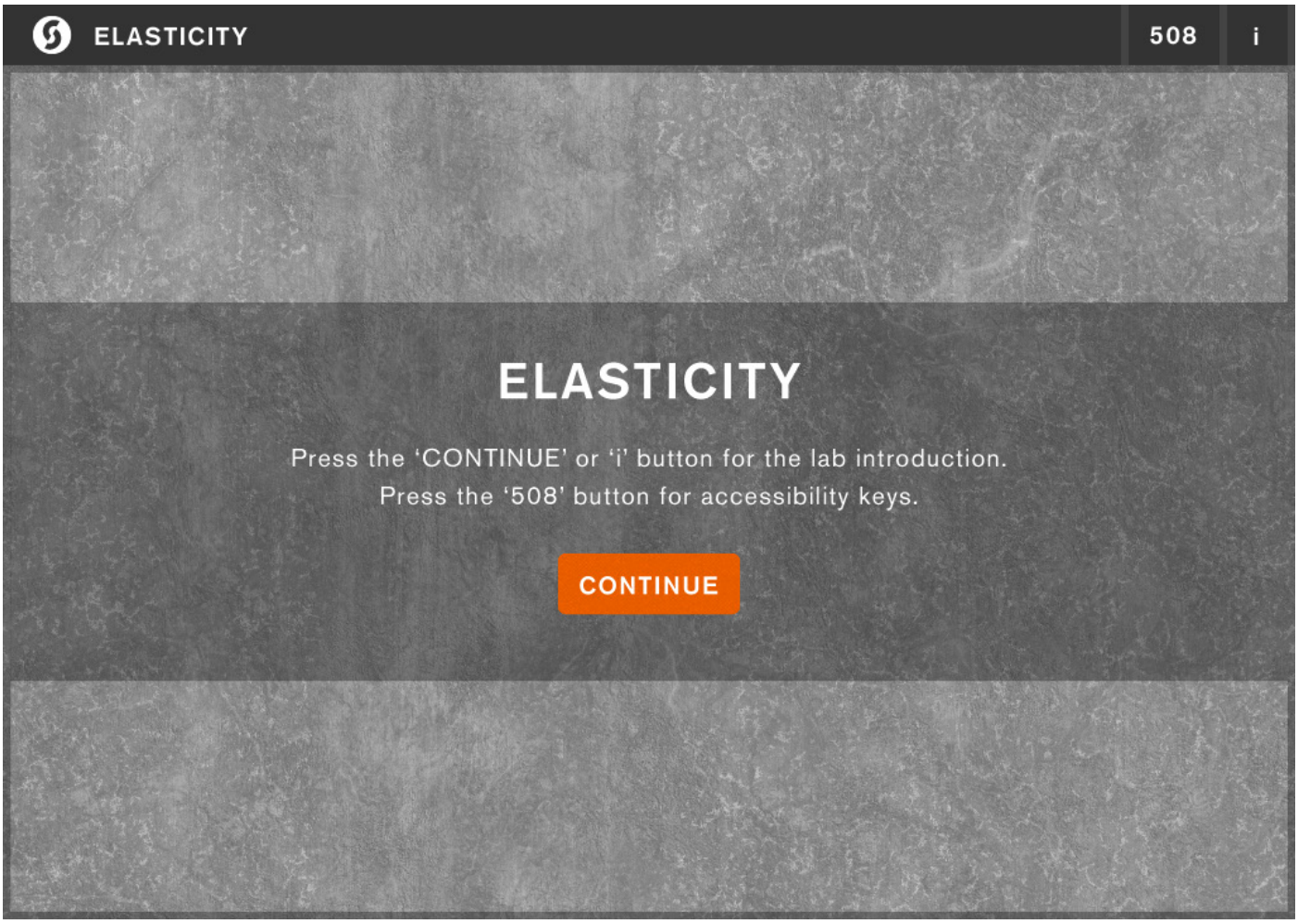


Screen 01

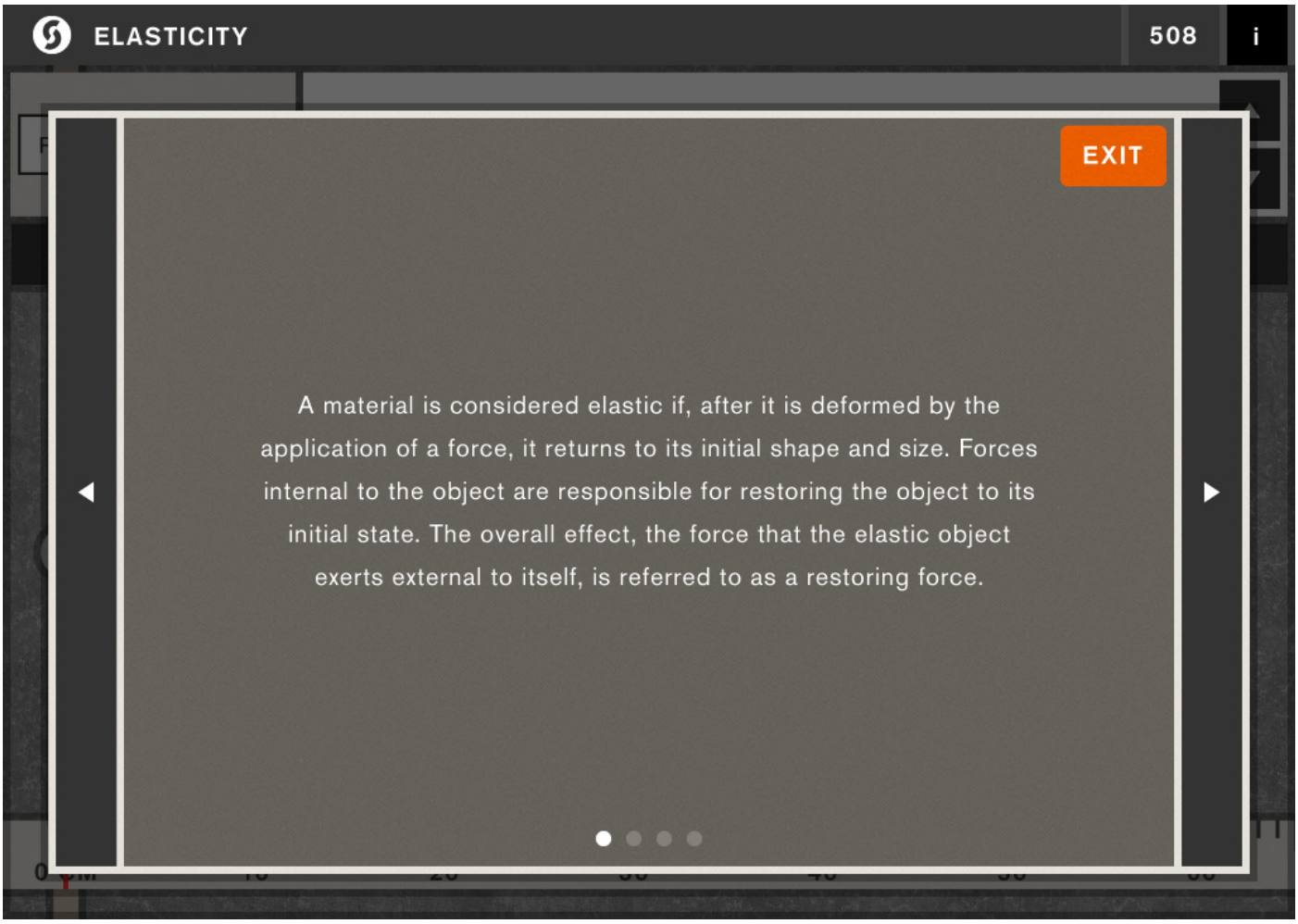
Note: the red comments in this document signify actionable items or require special attention.

Any of this content and messaging will be finalized by the content experts: the faculty.

The sentences within quotes in this document reflects the text on the screen.

"ELASTICITY"

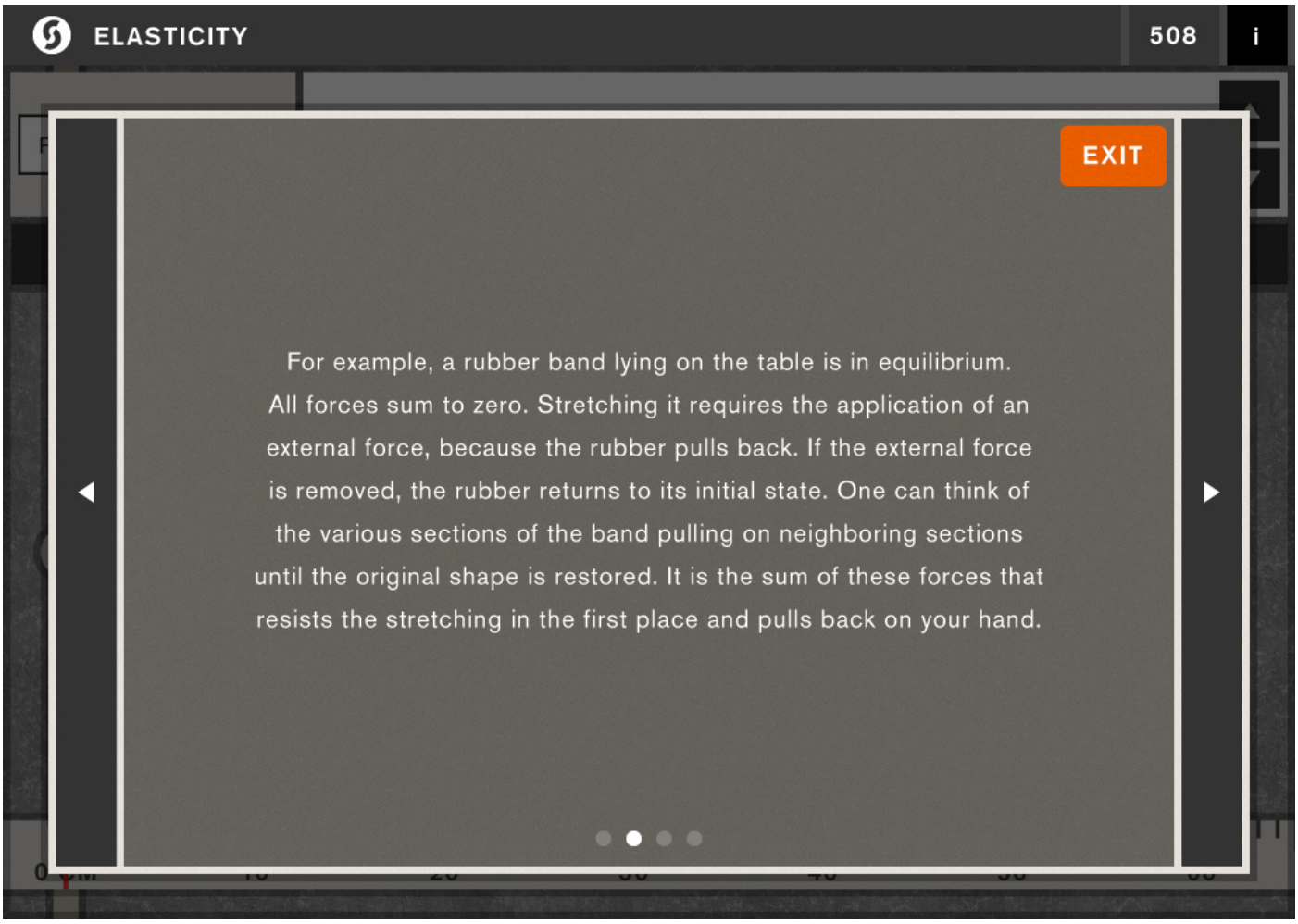
"Press the 'CONTINUE' or 'i' button for the lab introduction. Press the '508' button for accessibility keys."



Screen 02

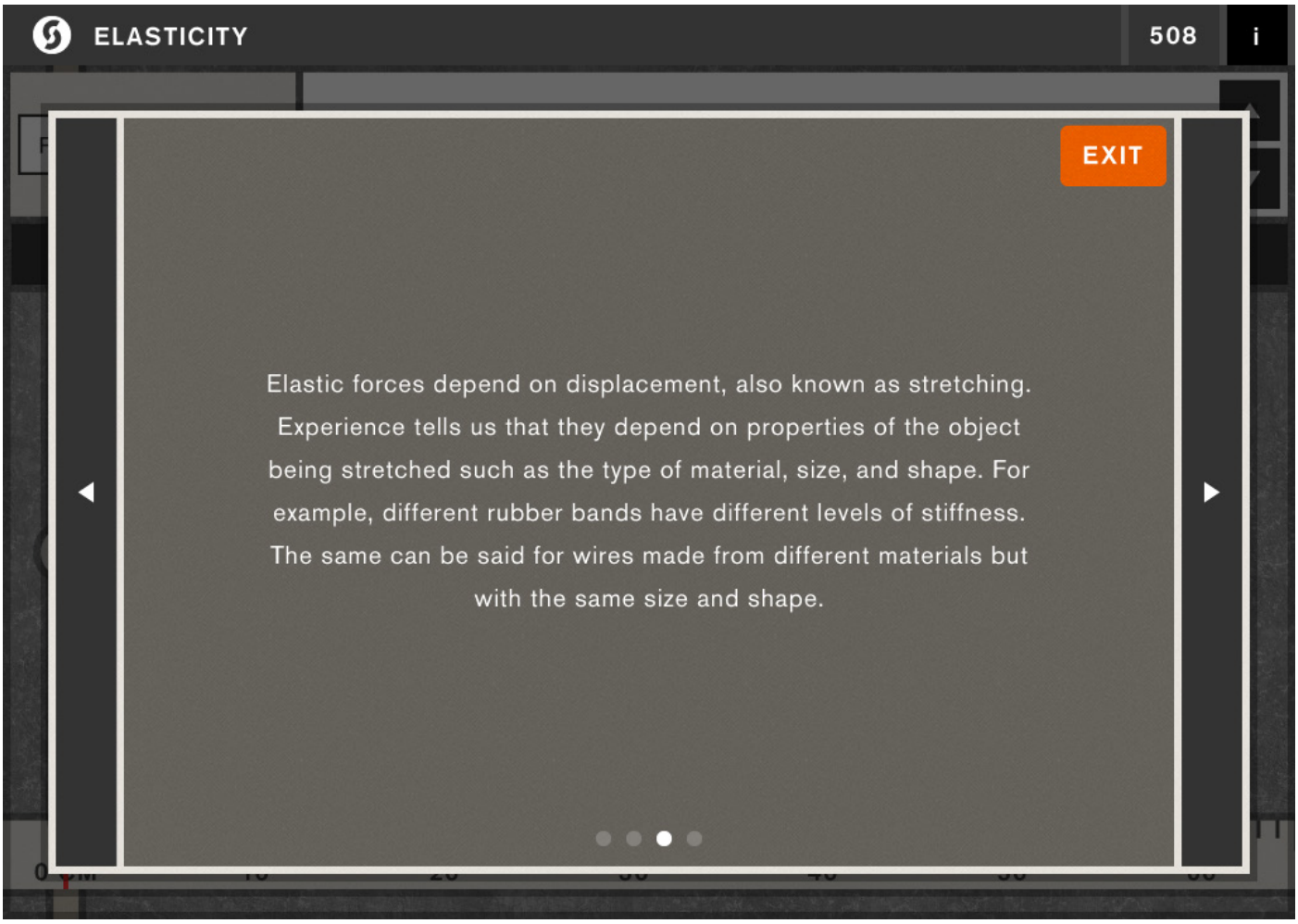
The introduction is self-guided, and the student can press the EXIT button when they're done and come back to the 'i' menu at any point during the lab.

