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# Primary Science with €Sense

## Getting Started

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**CENTRE FOR MICROCOMPUTER APPLICATIONS**

**[www.cma-science.nl](http://www.cma-science.nl)**

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## 1. What is €Sense?

€Sense is a simple USB device, a so-called measuring interface, that can be used to measure sound, light and temperature. It has three built-in sensors: sound (a), light (b), temperature (c), and the sensor input (e) for an external temperature sensor (d) which is delivered together with €Sense.

The LED (f), located on the top, indicates interface initialization after connecting it to a USB port (g) of the computer. This LED and a built-in buzzer can also be used as actuators in Control activities with €Sense.



*Figure 1. €Sense with an external temperature sensor.*

## 2. How does it work?

Sensors measure analogue changes in the surroundings and convert these quantities into electrical signals. The €Sense interface reads the signals from the sensors and communicates with the computer through a USB port. The computer via the software program Coach 6 Lite can display real time measured data 'as it is happening'. The interface does not record the data – it just sends it to the computer.

### 3. Coach 7 Lite software

For displaying the data collected by €Sense on the computer the Coach 7 Lite (or Coach 7) is used. Coach 7 Lite allows to:

- measure precisely
- monitor very fast and very slow events
- display data in analog and digital meters
- display data in a table and graphs
- test predictions
- analyse the collected data
- save and print the student results.

### 4. Installation of Coach 7 Lite

#### TO INSTALL COACH 7 LITE:

- Register at <http://intranet.cma-science.nl/orderc7/orderlite.php> to receive via e-mail the download link and your installation information. Your installation name and code are unique identifiers that are required in order to successfully run Coach 7 Lite.
- Via the link in your e-mail download the Coach 7 Lite installation file, for Windows \*.MSI file, for MAC \*.DMG file.
- Install Coach 7 Lite:
  - **For Windows:** Double-click the Coach 7 MSI installation file, click OK and Setup. Follow instructions on the screen.
  - **For Mac:** Open the Coach 7 DMG installation file. Drag the Coach 7 icon to the Applications icon, or copy the Coach 7 icon manually to the place of your choice. If necessary, approve Coach 7 App in the 'System Preferences' => 'Security & Privacy' => 'General'
- When Coach 7 is started the first time it asks to specify the license information (name and code, which you have received via the e-mail), and the user interface language.
- Primary Science Activities for €Sense will be available in the Coach folder 'Measurement'.

## 5. Connecting €Sense to the computer

Simply plug the USB-plug of €Sense into a free USB-port of your computer. The LED of the interface will switch on for a short period of time. This means that the interface initializes.

## 6. €Sense's sensors

### 6.1. Light sensor

The Light sensor has three measuring ranges, 0 .. 1500 lux, 0 .. 15000 lux, and 0 .. 150 000 lux. The sensor and its range are pre-selected in the Primary Science Coach Activities.

### 6.2. Sound sensor

The €Sense's sound sensor has two measuring ranges between -9.5 and 9.5 Pa (Pascal) for measurements of sound waveforms and between 50 and 110 dB (decibels) for measurements of sound intensities. The sensor and its range are pre-selected in the Primary Science Coach Activities.

### 6.3. Internal temperature sensor

The internal temperature sensor has a measuring range between 5 and 45 °C. The sensor is suitable for temperature measurement in air. This sensor is not used in the Primary Science Coach Activities.

### 6.4. External temperature sensor

The external temperature sensor is delivered together with €Sense. The sensor can be connected and disconnected to €Sense at any time by connecting its jack plug to the sensor input at the front of the interface. The sensor has a measuring range between 10 and 120 °C and is suitable for temperature measurement in liquids (water, mild acidic solutions) and air. The sensor and its range are pre-selected in the Primary Science Coach Activities.

#### **WARNING!**

Do not use the external temperature sensor to measure temperatures higher than 120 °C and **never** put any part of the sensor **in a flame** or on a **hot plate**.

Avoid submerging the sensor probe beyond the stainless steel part. The handle is not waterproof.

## 7. Starting Coach 7 Lite


To start Coach 7 Lite:

### Windows

- Click on the Windows Start button, move to Programs, then to CMA Coach 7 Lite and next click on Student, or
- Click the Coach 7 Lite icon on the desktop, or
- Double-click a Coach 7 Activity file (\*.cma7) or a Coach Result file (\*.cmr7).

### MAC

- Click the Coach 7 App (by default located) in Applications.

