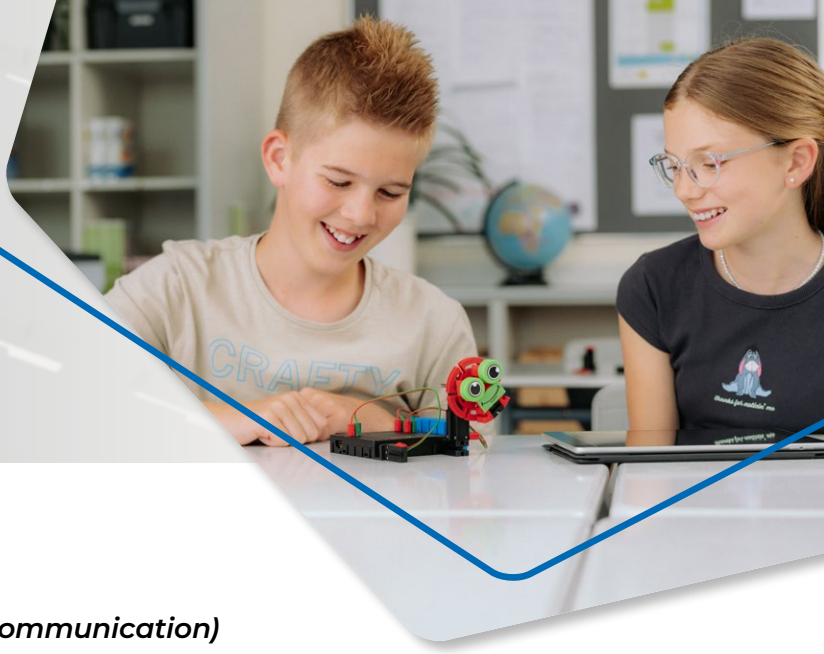
Entry-level models

to become familiar with the components and programming



KEY QUESTIONS:

- **What function can a switch perform?** ***(Communication)***
- **What types of switches are there?** ***(Communication)***
- **What examples from everyday life use a remote-controlled function or trigger a switching operation?** ***(Communication)***
- **Which sensors can trigger actions?** ***(Creativity)***
- **What function must a repetition loop and a time loop fulfill?** ***(Communication)***
- **Which actuators can be triggered by a switching operation?** ***(Creativity)***

THE TEACHING CONCEPT AT A GLANCE

Grade level:	5–7
Time required:	1 hour each / possibly with differentiation groups
Degree of difficulty:	Models Programming
Models:	• Circuit with LED and button • Circuit with LED and gesture sensor • Motor with rotational movement • Motor with vertical movement

MODEL DESCRIPTION / TASK

Eight simple basic tasks are designed to introduce students to work with the STEM Coding Max experiment box. First, the design of the RX controller, the controller configuration, and the structure of the programming interface are clearly described. For example, simple switching operations are triggered by a sensor. This processes information within a self-created program in the control system and, if necessary, switches on an actuator or performs a function.

SUBJECT REFERENCE

- **Information technology:** Programming basics
- **Physics:** Sensors, actuators
- **Technology:** Gear theory, basics of electr. circuit

LESSON PLAN

Introductory phase

Classroom discussion	• Clarify in the classroom discussion which basic circuits can occur (connection of sensors, actuators, repetition loops, time loops, if-then functions ...). • Discuss what can be switched off and on (everyday examples). • Name possible types of sensors: Sensors for brightness, movement, switching on, switching off, toggling ... • Name possible programming loops: Switch-on delay, switch-off delay, time, repetition ... • Name possible functions of actuators: turn, lift, illuminate, switch ...
Support, if necessary	• Show sensors, actuators and components from the assembly kit, use presentation media if necessary.

Planning Phase

Classroom discussion	• The basic structure of the app and its functions, e.g. help buttons, the function of the basic circuits, differentiation options ... are shown and explained. • The progression of the work steps in the app when processing a project is shown.
Classroom discussion	Preparation of the work phase: • The basic function of a switch (e.g., closed or open circuit), an LED (e.g., operating principle), a motor (e.g., operating principle), and their possible connection variants are discussed. • The triggering of the switching process and the desired change to an actuator function within a program are discussed. • The triggering of an actuator and its possible connection variants after the switching process are discussed.

Classroom discussion	• The distribution of work for the lesson is specified. The following eight basic tasks (circuits; increasing degree of difficulty) are implemented as an introduction: a) An LED switches on when the program starts. b) Pushing a button switches an LED on and off again. c) A button switches an LED on or off with a time delay. d) A button switches on the flashing function of an LED. e) An LED is manually switched on or off. f) An LED is automatically switched on when the brightness decreases. g) A motor performs a rotational movement. h) A gear motor performs a lifting movement.
Partner or individual work	• The students familiarize themselves with the app and download the corresponding task.

Construction Phase

Partner or individual work	• The students use the app to construct the tasks. The app guides them through the program in short steps. • The circuits are wired. The app guides them through the program in short steps.