Introduction page 1:
"A material is considered elastic if, after it is deformed by the application of a force, it returns to its initial shape and size. Forces internal to the object are responsible for restoring the object to its initial state. The overall effect, the force that the elastic object exers external to itself, is referred to as a restoring force."



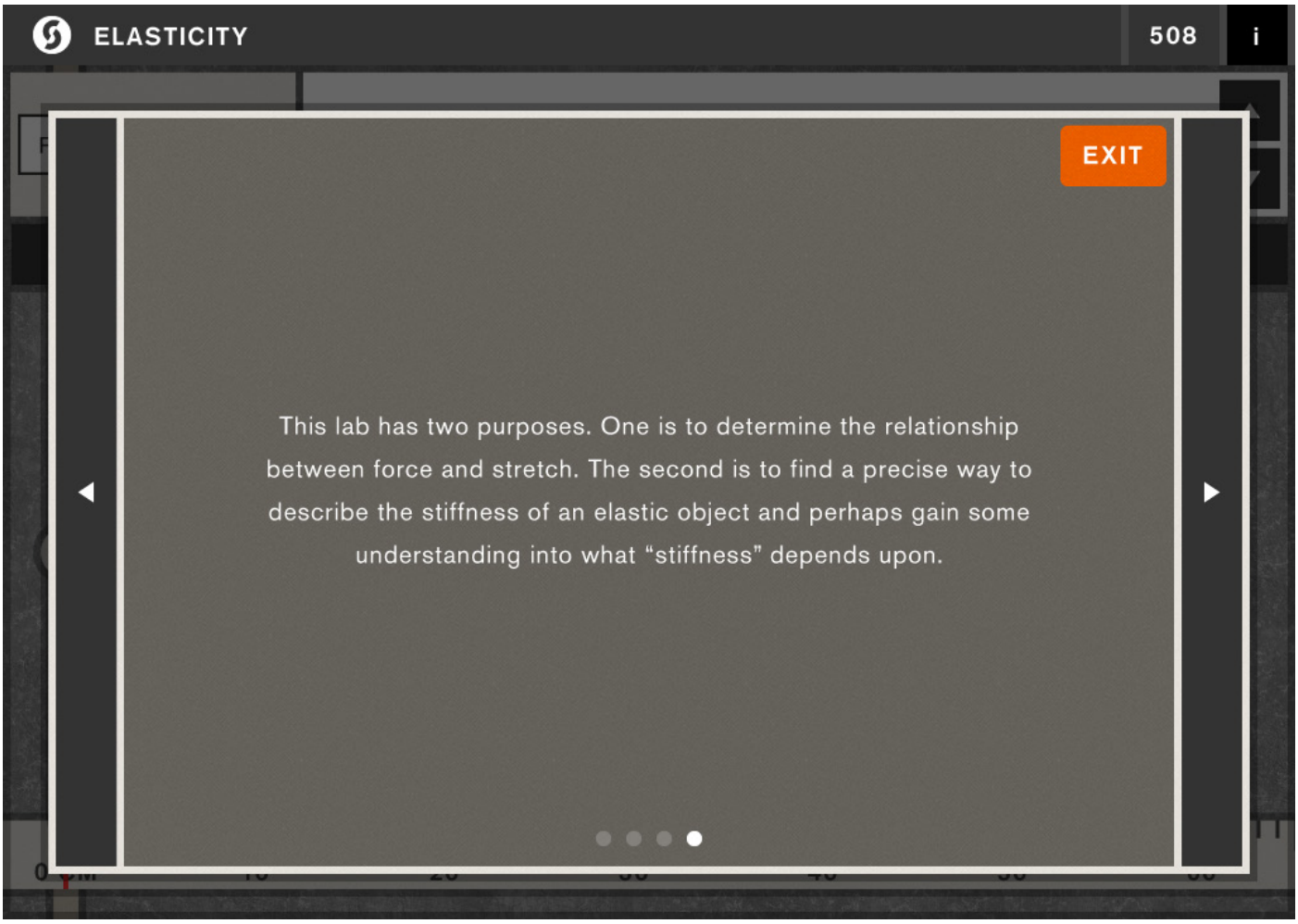
Screen 03

Introduction page 2:
"For example, a rubber band lying on the table is in equilibrium. All forces sum to zero. Stretching it requires the application of an external force, because the rubber pulls back. If the external force is removed, the rubber returns to its initial state. One can think of the various sections of the band pulling on neighboring sections until the original shape is restored. It is the sum of these forces that resists the stretching in the first place and pulls back on your hand."



Screen 04

Introduction page 3:
"Elastic forces depend on displacement, also known as stretching. Experience tells us that they depend on properties of the object being stretched such as the type of material, size, and shape. For example, different rubber bands have different levels of stiffness. The same can be said for wires made from different materials but with the same size and shape."



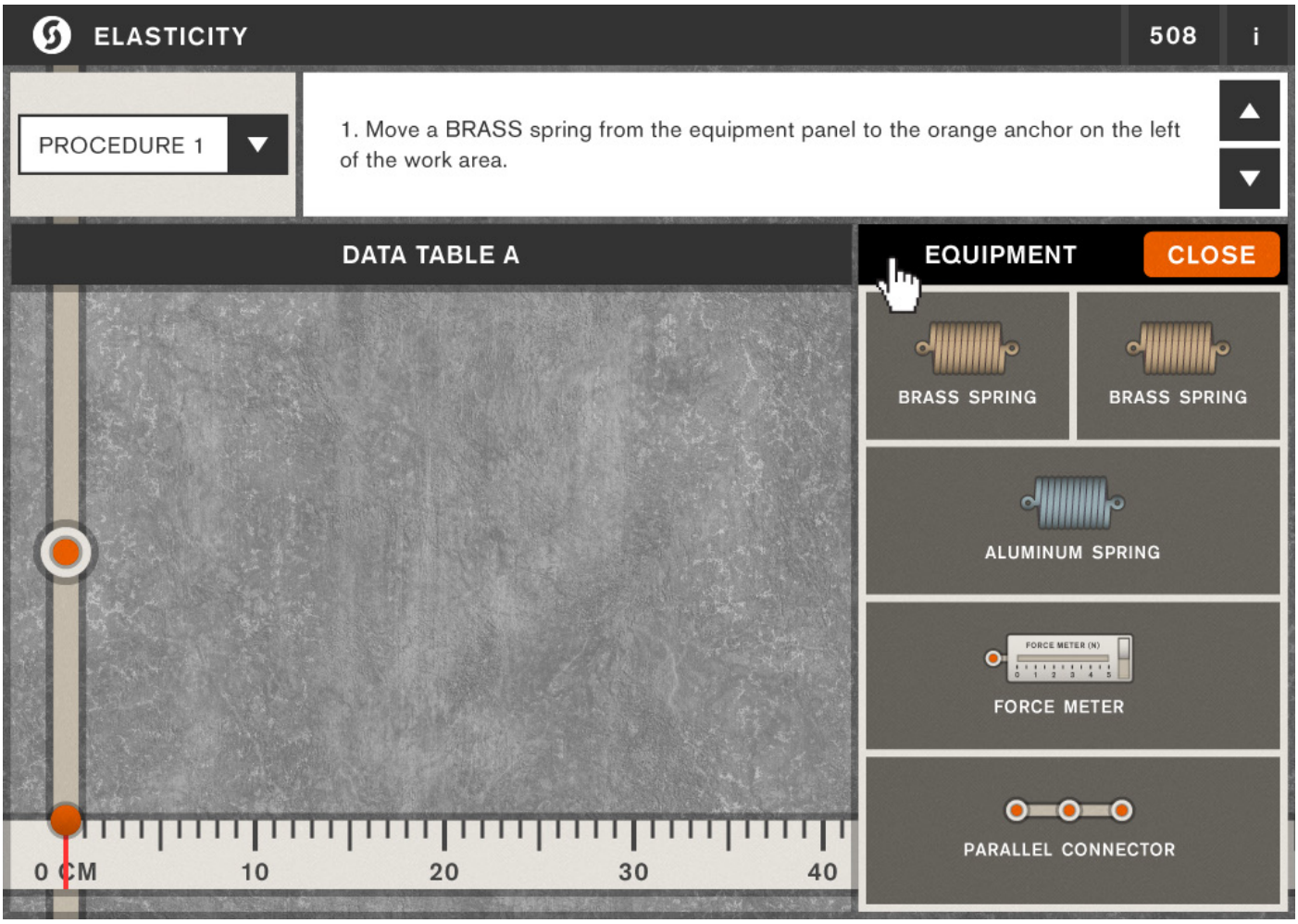
Screen 05

Introduction page 4:
“This lab has two purposes. One is to determine the relationship between force and stretch. The second is to find a precise way to describe the stiffness of an elastic object and perhaps gain some understanding into what ‘stiffness’ depends upon.”

Screen 06

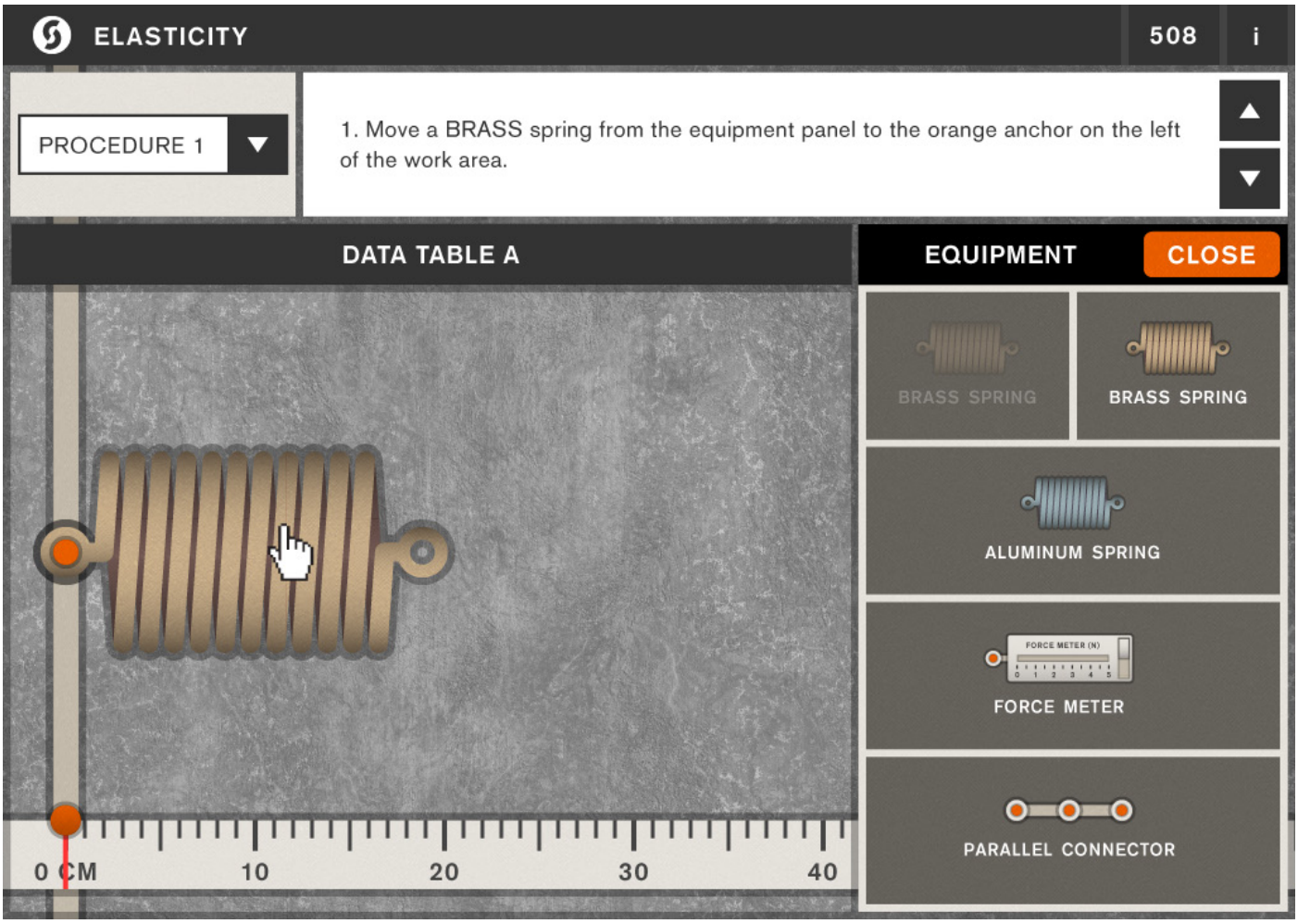
When the student closes the introduction, they will see the procedure instructions. The procedures, like Ohm's Law and Studying Electric Circuits, are anchored to the top of the work area. The DATA TABLE and EQUIPMENT panel are both dropdowns.

Procedure 1, Step 1:
"1. Move a BRASS spring from the equipment panel to the orange anchor on the left of the work area."