To exit Coach 7 Lite click the **Exit Coach 7** button  in the upper left corner of the Main toolbar.

## 8. Opening Coach Activity

To open a Coach Activity press the  **Open CMA Projects** button and browse in the dialog to the desired Activity and click it. The selected Activity opens.

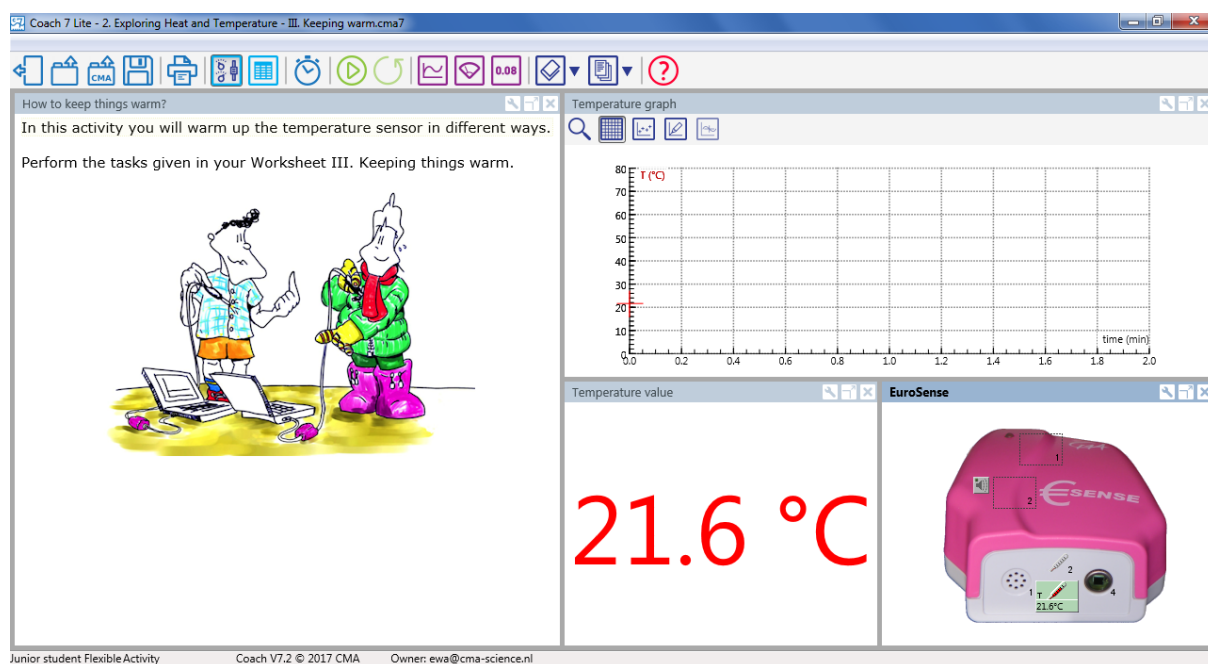


Figure 2. Coach Activity Screen.

### THE COACH ACTIVITY SCREEN CONSISTS OF:

- Title bar with the name of the current folder and Activity/Result.
- Activity toolbar, which can contain different buttons.
- Coach panes such as the €Sense panel, a table, graphs, values, meters, texts, images and videos panes.
- Status bar – displays the Coach 7 Lite version number.

## 9. €Sense panel

The €Sense panel displays the image of the €Sense interface and the icon of the active sensor. When €Sense is correctly connected the actual value, measured by the sensor, is displayed on the icon.



Figure 3. When a mouse cursor is located above the sensor icon Coach displays the sensor information: the sensor type and its measurement range.

In most activities the sensors are already set-up and ready for measurements. In some cases for the light sensor it may be needed to change the sensor measurement range.

### TO SELECT ANOTHER MEASUREMENT RANGE OF A SENSOR:

- Right-click a sensor icon, go to **Set Input Range** and select the desired measurement range.

In the Activity 'Own lab' students can set-up and perform their own experiments. The €Sense panel is empty.

### TO ACTIVATE A SENSOR:

- Right-click an empty sensor position icon on the €Sense image and select the option **Enable** to make a sensor ready for the measurement. Select the desired measurement range via the option **Set Input Range**.

- To disable the sensor right-click the sensor icon and select **Disable**.

To display the data in a graph, on a meter or as a digital value, click the sensor icon on the €Sense image, select **Display as > Graph, Meter or Value**, and click an empty pane, in which you want to place the selected display.