Programming Phase

Partner or group work	• The students write the program for the tasks. The app guides them through the program in short steps; the app provides assistance. • The program is transferred to the RX controller after each programming step.

Experimentation and Test Phase

Partner or group work	• The circuits are put into operation and tested. • Possible malfunctions in the functional sequence must be found and eliminated. The app offers assistance. • Any optimizations to the hardware (e.g., loose wiring) and the programming of the sensor command output (e.g., time delay) are carried out.

Final Phase	
Presentation	• Procedure 1: A selected group of students present the circuits. • Procedure 2: The respective group of students present the circuits.
Discussion in plenary	• Discussion of the further procedure in up-coming lessons. • **Optional:** Presentation of a planned project for motivational purposes.

METHODOLOGICAL AND INSTRUCTIVE TIPS

Differentiation options

Depending on previous knowledge within the respective groups, the groups can work independently on the eight introductory tasks in sequence at their own pace.

Differentiation tasks can be set for particularly fast groups.

Examples:

- Installation of a second LED in a different color that flashes alternately with the first LED.
- Programming task in which one LED lights when the motor is running clockwise and the other lights when it is running counterclockwise.

Motivational aspects

Building the basic circuits, which can be programmed using a “mini-computer”, has a motivating effect on many students. It is important to ensure that concerns about the system or the possibly unfamiliar methods are reduced or do not arise in the first place. Working independently with the support of an app is also becoming increasingly popular. The groups determine the working rhythm and speed themselves.

An additional motivating factor is that more complex construction tasksrelated to every-day life can be realized.

Optional download:

- Circuit diagram
- Building instructions

ADDITIONAL MATERIALS

- If necessary, use drawing media (paper, whiteboard, or projection screen) to introduce the topic.

FUNCTIONS OF ENTRY-LEVEL MODELS AND THEIR TECHNICAL SOLUTIONS

Function of the sensors/actuators	Technical solution
a) Switch an LED on and off.	Displaying a signal with an LED
b) Switch an LED on and off with a button.	Evaluate a button signal and activate an LED
c) Switch an LED on and off with a time delay using a button.	Evaluate a button signal and activate an LED after a time delay using a time loop
d) Allow LED to flash after pressing the button.	Evaluate a button signal and modulated control of an LED
e) Manually switch an LED on and off.	Evaluate the signal from a gesture sensor and activate an LED
f) Automatically switch an LED on and off in the dark.	Evaluate the signal from a brightness sensor and control of an LED
g) Turn a motor left and right.	Evaluate a button signal and motor control
h) Raise and lower a motor slightly.	Evaluate a button signal and motor control with independent return

MATERIAL LIST

Entry-level model 1 (circuit with LED and button) – Basic tasks a) to d)

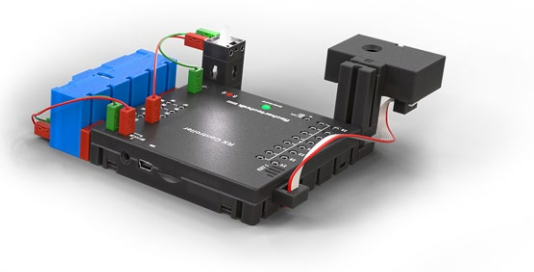
Sensors	Function
1 button	Trigger the switching signal

Actuators	Function
1 LED, white	Lighting

Entry-level model 2 (circuit with LED and gesture sensor) – Basic tasks e) to f)

Sensors	Function
1 RGB gesture sensor	Trigger the switching signal

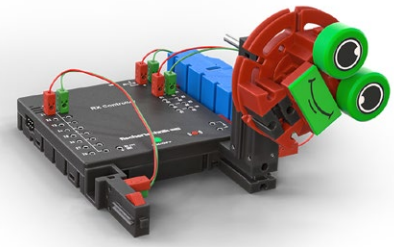
Actuators	Function
1 LED, white	Lighting



Entry-level model 3 (motor with rotational movement) – Basic task g)

Sensors	Function
1 button	Trigger the switching signal

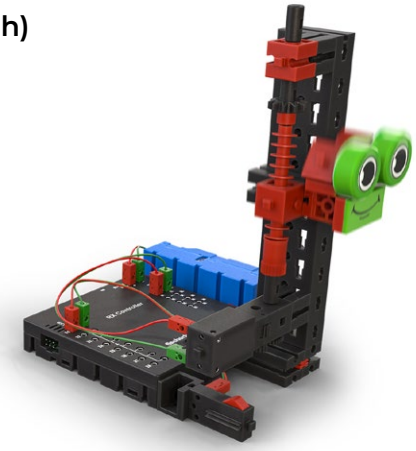
Actuators	Function
1 motor	Rotary movement



Entry-level model 4 (motor with vertical movement) – Basic task h)

Sensors	Function
1 button	Trigger the switching signal

Actuators	Function
1 motor	Linear movement



Differentiation

Sensors	Function
1 button	Trigger the switching signal

Actuators	Function
1 motor	Linear movement
1 LED red	Lighting
1 LED green	Lighting