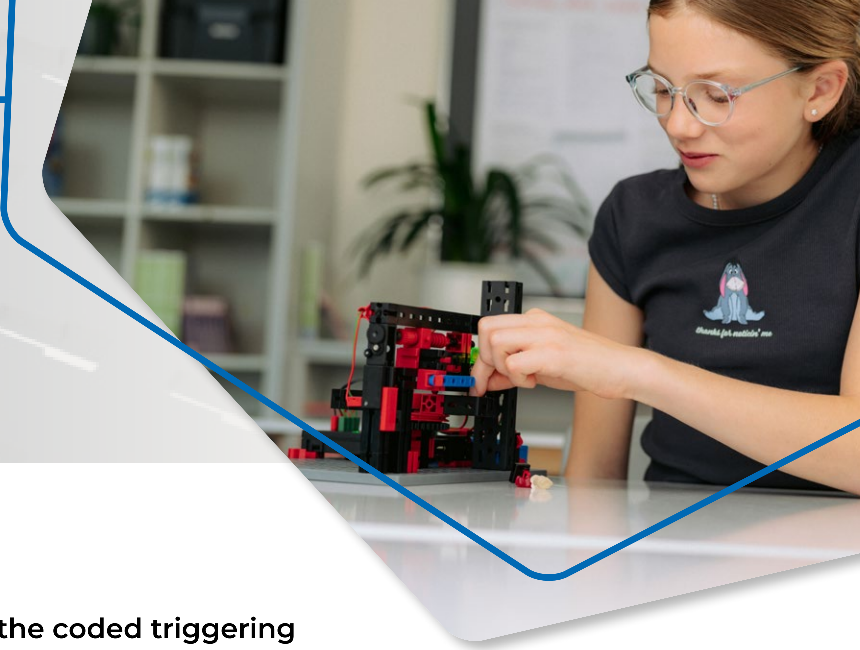
MODEL 8

Candy machine

Give me candy!



KEY QUESTIONS:

- **Which functions must be fulfilled for the coded triggering of a process? *(Communication, Collaboration)***
- **How can the user select the goods contained in the vending machine? *(Communication, Collaboration)***
- **How can the goods in the system be protected against access or how can access be granted? *(Creativity, Critical Thinking)***
- **What aspects of the design need to be considered to ensure that the system is protected against manipulation and is as robust as possible? *(Creativity, Critical Thinking)***

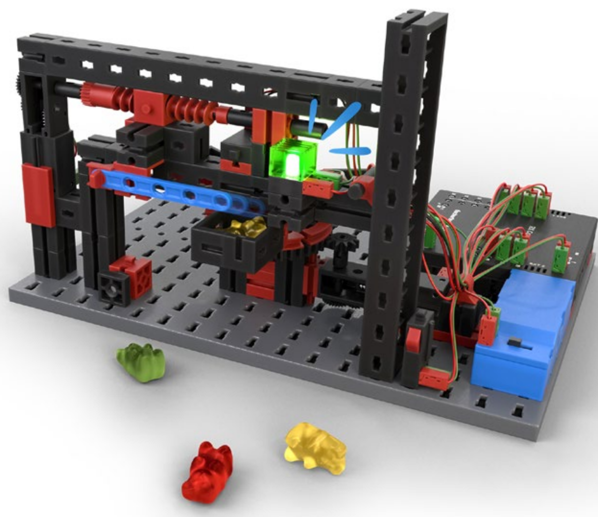
THE TEACHING CONCEPT AT A GLANCE

Grade level:	6–8
Time required:	2 double lessons
Degree of difficulty:	Model
	Programming
Model type:	a stationary dispenser, individually fillable for dispensing various small items (sweets, tablets, food supplements, ...)

MODEL DESCRIPTION / TASK

Students plan and implement a vending machine for the stocking and targeted distribution of small items, e.g., sweets. The desired product is selected on a motorized turntable using a button. The product is recognizable, but not yet removable. The product can then only be removed via an access system using a magnetic switch (reed switch). A motorized access guard opens for this purpose.

To extend the system, a warning light (LED) can be integrated to indicate when the product can be safely removed. This light flashes as a warning before the safety is locked.



EVERYDAY RELEVANCE

The automatic operation of a machine and the dispensing of an (edible) item have a strong motivational effect on the students. Many comparable solutions are known from everyday life (gumball machine, drinks machine, car scooter ...).