To display the data in a table click the **Data Table** button , click  to hide it.



To display the €Sense panel click the **Interface** button , click  to hide it.

## 10. Measuring

As long as a measurement is not started the data are snapshot by the active sensor. The actual value, measured by the sensor, is displayed on the sensor icon, as a large value or on a meter.

After the measurement is started the data are recorded over a given period of time (measurement time), and displayed in a graph or table.

### TO START MEASUREMENT:

- Click the button **Start** .
- Data from the active sensor are collected according to the specified measurement settings.
- The measurement stops when the specified measurement time has been reached.
- To replay a recorded measurement click the activity toolbar button **Replay** , set the replay speed (default real-time) or specify the time interval in which the measurement should be replayed and click **Start**.

### TO INTERRUPT MEASUREMENT:

- Click the button **Stop**  or press <Esc>.


### TO CHANGE MEASUREMENT TIME:

- Click the button **Measurement Settings**  and type in a new measurement time value.

### TO SAVE THE MEASUREMENT:

- Click the button **Save as**  and type in a name.

## 11. Working with Measurement Runs

Each time you click the activity toolbar button **Start** , the data collection starts again and a new measurement run is added to the data table and to the graphs.

A graph can contain several measurement runs.

Runs are distinguished by means of a shade of the variable color. The latest Run gets the darkest shade. The Run buttons, displayed at the right side of the Graph Toolbar, indicate the number of available Runs.

It can be useful to work with more runs in case of comparison of data collected during different experiments is needed. But in many other cases, for better visibility of data, it is better to hide or delete measurement runs. It is recommended to save the the Results first.

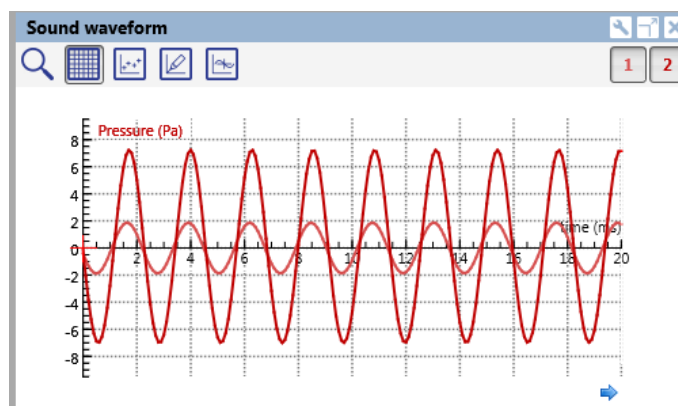



Figure 4. Two measurement runs recorded with the sound sensor

### TO HIDE A RUN ON A GRAPH:

- Click on the active Run# button  to hide the run#.
- Click on the inactive Run# button to show the run#.

### TO DELETE A RUN:



- Right-click the **Graph** pane or click its Tool menu and select **Delete Run** or right-click the Data Table window or click its Tool menu and select **Runs > Delete**.
- Select the run you would like to delete. Options **All** and **All Except Newest** allow to delete all runs or all runs with exception of the latest run.

The selected run is removed from the table and the remaining runs are renumbered. Notice that this action **cannot be undone** and the data of the deleted run are **lost**.



## 12. Analyzing data

### 12.1. Zooming

- Click  to automatically zoom to fit or move the cursor over the diagram, until shape changes into a magnifying glass and drag an area to zoom in.
- Click  to zoom out.

When a graph is zoomed in then scroll arrows appear along the diagram axes. By pressing an arrow button, the diagram scrolls in the direction of the arrow.

In this way you can view other parts of the diagram with the same magnification.

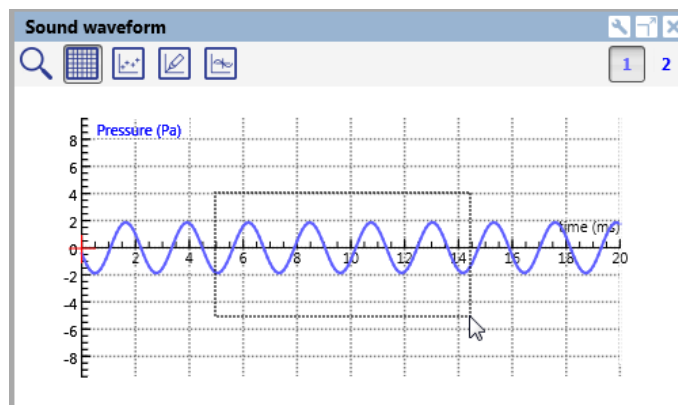



Figure 5. Zooming graph.