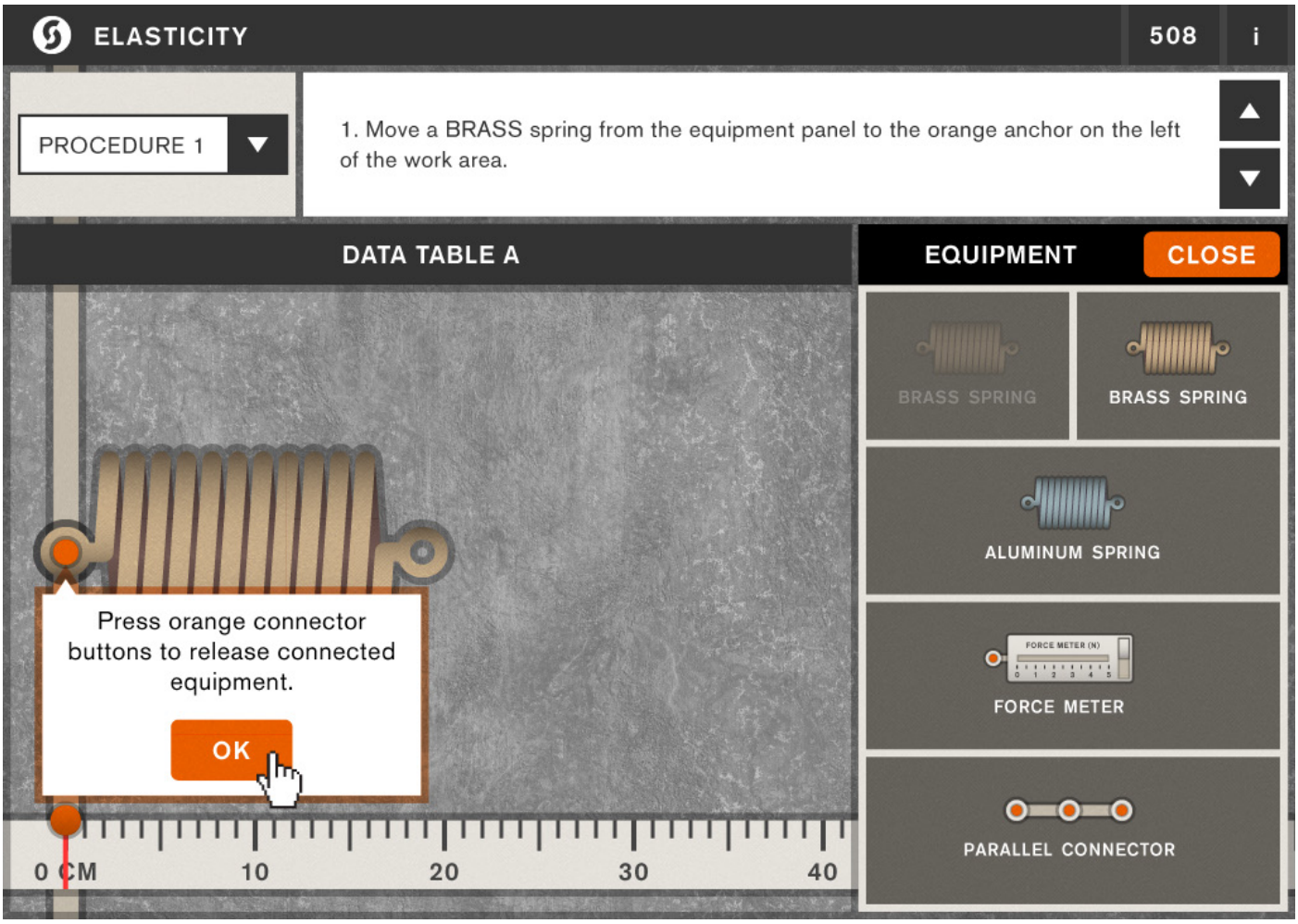
Screen 07

The student can access the equipment from the EQUIPMENT dropdown.



Screen 08

Each piece of equipment is a draggable button and will snap into position when it is near an anchor point. The equipment will not fully lock into place until the student releases the object.

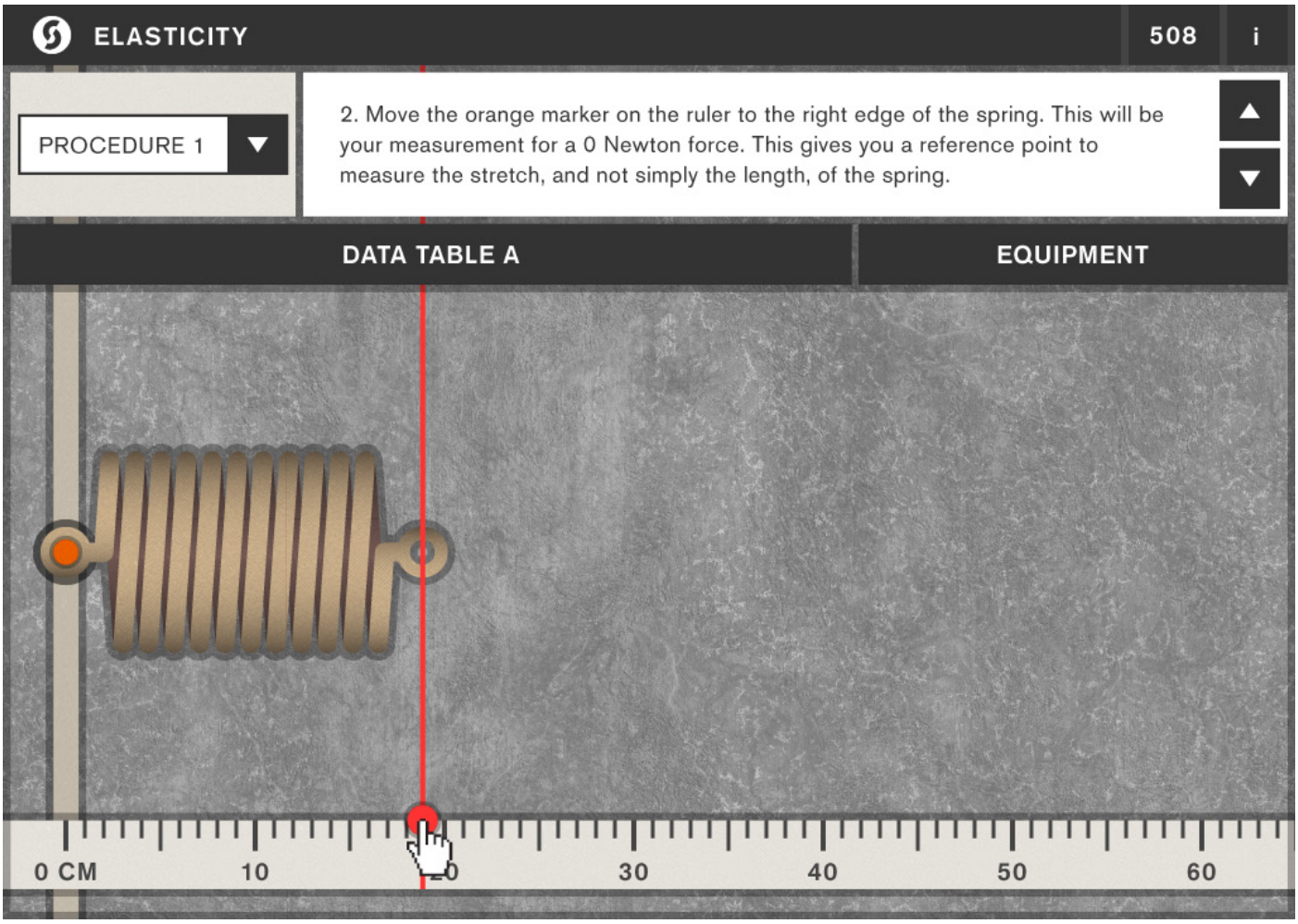


Screen 09

When the first spring is placed on an anchor, there will be a message telling them that they can "Press orange connector buttons to release connected equipment." This message will only display once.

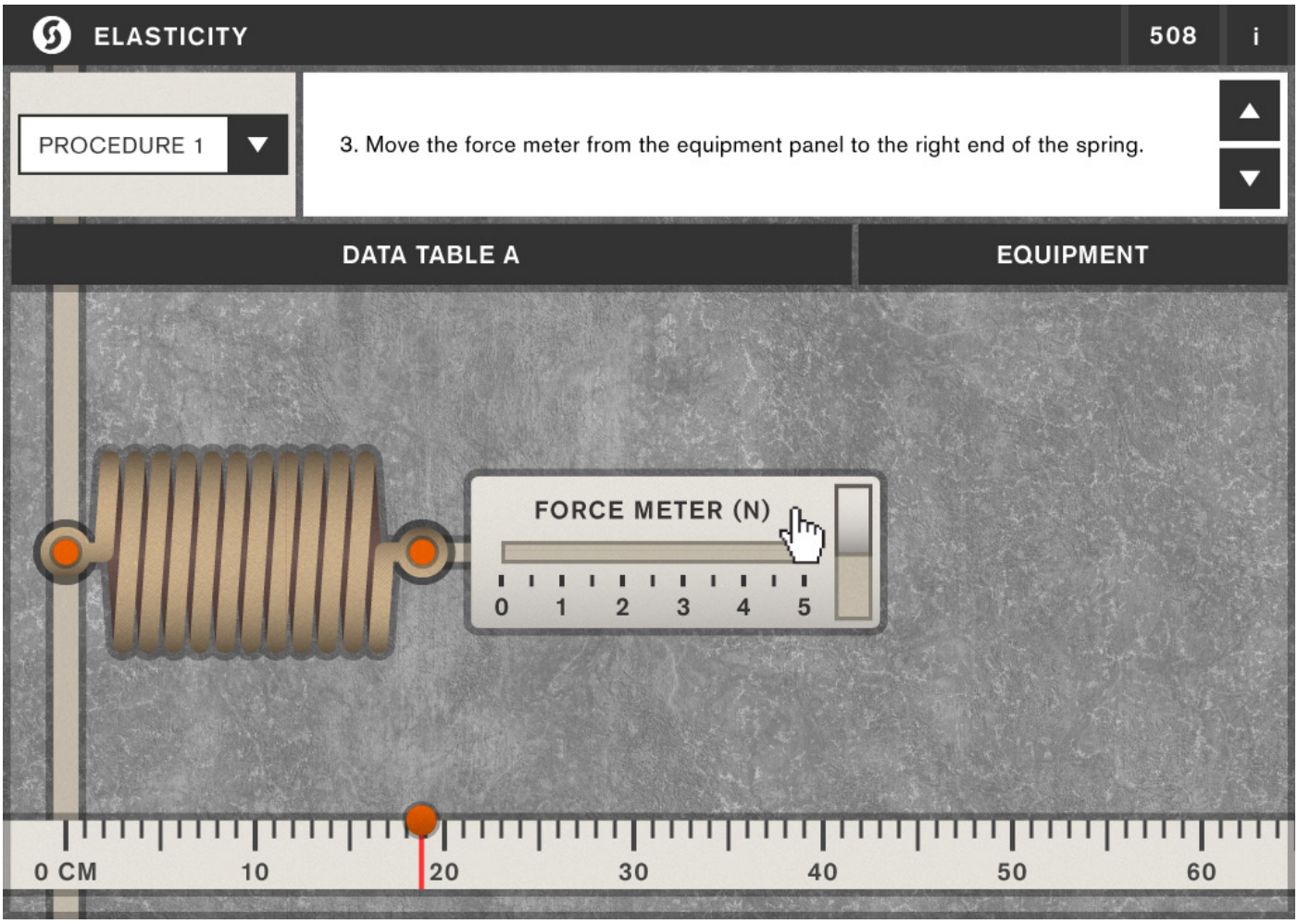
A second message will display once, "Drag disconnected equipment back to the equipment panel to remove it from the work area."

The ability to drag equipment back into the equipment panel will allow this lab to be completely self-guided, including the procedure menu. All items in the procedure menu will be open from the beginning.



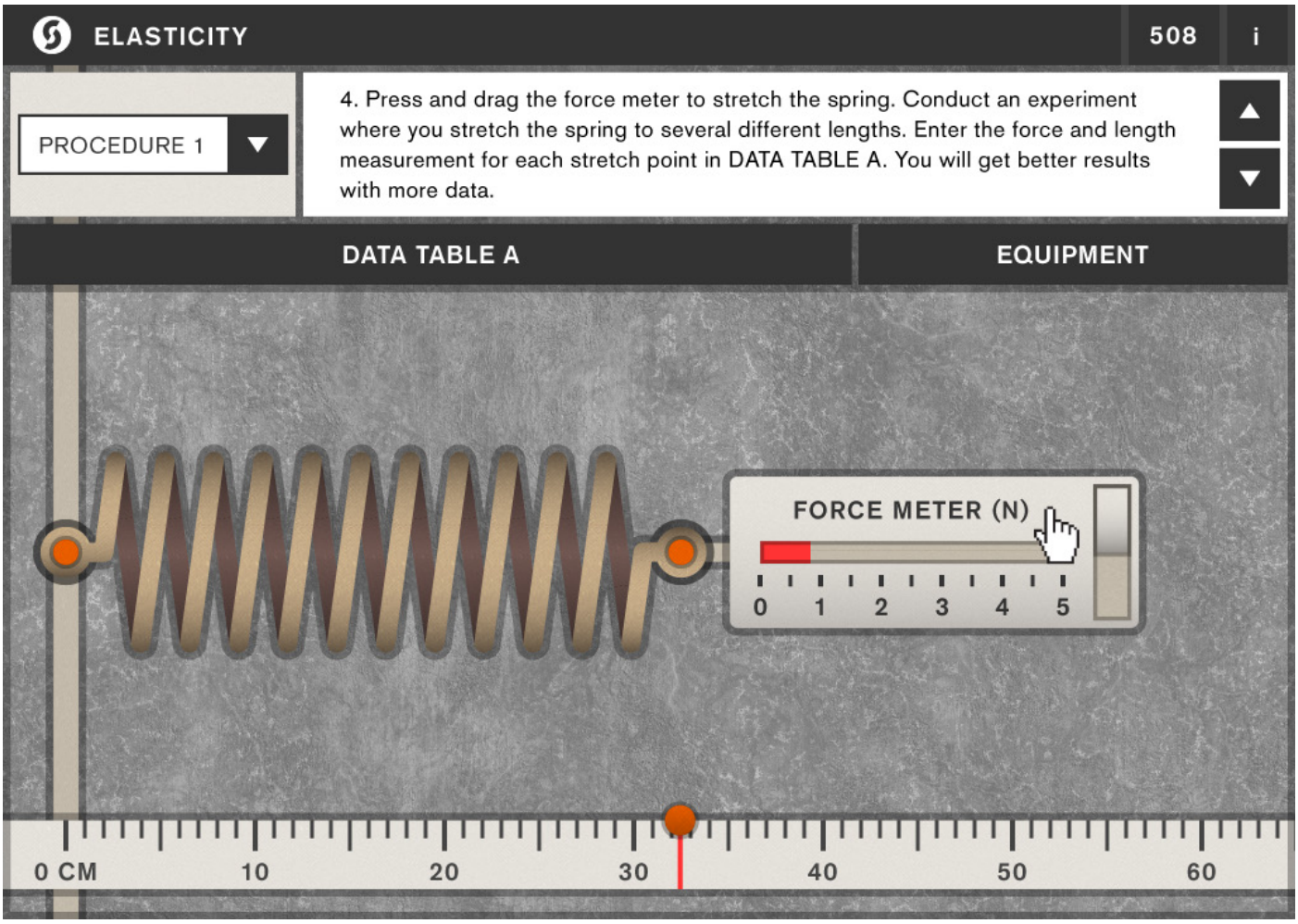
Screen 10

Procedure 1, Step 2:
"2. Move the orange marker on the ruler to the right edge of the spring. This will be your measurement for a 0 Newton force. This gives you a reference point to measure the stretch, and not simply the length, of the spring."



