Jockey Club STEAM Education Resources Sharing Scheme*** is a 4-year project (2019-2023) funded by The Hong Kong Jockey Club Charities Trust and operated by the School of Science and Technology, Hong Kong Metropolitan University.

Traditionally, knowledge is transferred to students through a teacher-centred approach. Teachers teach students based on a subject-based curriculum that aimed for content acquisition. However, little attention is given to how students learn and apply the knowledge to tackle matters in and beyond classrooms. Moreover, the knowledge domains are covered in terms of individual subjects, such as Physics, Biology, Chemistry, and Mathematics. Students learn individual subjects separately without holistic integration. As a result, students may not be sufficiently equipped to solve authentic problems in the real world.

*"While Hong Kong students perform well in science, technology and mathematics, they may focus on disciplinary studies and may not evenly participate in hands-on activities in schools. Therefore, it is necessary to strengthen the ability of students to integrate and apply their knowledge and skills across different subject disciplines through solving daily life problems with practical solutions and innovative designs." (Curriculum Development Council, 2015).*

Under this Scheme, the operational team will create a set of STEAM modules for secondary schools to strengthen students' ability to integrate and apply their knowledge and skills across different subject disciplines with a special focus on the use of innovative teaching pedagogies for STEAM education, i.e.

**S**cience
**T**echnology
**E**ngineering
**A**rts
**M**athematics

At least 20 modules would be developed to target students of average ability in solving authentic problems in daily life. Each module would provide 4 to 40 contact hours of student activities. In addition, students would do preparation or follow-up activities during non-contact hours. The ratio between contact hours and non-contact hours is approximately 1:1.

This document provides a detailed module plan for learning, teaching and assessment activities. The module will provide an opportunity for students to learn STEAM through hands-on and minds-on activities that integrate knowledge and skills across Science, Technology, Engineering, Arts and Mathematics under real-world contexts.

# 1. Module Outline

## 1.1 Module Title: WE Speak Louder

*"WE Speak Louder"* aims to study the characteristics and working principles of a loudspeaker. The limitations of loudspeakers will be investigated. Students will build a simple amplifier circuit for a loudspeaker.

The module is compiled with the following 2 units,

- Unit 1 – Studying a Loudspeaker; and
- Unit 2 – Building a Simple Amplifier.

## 1.2 Participants Recommended for this Module

☑ Junior Secondary School Students
☐ Senior Secondary School Students
☐ Others (please specify:_____)

## 1.3 Module Aims

The module "*WE Speak Louder*" aims to:

- Study the applications of loudspeakers in daily life.
- Study the characteristics and working principles of loudspeakers.
- Study the limitations of loudspeakers.
- Build a simple amplifier circuit for loudspeakers.

## 1.4 Module Learning Outcomes

Upon the completion of the module, students should be able to:

- *Discuss* the applications of loudspeakers in daily life.
- *Describe* the basic characteristics of loudspeakers.
- *Discuss* the limitations of loudspeakers.
- *Describe* the operations of an amplifier circuit.

## 1.5 Learning & Teaching Approach / Practice

Students will carry out several experiments to investigate the characteristics and operations of a loudspeaker. Students will have practical experience in using some common equipment such as function generators, oscilloscopes, etc. Students will also build a simple amplifier circuit using ICs, resistors and capacitors, etc.

## 1.6 Nature of STEAM Activity

| Element | Description | Composition |
|---|---|---|
| **S**cience | • Apply the concepts of wave and electricity. | ✪✪ |
| **T**echnology | • Use common lab equipment: function generator, oscilloscope, ICs, resistors and capacitors. | ✪✪✪ |
| **E**ngineering | • Build electronic circuits. | ✪✪✪ |
| **A**rts | • Experience and learn about frequencies in an audio signal | ✪ |
| **M**athematics | • Apply ratio, formulae and functions | ✪ |

## 1.7 Mapping of Key Learning Areas (KLAs)

| Unit | Science Education | Technology Education | Mathematics Education | Arts Education | Others |
|---|---|---|---|---|---|
| Units 1 & 2 | SS7.1.5<br>The electromagnetic spectrum<br><br>SS5.4.3 & 5.4.5<br>Ohm's contribution to current electricity | TK9.1<br>Mechanical, electrical, electronic and pneumatic control systems<br><br>TK16.1<br>Computer and computer operation<br><br>TK5.9-TK5.11<br>Safe use of tools and equipment<br><br>TK5.10<br>Appropriate choice and use of tools, equipment and machines for realization of design solution<br><br>TK5.11<br>Product design<br><br>TK6.3<br>Production process in various fields | MJ6.1-MJ6.2<br>Rates, ratios and proportions<br><br>MJ13.1-MJ13.3<br>Formulae | | |