### 12.2. Reading coordinates of points in graphs

The option **Scan** is used to read co-ordinates of data points in graphs. A crosshairs in the graph marks the scanned point. The co-ordinates of all the points of active runs are displayed in a box in the upper right corner of the graph. This box can be dragged to another location.

- Click the **Scan On** button  in the Toolbar or select the Tool menu option **Scan**.
- Click a point of the graph and its co-ordinates are displayed. When there are more Runs or more variables displayed along the vertical axes the co-ordinates of all Runs.
- Move through the data points in the graph with the mouse or with the right and left arrow keys.
- If you want to store co-ordinates, you have to write them down. It is not possible in Coach to store the scanned co-ordinates automatically.

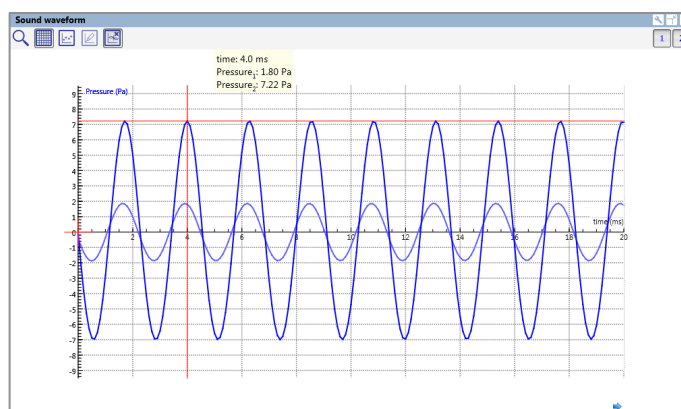



Figure 6. Scanning values.



- Stop scanning by clicking the **Scan Off** button  button or by selecting **Stop Scanning** from the Tool menu.

### 12.3. Sketching a prediction graph

The option Sketch can be used to manually draw a graph and to draw a prediction of a measurement graph; after the measurement run is executed, the shape of the predicted graph can be compared with the measured graph.

- Click the **Sketch On** button  in the Toolbar or select the Tool menu option **Sketch**.

- Draw a smooth curve by dragging to the right (erase by dragging to the left) or click several points to draw a point-to-point graph. Double-click at a point in the sketched graph to erase the part of the graph beyond this point.

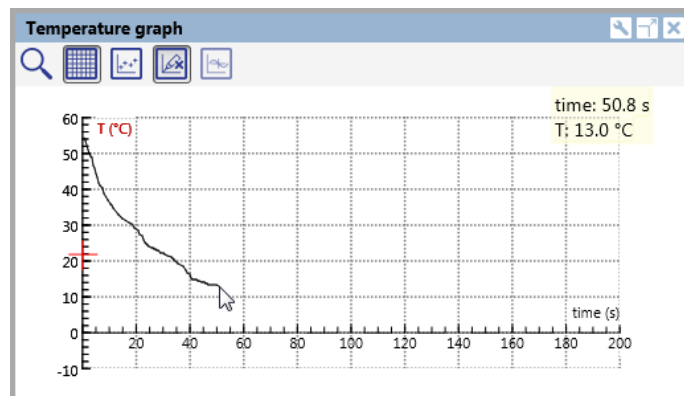



Figure 7. Sketching a prediction.

- Stop sketching by pressing <Esc>, by clicking the **Sketch Off** button  or by selecting the Tool menu option **Stop Sketching**.
- To erase a sketch select the **Erase Sketch** option.

A new set of data, a new run named Sketch of variable with a variable Sketch var and a new run named Sketch, are added to the table. The Sketch variable is a manual type of variable and its data may be edited directly in the Data Table. By default the sketch graph is drawn in black color.

## 13. Annotating the diagram

It is possible to place descriptive text labels in a graph. They can be used to label individual graphs or to point out interesting features. Annotations are displayed in the diagram but also appear when the diagram is printed or copied to the clipboard.

### TO ADD AN ANNOTATION:

- Right click the diagram and select **Add an Annotation...**
- Type in text. If desired click the **Font** button to change the text font and its color. Select **Framed** to place the annotation in a frame (default = no frame).
- Click **OK** to confirm or **Cancel** to return to the original diagram.
- Drag the annotation to the desired position of the diagram (make sure the mouse cursor has the shape of a hand).
- When desired, repeat this procedure to create more annotations.