Screen 11

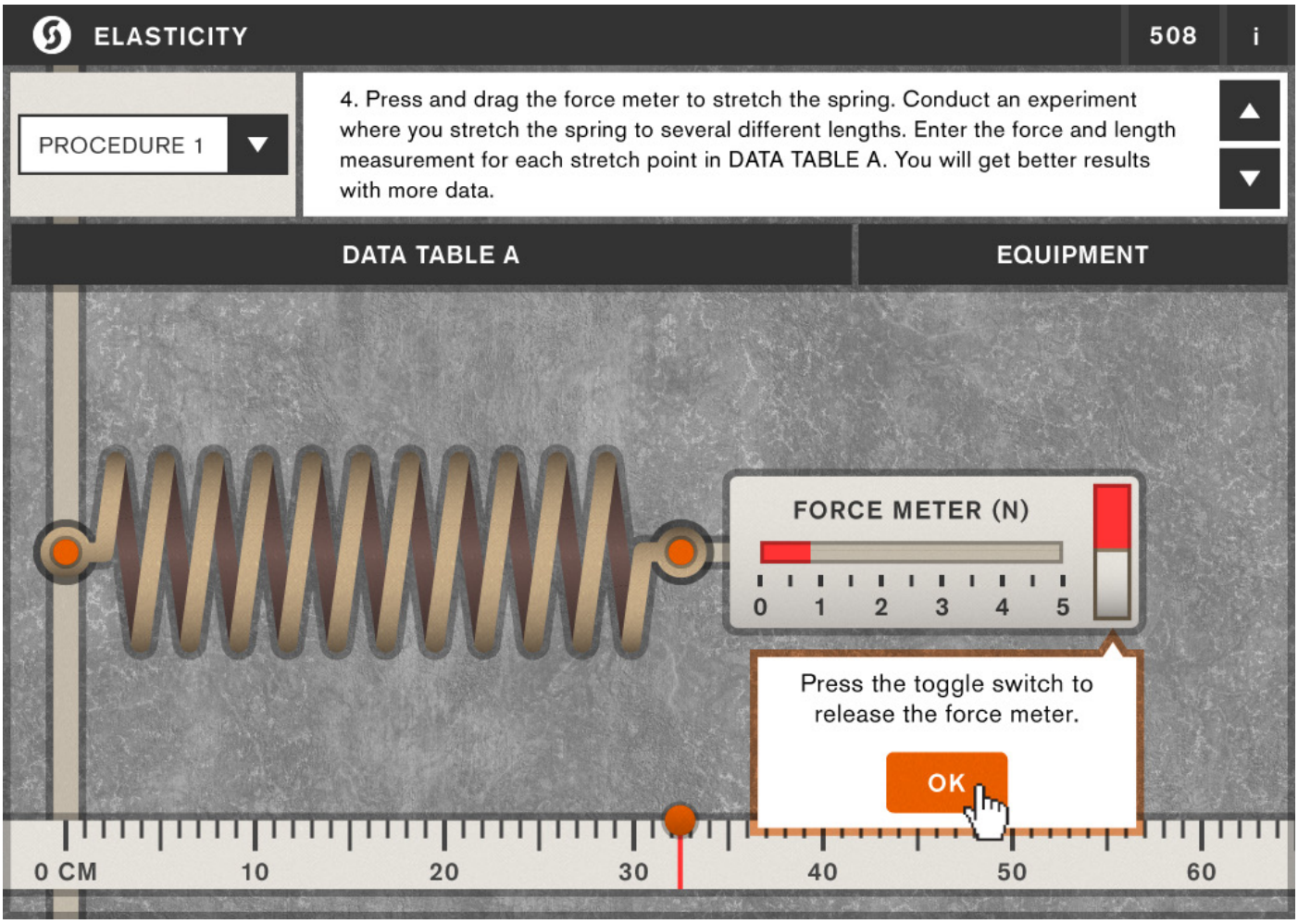
Procedure 1, Step 3:
"3. Move the force meter from the equipment panel to the right end of the spring."



Screen 12

Procedure 1, Step 4:
"4. Press and drag the force meter to stretch the spring. Conduct an experiment where you stretch the spring to several different lengths. Enter the force and length measurement for each stretch point in DATA TABLE A. You will get better results with more data."

The student can press on any part of the force meter then drag it horizontally. The ruler marker moves in relation to the extention of the spring.

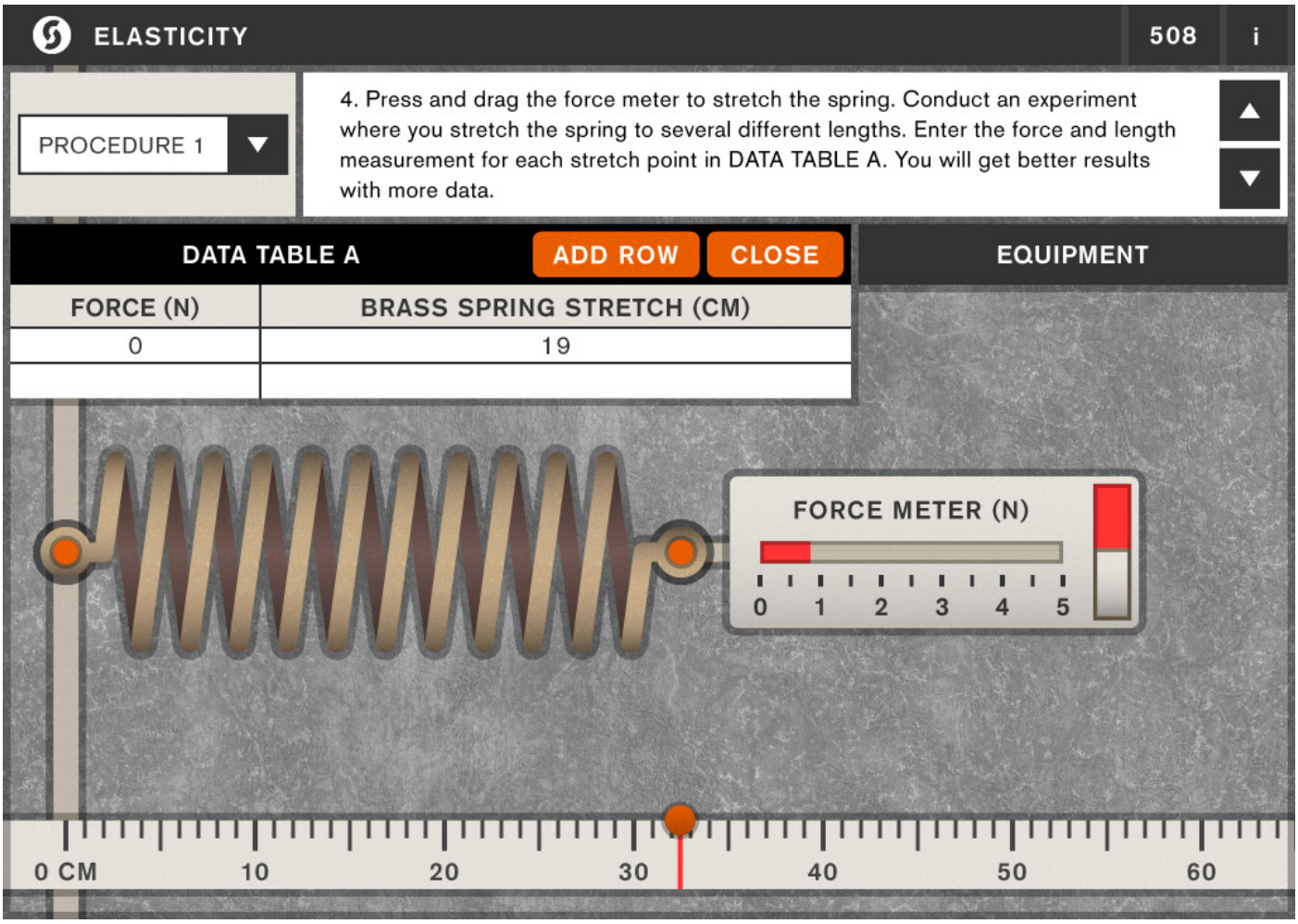


Screen 13

When the student releases the force meter, it will lock in place. This will make it easier for the student to take measurements. Pressing the toggle button on the force meter will fully release the force meter, at which point the spring will collapse back to it's resting position.

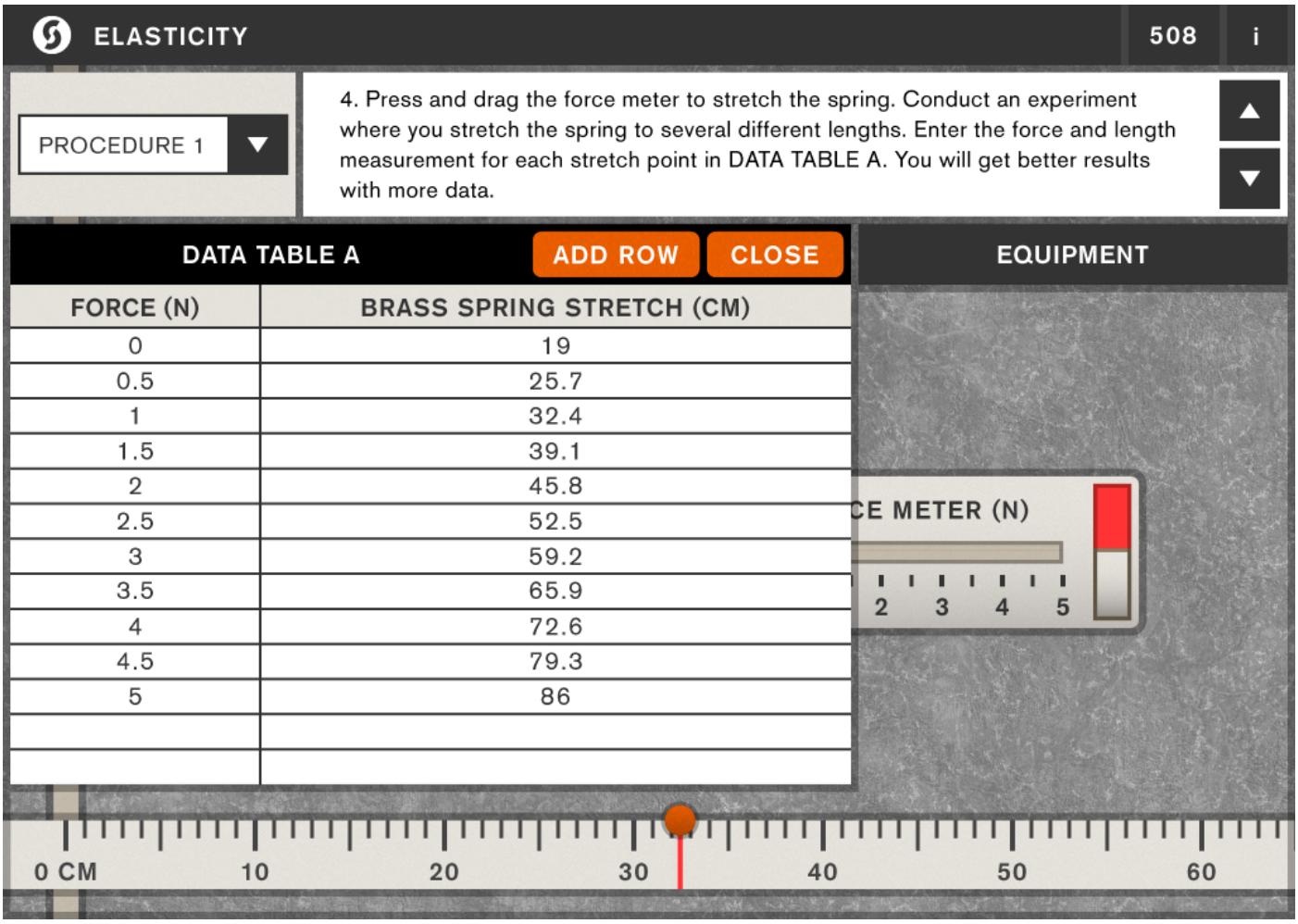
If the force meter is locked in position, the student can pick it back up and continue moving it in either horizontal direction.

The message "Press the toggle switch to release the force meter" will only display the first time the student uses the force meter.