However, the incentive to manipulate a professional investment in your own favor is also well-known. This gives rise to considerations about making your own solution transparent while also being as tamper-proof as possible.

SUBJECT REFERENCE

- **Physics:** Detection of physical variables (rotation angle, end stop)
- **Information technology:** Basics of programming, switches, sensors, time loops
- **Economics:** Sales strategies
- **Mathematics:** Circular angle

LESSON PLAN

Introductory phase	
Classroom discussion	• Inquire about everyday applications in which processes are set in motion by coding-controlled systems. • Discuss the possibilities of manipulating such systems and protection against manipulation. • Discuss the advantages and disadvantages of various tamper protection options. • Specify which sensors and actuators should be used. The functional principle of the sensors and the actuator is discussed. • If necessary, offer the prospect of initial differentiation options. • The teacher specifies the basic function of the system to be achieved, and this is discussed together.
Support, if necessary	• Show sensors, actuators and components from the assembly kit, use presentation media if necessary.

Planning Phase

Classroom discussion	• The teacher specifies the procedure using the work steps in the app.
Partner or individual work	• The students familiarize themselves with the app and download the corresponding task. • Students complete the tasks for planning the system in the app.
Optional: Partner or group work	• The students sketch a possible system, discuss the, and agree on a design.

Construction Phase

Partner or individual work	• Students use the app to build the dispenser machine. The app guides them through the program in short steps.

Programming Phase

Partner or group work	• Students write the program for the dispenser machine. The app guides them through the program in short steps; the app provides assistance. • The program is transferred to the RX controller.

Experimentation and Test Phase

Partner or group work	• The machine is put into operation and tested. • Possible malfunctions in the functional sequence must be recognized and eliminated. The app offers assistance. • Any optimizations in the programming (time loops for closing the removal) must be carried out. • The protection of the system against manipulation is tested if necessary.

Final Phase

Optional: Presentation and allocation of differentia-tions	• The teacher may approach students eligible for differentiation. The optimization possibilities of the system (optical display) are clarified. • The app guides the quick students through the necessary steps.
Discussion in plenary	• Project debriefing in class. • The strengths and weaknesses of the solutions are recognized and transferred to everyday machines.

METHODOLOGICAL AND INSTRUCTIVE TIPS

Differentiation options

A green LED can be added to the system and programmed so that the system issues a visual approval (green LED) when the goods can be removed.

A flashing function can also be programmed to indicate when the removal safety device is locked.

Motivational Aspects

Sweets alone have a certain effect on the students. But the automated output of tangible things (as opposed to just information) also has an appeal. The students are familiar with the associated topic of manipulating information (in this case input information) which is relevant in many other areas of life. Both factors enable the promotion of intrinsic motivation.

PROGRAMMING SKILLS

- Program start
- Continuous loop
- Integration of sensors
- Integration of actuators
- Loop **repeat until**
- Loop **if – then**
- Loop **wait until**
- Use of variables and their change
- Working with subprograms
- Working with complex programs

ADDITIONAL MATERIALS

Optional download:
- Circuit diagram
- Building instructions

- **Optional:** Drawing media (paper, whiteboard, or projection screen)

FUNCTIONS OF THE MODEL AND THEIR TECHNICAL SOLUTIONS

Function of the sensors/actuators	Technical solution
Detection of a signal to rotate the storehouse	Evaluating the input button signal
Rotation of the storehouse	Control of the rotary carousel motor
Stop position of the storehouse	Evaluating the cam-controlled signal of the position sensor
Recording the legitimacy of the issue	Triggering the reed switch
Opening the access guard	Control of the barrier motor via a time loop
Waiting time for the motor control unit to remove the goods	Time loop
Closing the access protection	Control of the barrier motor
Switching off the motor of the access guard	Evaluating the signal from the end switch
Differentiation 1: visual output that goods can be removed	Green LED lights up
Differentiation 2: visual output that access guard closes immediately	Green LED flashes

MATERIAL LIST

Sensors	Function
1 button	Signal for gear motor 1
1 button	End switch for gear motor 1
1 button	End switch for gear motor 2
1 reed switch	Signal for gear motor 2

Actuators	Function
1 gear motor 1	Turning the storehouse
1 gear motor 2	Opening the access guard
Differentiation: 1 LED, green	Optical indicator light