*Remark: Mapping the skill sets in this module with the respective KLAs in the school curriculum that would be covered.*

## 1.8 Module Structure

| Units | | Contact Hours |
|---|---|---|
| 1 | Studying a Loudspeaker | 2 |
| 2 | Building a Simple Amplifier | 2 |
| | **Total** | **4 hours** |

*Remark: A total of **4** non-contact hours of the module are recommended.*

## 1.9 Thematic Area

- ☐ Environment & Health
- ☐ Food & Biotechnology
- ☐ Digital Transformation
- ☑ S.M.A.R.T.

# 2. Module Design

## 2.1 Unit 1: Studying a Loudspeaker

Loudspeakers can be found in our daily lives, such as TVs, phones. The loudspeaker converts electrical signals to sounds so that we can hear them. How does the speaker work? Is there any limitation?

In this unit, students will investigate the characteristics of a loudspeaker by testing it with common lab equipment. They will study the performance and limitations of the speaker.

### 2.1.1 Objectives

Upon completion of *Unit 1*, students should be able to:

- *Describe* the major components of a loudspeaker.
- *Measure* the performance of a loudspeaker.
- *Discuss* the characteristics of a loudspeaker.

### 2.1.2 Pre-requisite (if appropriate)

Nil

### 2.1.3 Description of Activity

| Description | Duration (hr/min) | Resources |
|---|---|---|
| Introduction<br>• Introduce the signal generator and oscilloscope | 15 min | PPT(1) |
| Study a loudspeaker<br>• Demonstrate all the essential parts of a loudspeaker | 30 min | Short-clip (1) / onsite workshop (1) |
| Study the performance of the loudspeaker<br>• Teach on the parameters for sound quality<br>• Teach on the human audible frequency | 1 hr | Short-clip (2) / onsite workshop (2) |
| Summary | 15 min | PPT (1) |
| **Total** | 2 hours | |

### 2.1.4 Assessment (if appropriate)

Worksheet for studying loudspeaker.

## 2.2 Unit 2: Building a Simple Amplifier

Amplifiers are very important devices in common electronic equipment. The amplifier can take a weak input signal and magnify the amplitude in the output. One daily example is the amplifier used in Hi-Fi.

In this unit, the student will build a simple amplifier using ICs, resistors and capacitors. Students will study the properties of the amplifier by comparing the input and output signals.

### 2.2.1 Objectives

Upon completion of *Unit 2,* students should be able to:

- *Build* a simple amplifier
- *Describe* the properties of a simple amplifier
- *Compare* the input and output signals of a circuit
- *Describe* the limitation of an amplifier and its applications in daily life.

### 2.2.2 Pre-requisite (if appropriate)

Nil

### 2.2.3 Description of Activity

| Description | Duration (hr/min) | Resources |
|---|---|---|
| Introduction<br>• Present the scope and schedule of the project and learning objectives<br>• Demonstrate the end-products of the amplifier | 15 min | PPT (2) |
| Build a Simple Amplifier<br>• Demonstrate all the available parts of making an amplifier<br>• Teach on the basic of circuits design | 30 min | Short-clip (3) / onsite workshop (3) |
| Testing and evaluation of the end-products<br>• Measure the input and output of a simple amplifier<br>• Compare the input and output of the amplifier<br>• Investigate the performance of amplifier in different frequencies | 1 hr | Short-clip (4) / onsite workshop (4) |
| Summary | 15 min | PPT (2) |
| **Total** | 2 hours | |

### 2.2.4 Assessment (if appropriate)

- Worksheet for investigating simple amplifier
- Worksheet for frequency analysis of simple amplifier

# 3. Resources

## 3.1 Resources for Unit 1 – Studying a Loudspeaker

- PPT (Unit 1);
- Learning Portfolio; and
- Learning Portfolio (Teacher Version).

## 3.2 Resources for Unit 2 –Building a Simple Amplifier

- PPT (Unit 2);
- Learning Portfolio; and
- Learning Portfolio (Teacher Version).

# 4. References


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# 5. Acknowledgement


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