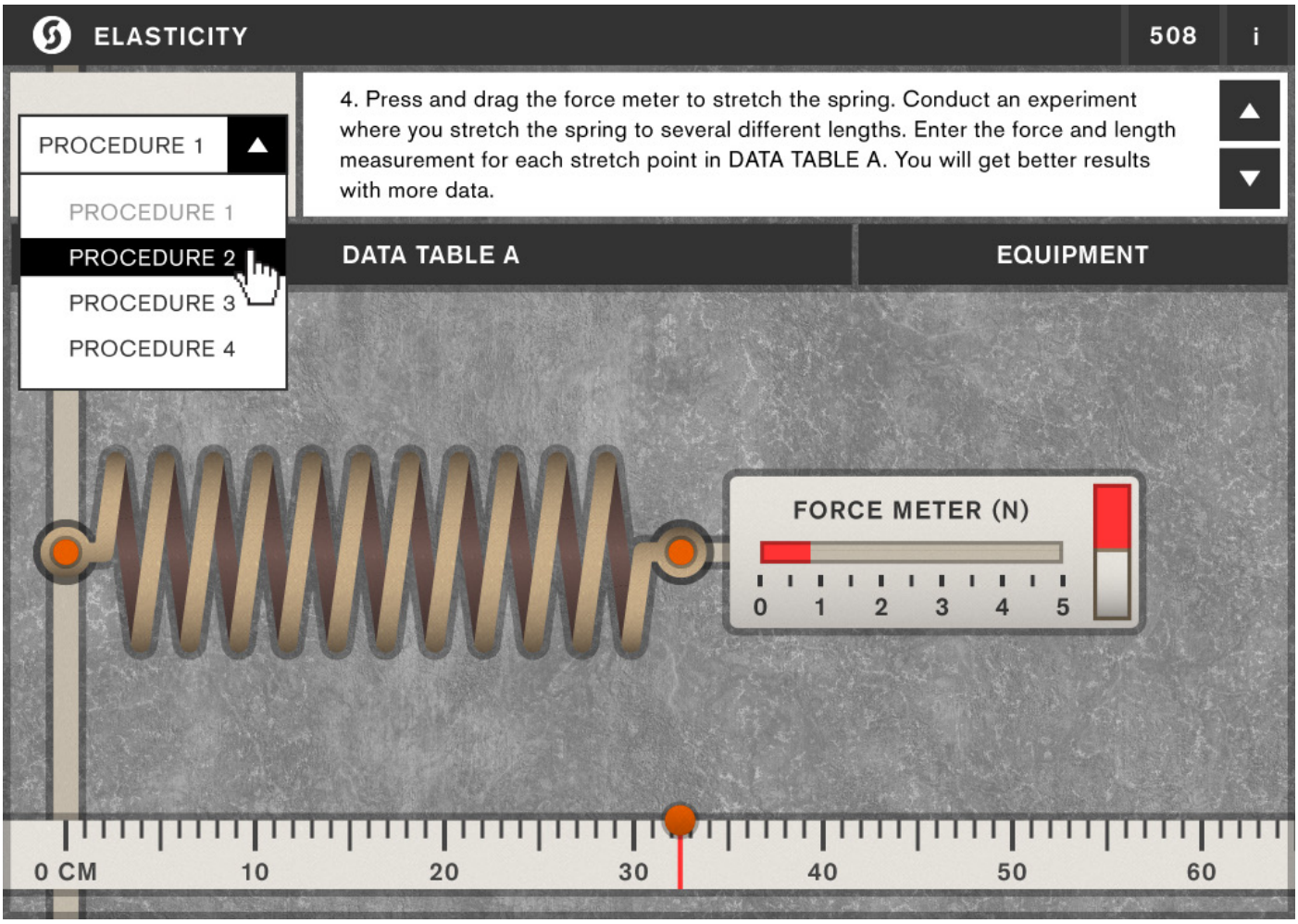
Screen 14

The data table will start out with two rows, one for the 0 point and one for their first stretch. They can press the ADD ROW button to increase the number of data points in each table. The ADD ROW button will be disabled when 13 rows are present (including the 0 row).



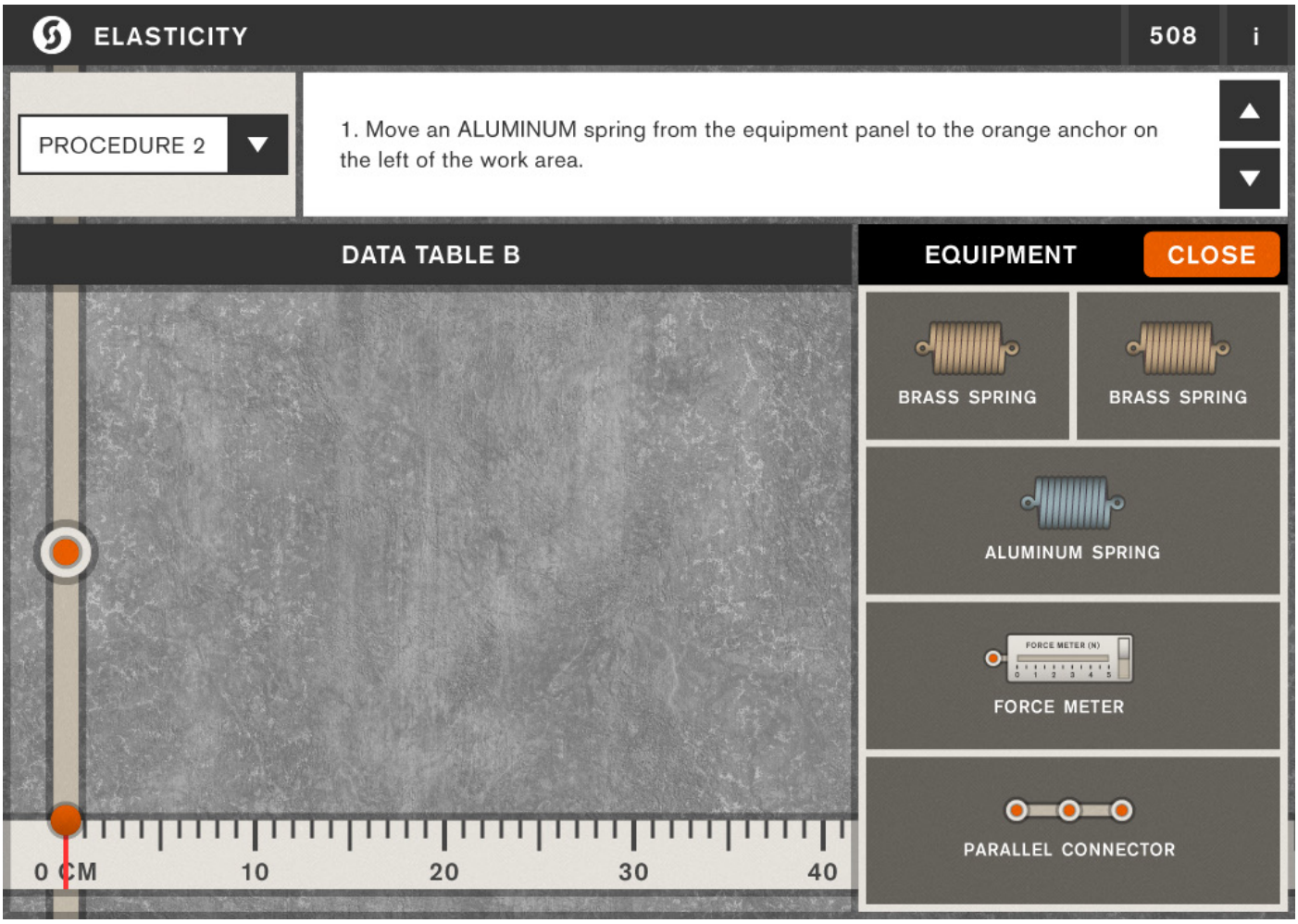
Screen 15

This is an example of the max number of rows with most of them filled in.



Screen 16

Since this lab is completely self-guided, the student will need to use the procedure drop-down to continue to the next procedure.



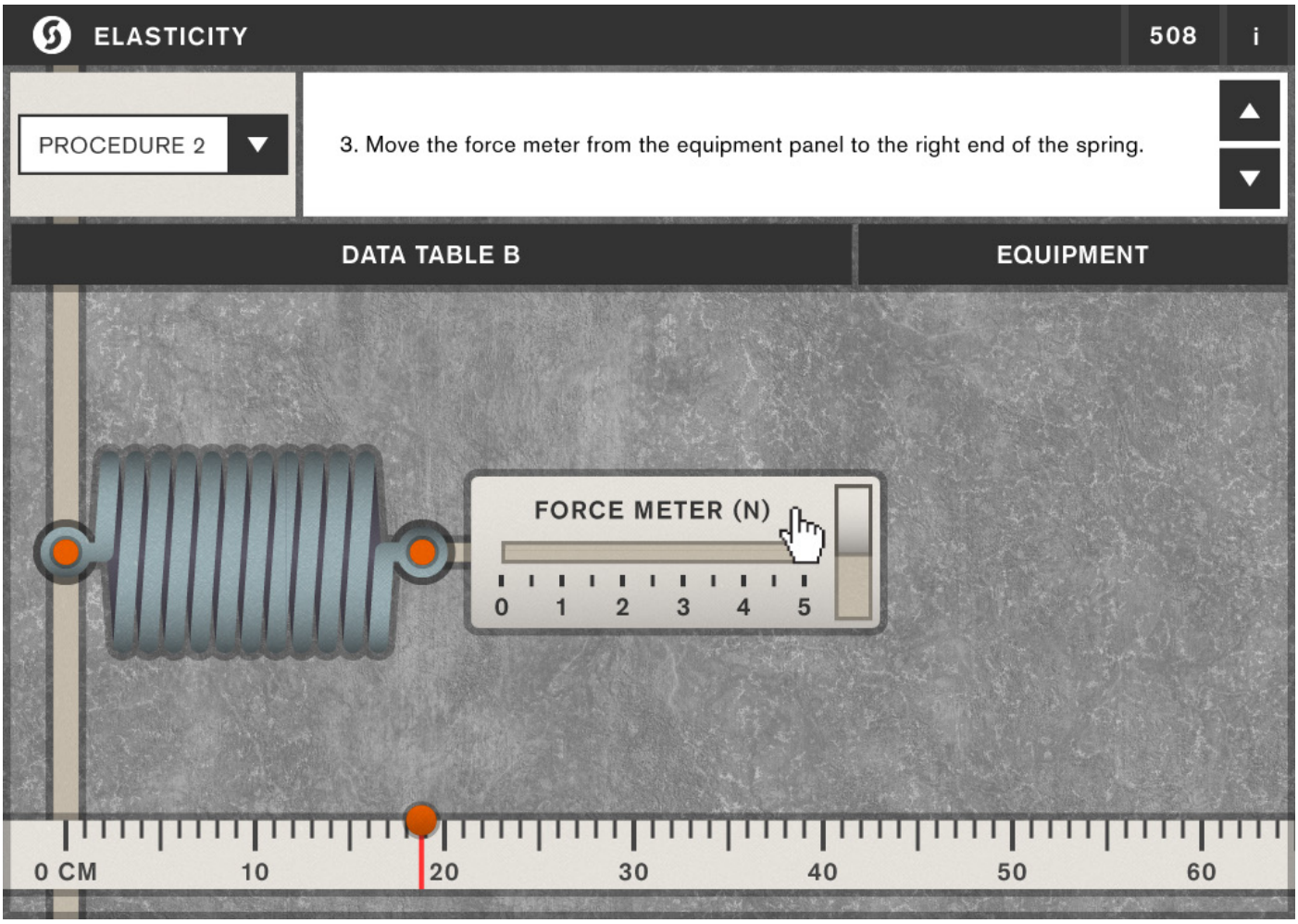
Screen 17

Each procedure will have it's own work area, giving the student a fresh start with the material placement.

Note: It could be an option to only have the equipment available that is needed for each procedure. So, on Procedure 2, the brass springs and parallel connectors wouldn't need to be there.

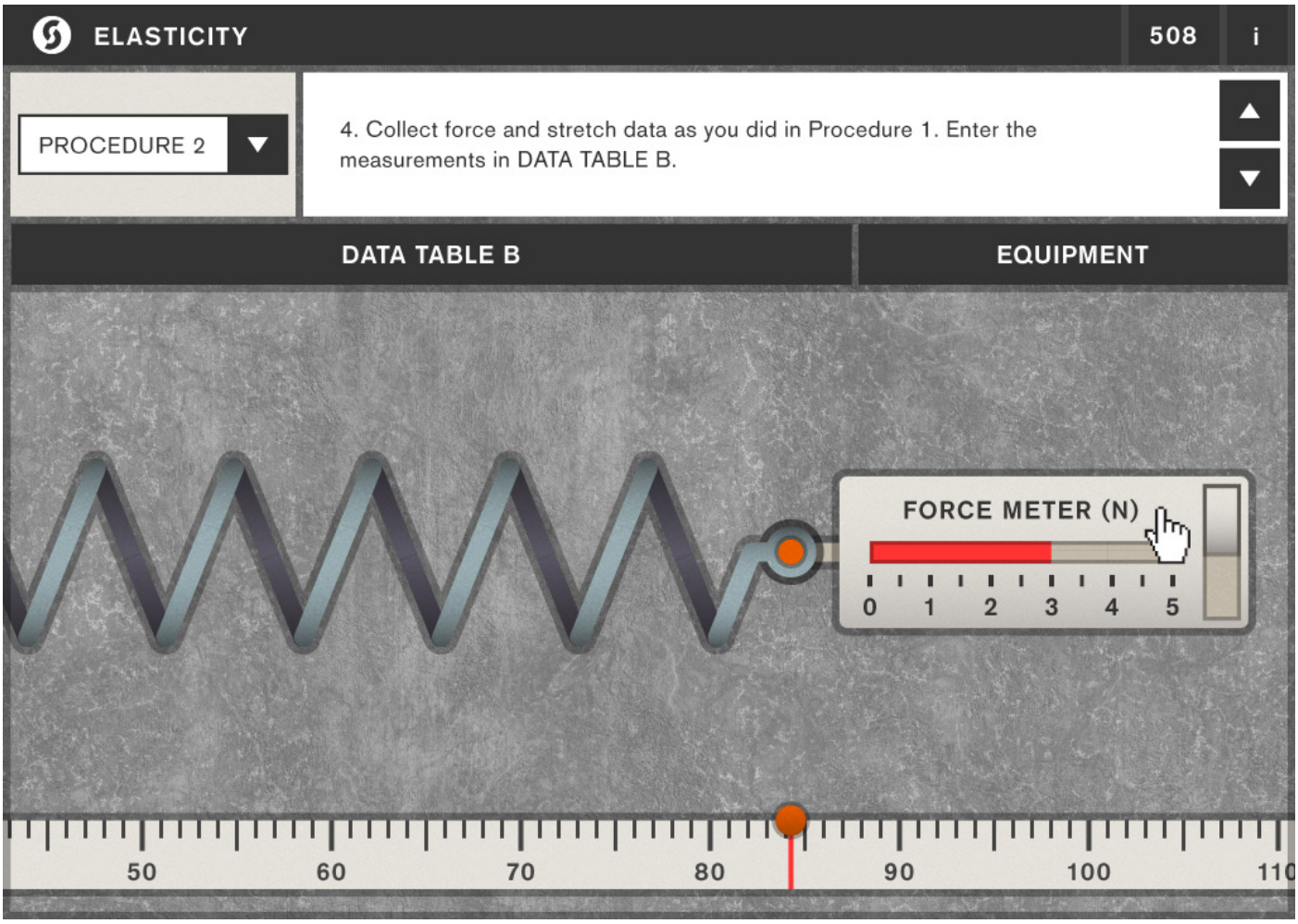
Procedure 2, Step 1:
"1. Move an ALUMINUM spring from the equipment panel to the orange anchor on the left of the work area."

Procedure 2, Step 2:
"2. Move the orange marker on the ruler to the right edge of the spring to set your stretch reference point."