### TO EDIT/DELETE AN ANNOTATION

- Right-click an annotation (make sure the mouse cursor has the shape of a hand) and select **Edit** or **Delete Annotation**.

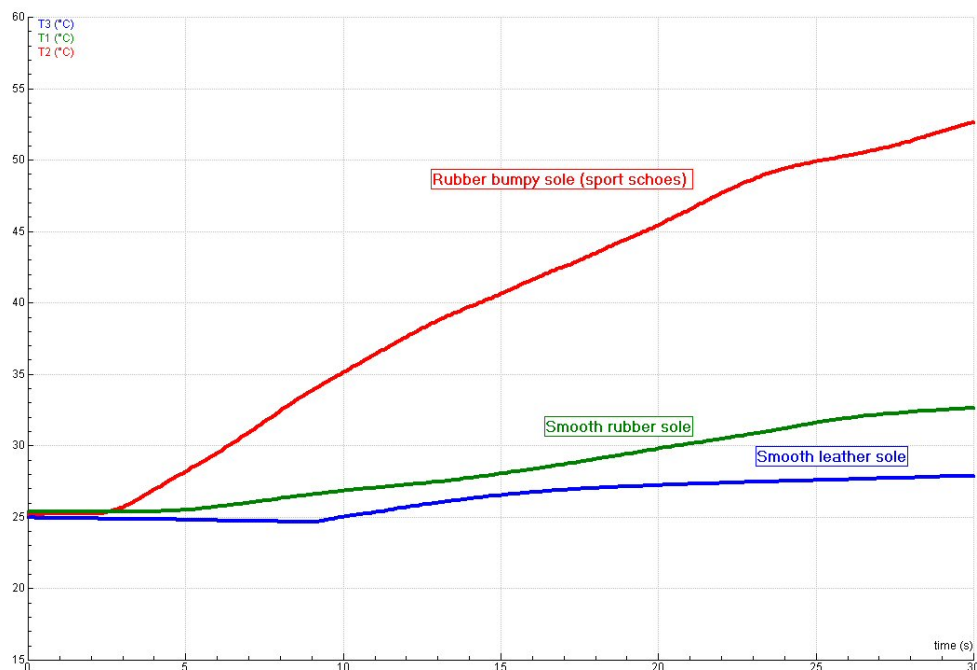






Figure 8. Annotating graphs.

## 14. Storing and printing student results

Students store the results of their work in Coach Result files (files with cmr7 extension). A Coach Result consists of all elements of the Activity (like texts, pictures, etc.) together with student changes - measurement data and student notes.

Working with Results is similar to working with Activities.

- To open a Result press the **Open** button  and browse to the desired Result. Click **Open**.
- To save a Result press the **Save as...** button , enter the name of the Result. Click **Save**.
- To delete a Result click the **Open** button  and browse in the dialog to the desired Result. Delete the file.
- To print the whole Coach screen use the **Print** button .
- To print the content of a pane right-click the pane to be printed and select **Print Window**.




















## 15. Problems when measuring with €Sense

It may happen that the communication between €Sense and the computer is lost. If this happens you have to reset €Sense. This can be done in two ways:

1. When there is no communication on opening of a Coach Activity/Results and the program displays the message that the panel €Sense can not be initialized then unplug the interface and plug it in again after a few seconds or plug it into another USB-port of your computer. Press **Retry** in Coach.
2. When the communication with the interface is lost while working in a Coach Activity/Result then (values on a sensor icon do not change at all):
  - Right-click the €Sense screen panel.
  - Select the **Reset Hardware** option. This option is only available if the €Sense panel is active in Coach.

Extensive information on working with Coach 7 can be found in the on-line Coach 7 Help System.

## Appendix: Buttons in Coach 7 Lite

	Exit Coach 7
	Exit Activity - to return to Main level
	Open CMA Projects - to open Activities delivered by CMA
	Open - to open an Activity/Result
	Save as... - to save an Activity/Result
	Print - to print the activity screen
	Interface Panel - to show/hide the Interface Panel
	Measurement Settings - to specify measurement time
	Start - to start a measurement
	Stop - to stop a measurement
	Data Table - to show/hide a table
	Graph - to display a graph
	Meter - to display a meter
	Value - to display a value
	Text - to display a text
	Picture - to display an image
	Video - to display a video
	Student Text - to display a text in which students can write their notes
	Help - to open Coach 7 Help System