Screen 18

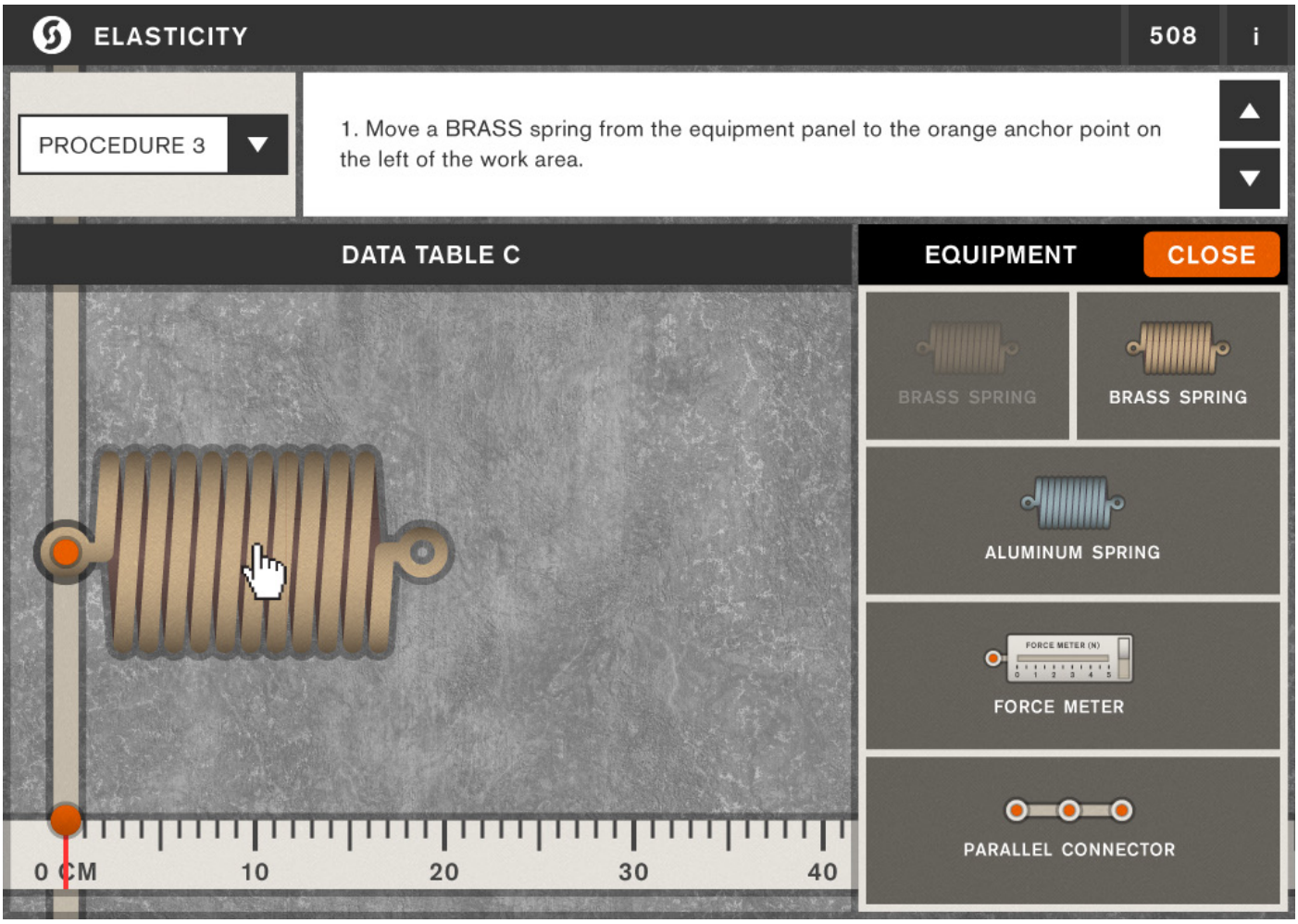
Procedure 2, Step 3:
"3. Move the force meter from the equipment panel to the right end of the spring."



Screen 19

Procedure 2, Step 4:
"4. Collect force and stretch data as you did in Procedure 1. Enter the measurements in DATA TABLE B."

At a certain point, the spring will need to expand beyond the original work area to take the longer measurements, especially in Procedure 2 (two brass springs in series). This is an example of the screen scrolling so that the force meter and ruler marker (current measurement reading) always stay in view.

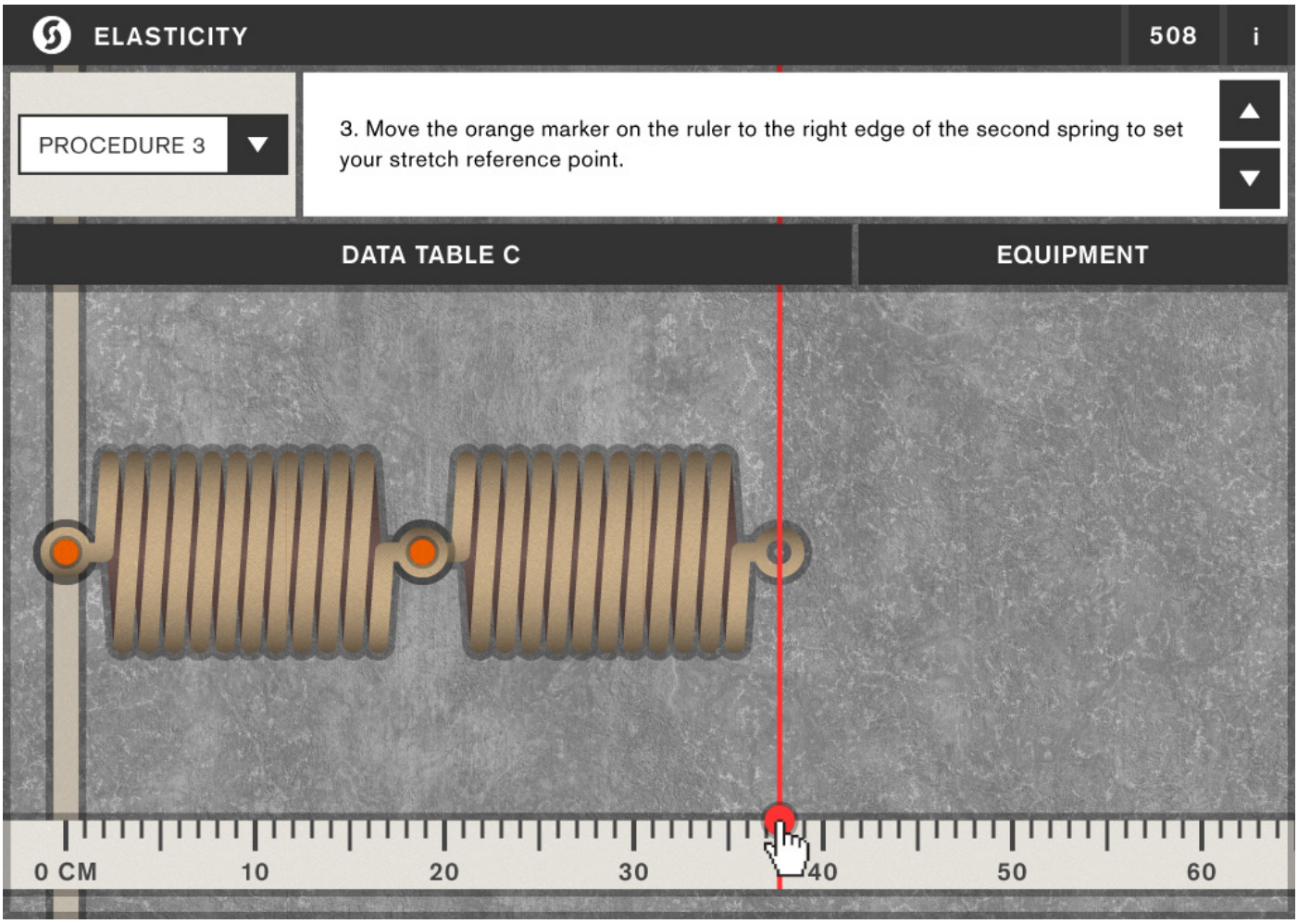


Screen 20

Procedure 3, Step 1:
"1. Move a BRASS spring from the equipment panel to the orange anchor point on the left of the work area."

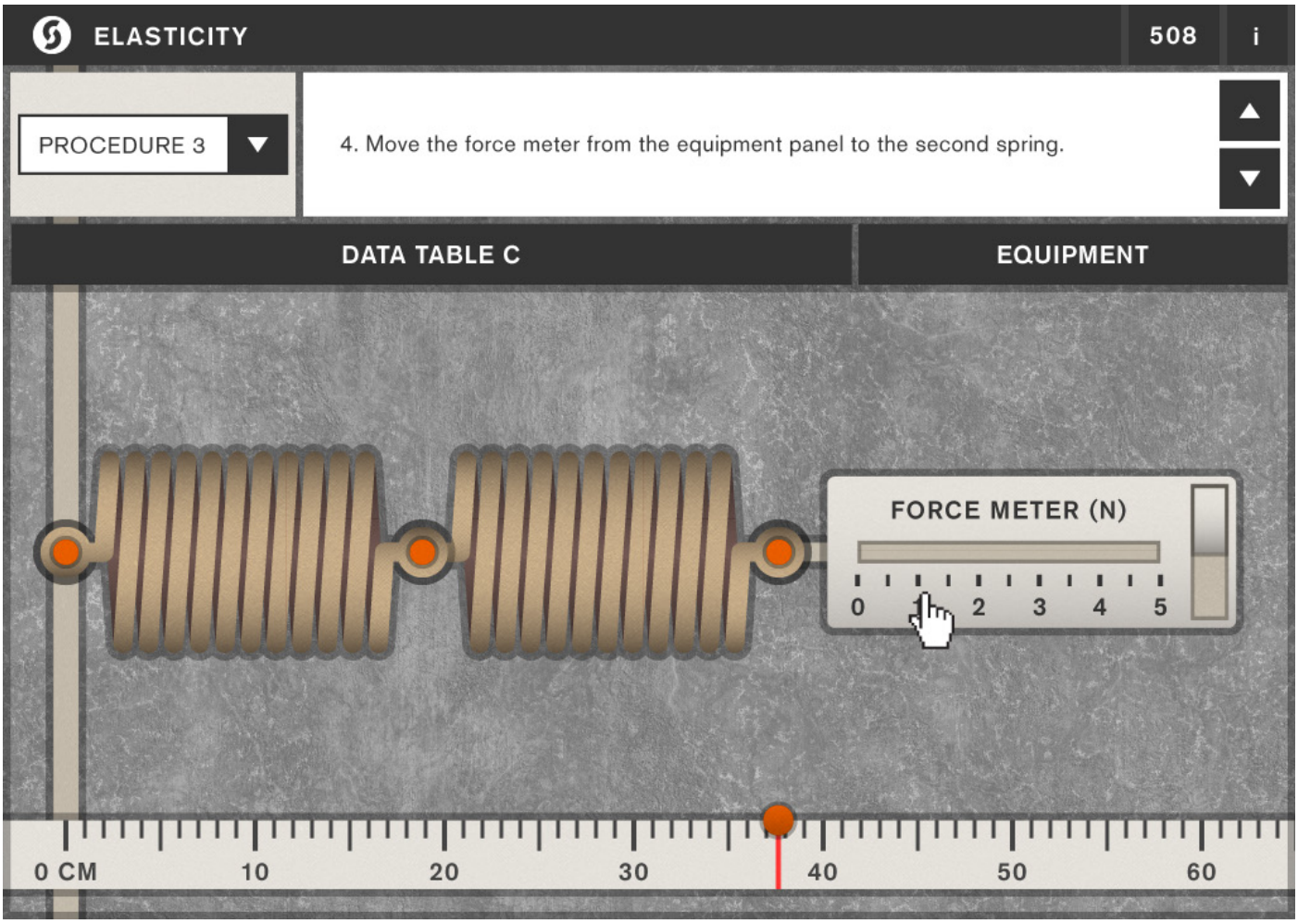
Screen 21

Procedure 3, Step 2:
"2. Move a second brass spring from the equipment panel to the right end of the first brass spring. This is called a series connection."



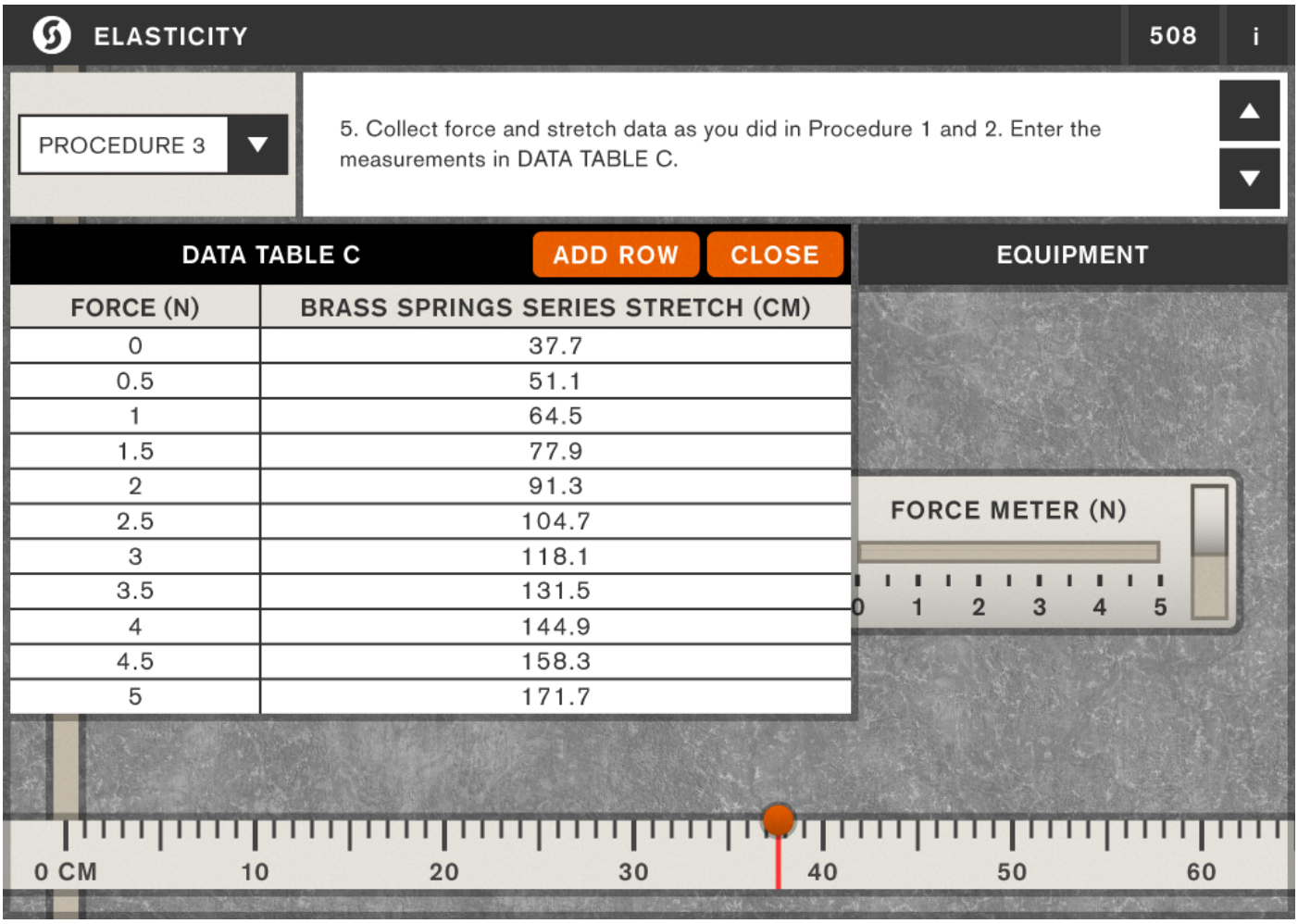
Screen 22

Procedure 3, Step 3:
"3. Move the orange marker on the ruler to the right edge of the second spring to set your stretch reference point."



Screen 23

Procedure 3, Step 4:
"4. Move the force meter from the equipment panel to the second spring."



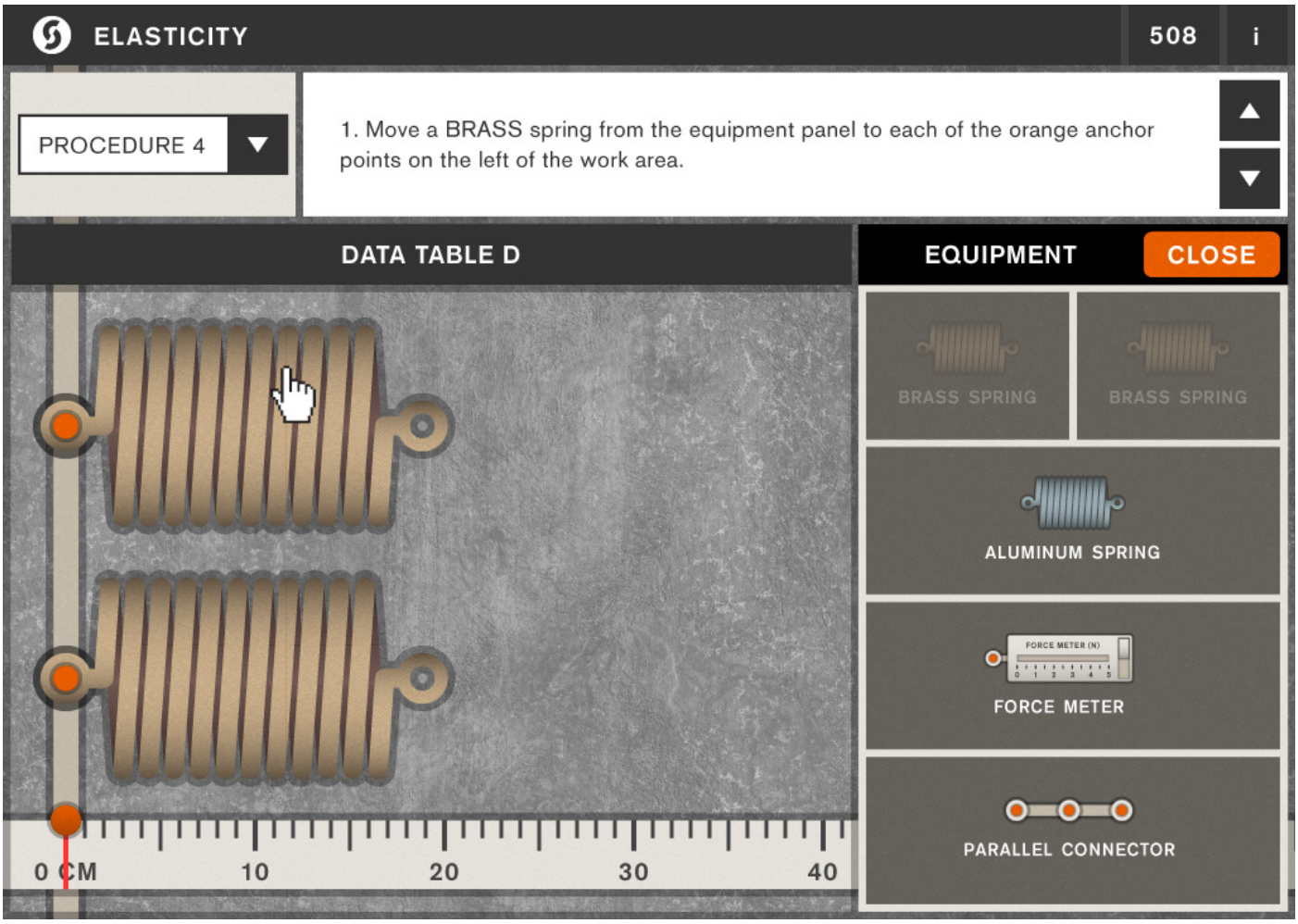
Screen 24

Procedure 3, Step 5:
"5. Collect force and stretch data as you did in Procedure 1 and 2. Enter the measurements in DATA TABLE C."

Screen 25

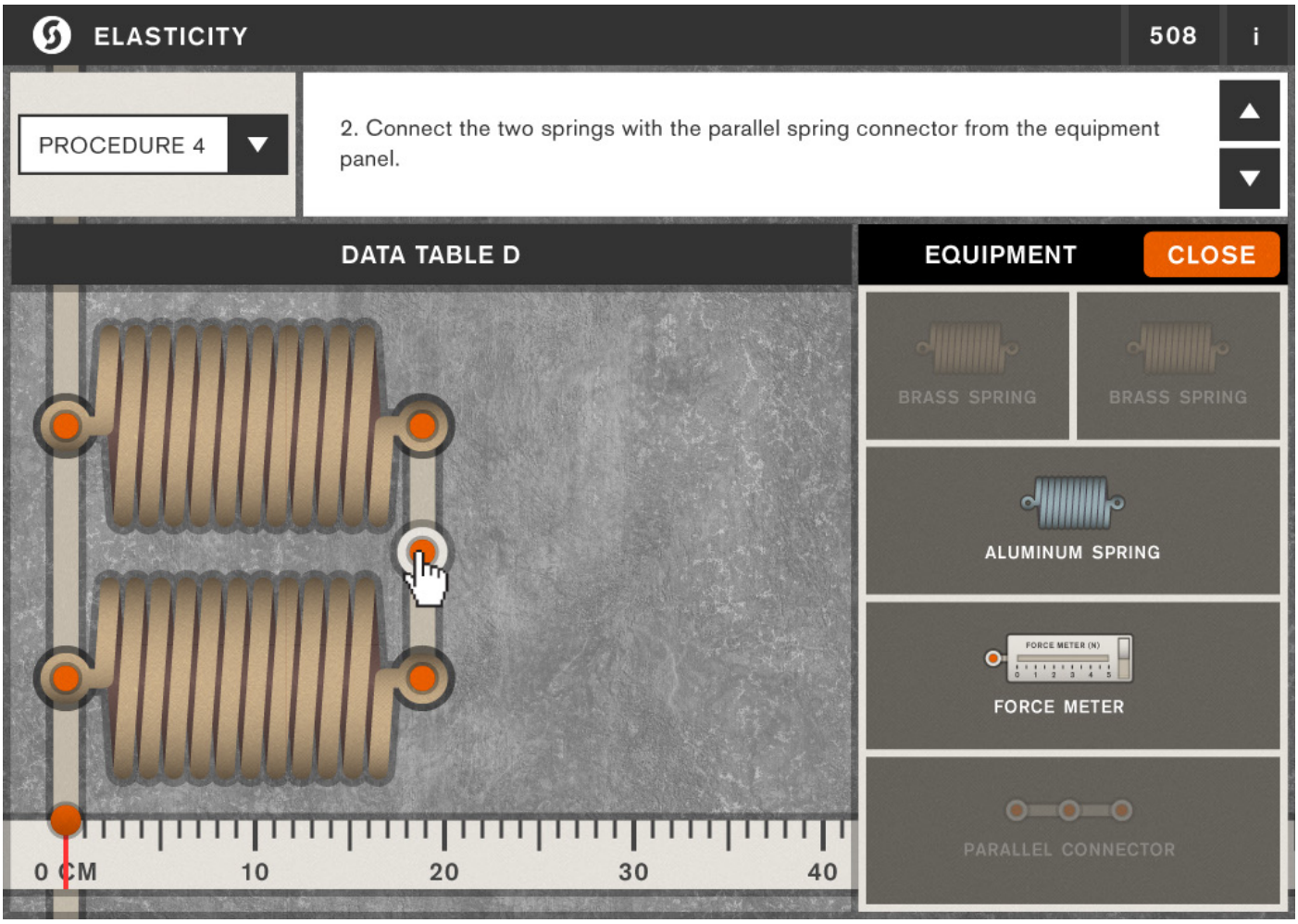
Procedure 4, Step 1:
"1. Move a BRASS spring from the equipment panel to each of the orange anchor points on the left of the work area."

Since Procedure 4 needs the springs to be in parallel, there are two anchor points.


ELASTICITY
508
i
PROCEDURE 4
1. Move a BRASS spring from the equipment panel to each of the orange anchor points on the left of the work area.
DATA TABLE D
EQUIPMENT
CLOSE
BRASS SPRING
BRASS SPRING
ALUMINUM SPRING
FORCE METER
PARALLEL CONNECTOR
0 CM
10
20
30
40

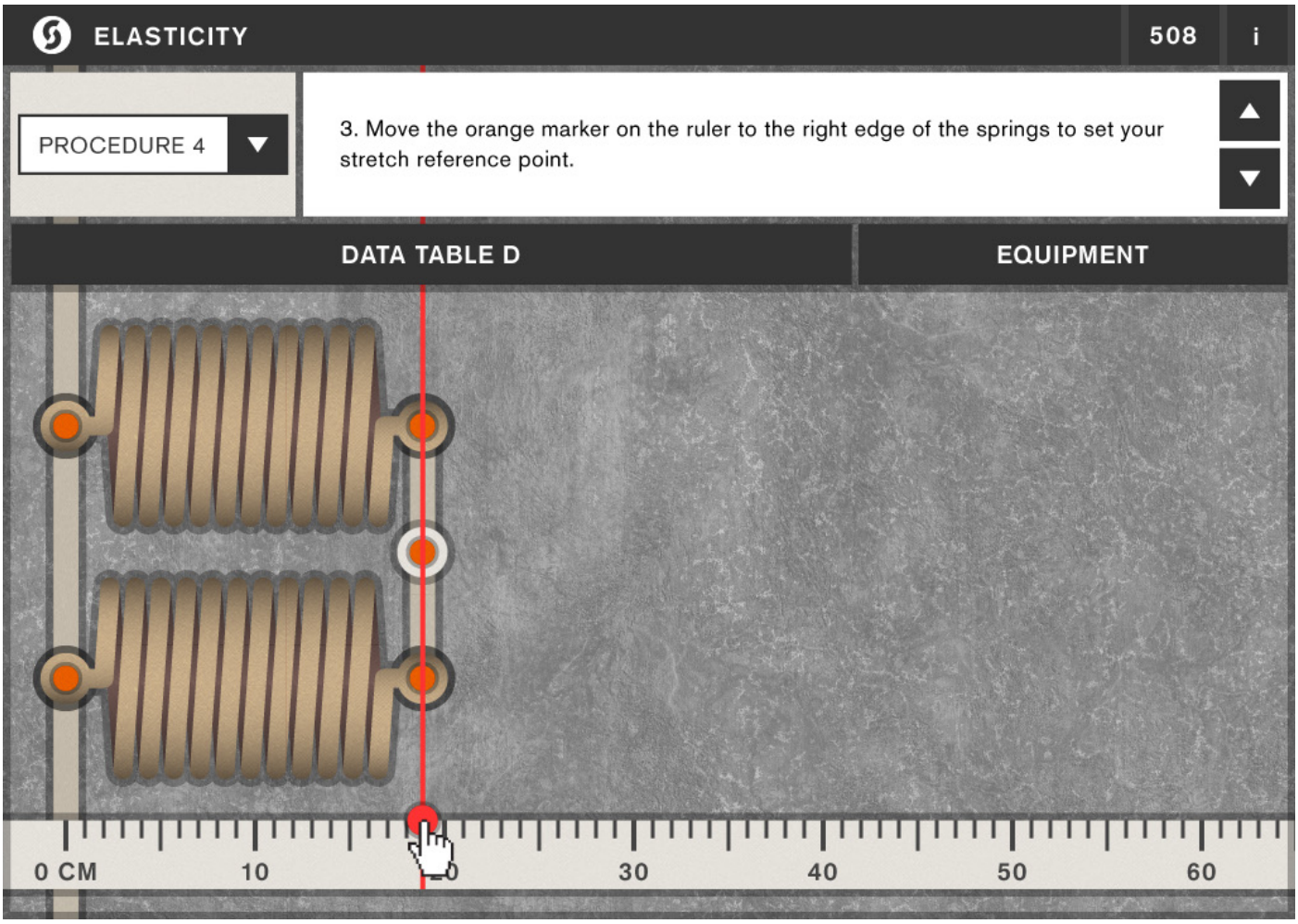
Screen 26

-



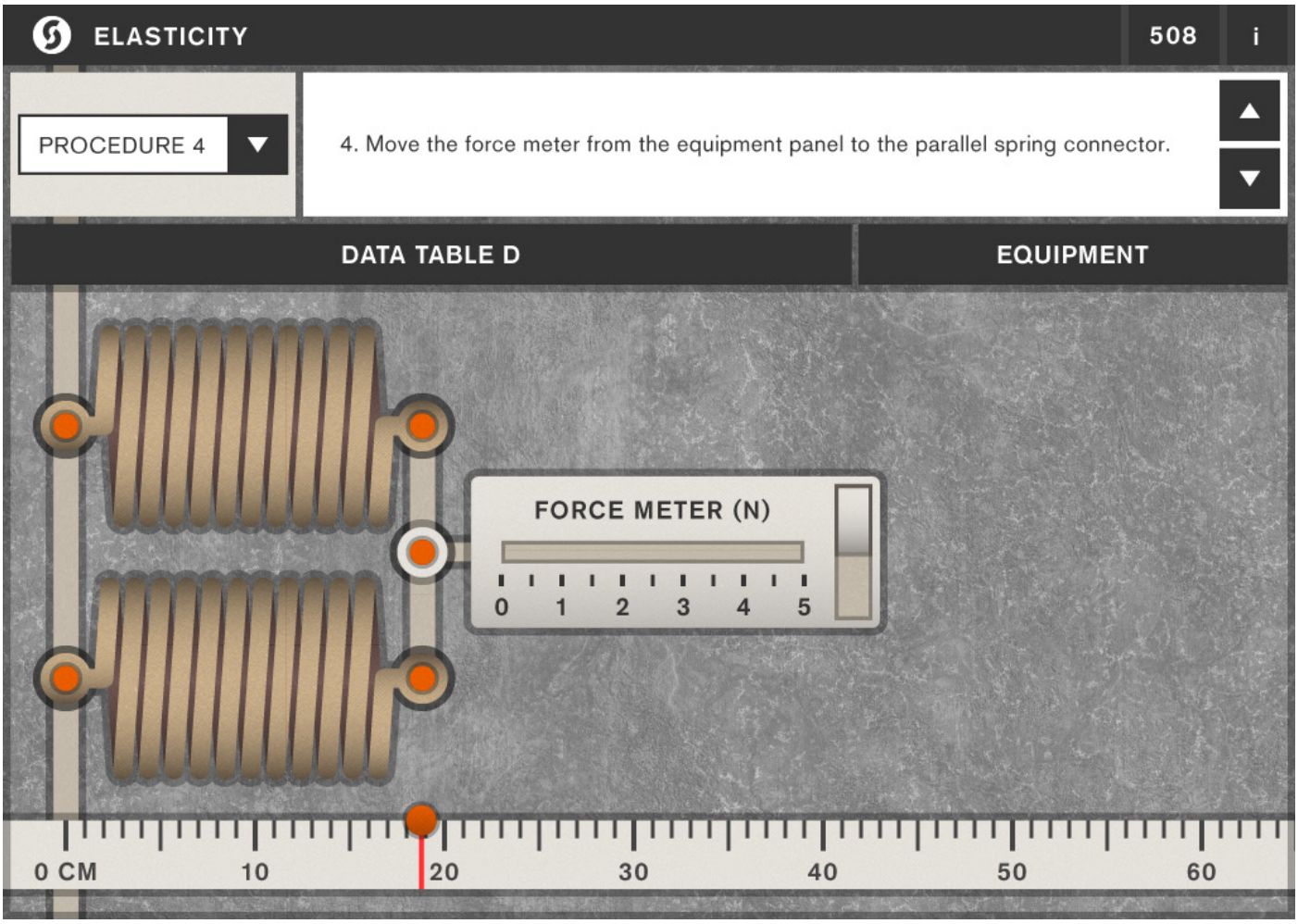
Screen 27

Procedure 4, Step 2:
"2. Connect the two springs with the parallel spring connector from the equipment panel."



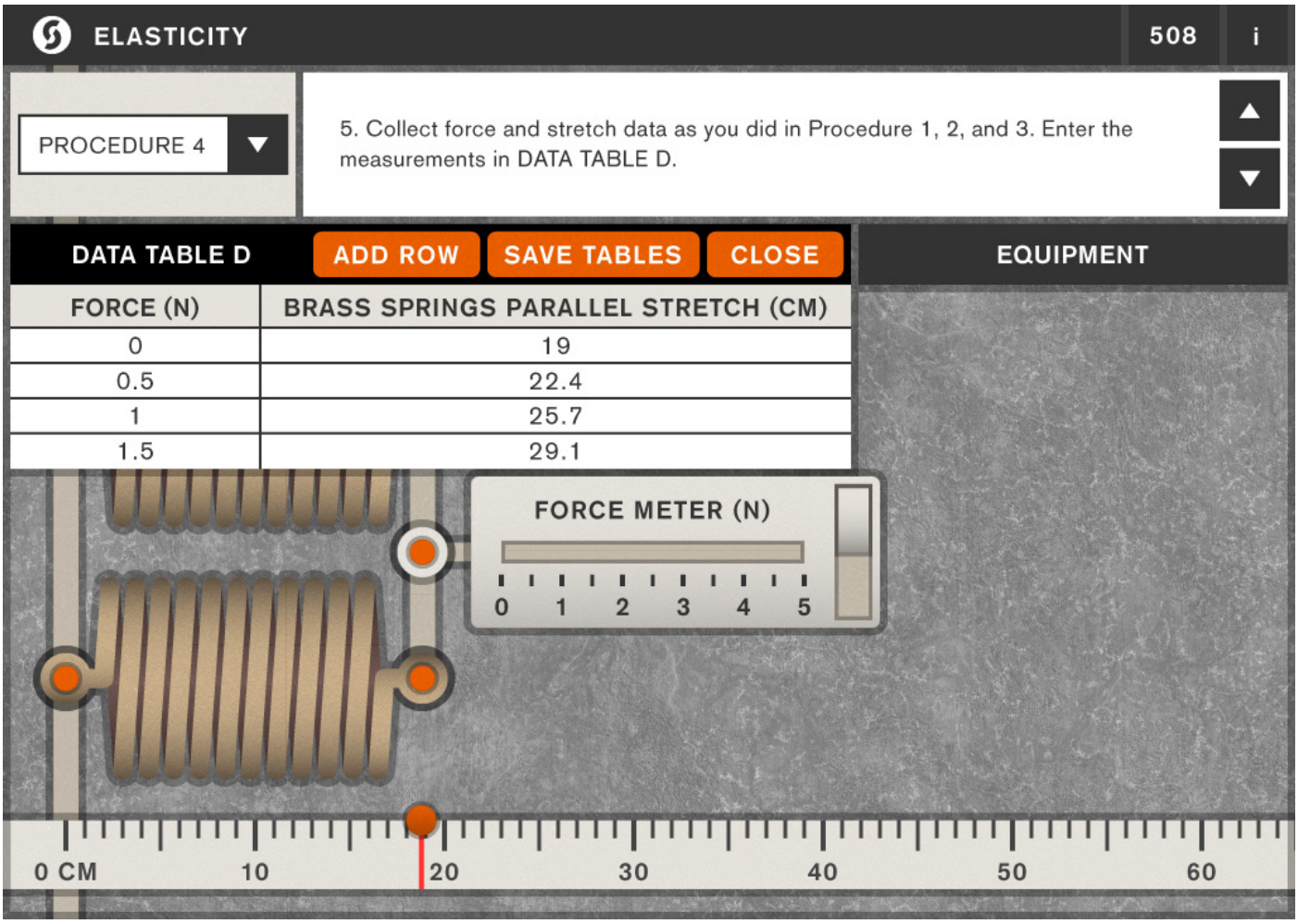
Screen 28

Procedure 4, Step 3:
"3. Move the orange marker on the ruler to the right edge of the springs to set your stretch reference point."



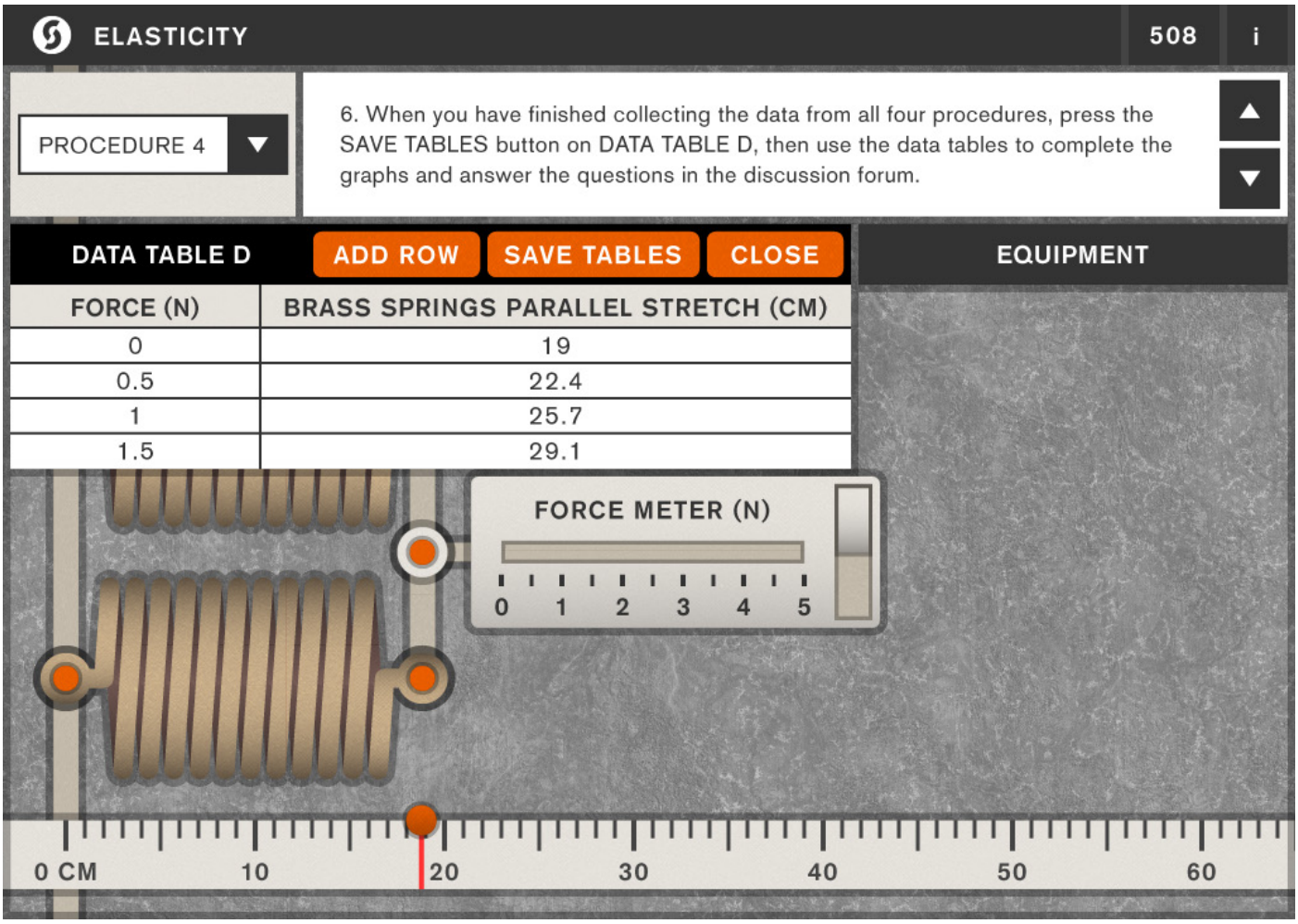
Screen 29

Procedure 4, Step 4:
"4. Move the force meter from the equipment panel to the parallel spring connector."



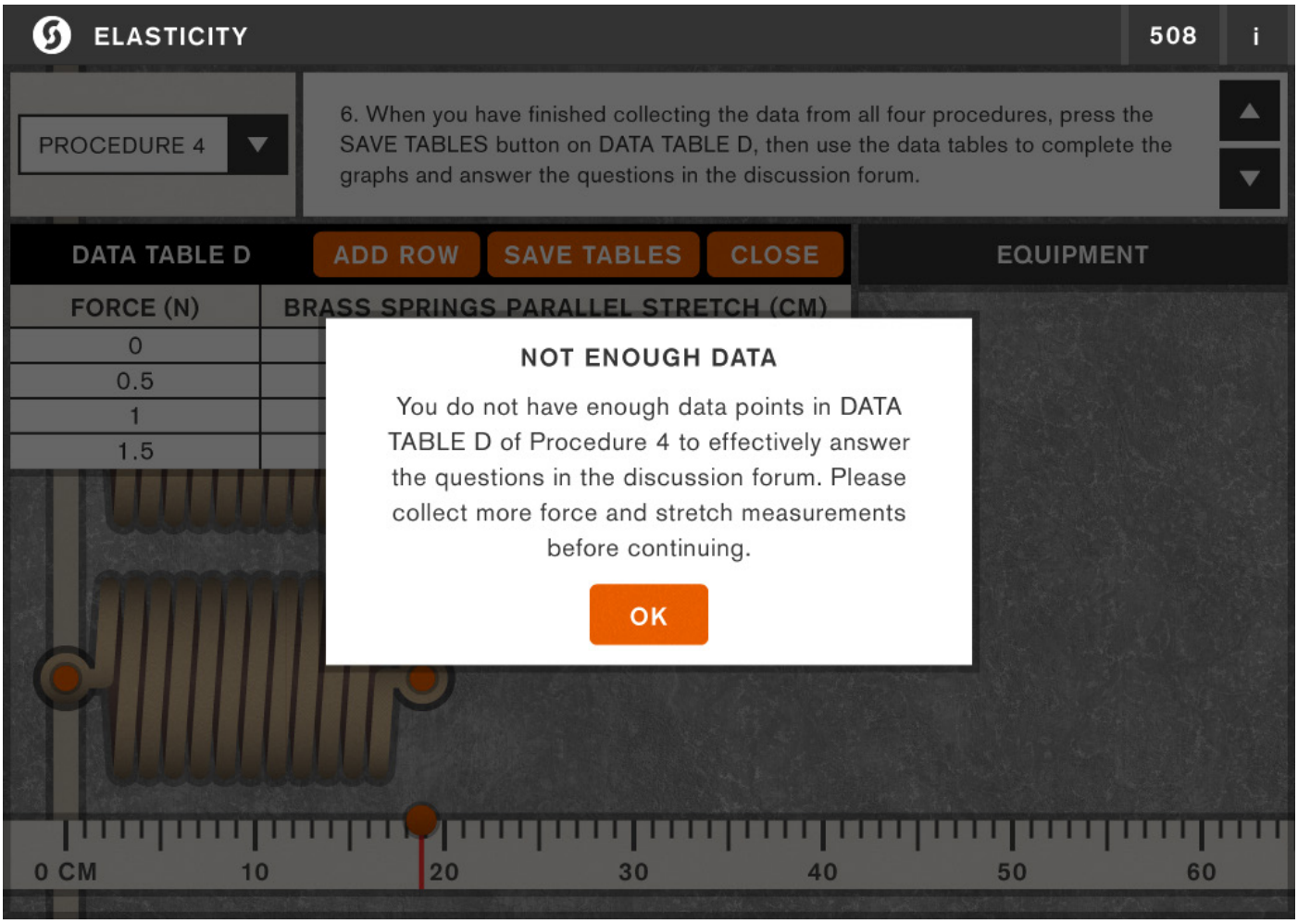
Screen 30

Procedure 4, Step 5:
"5. Collect force and stretch data as you did in Procedure 1, 2, and 3. Enter the measurements in DATA TABLE D."



Screen 31

Procedure 4, Step 6:
"6. When you have finished collecting the data from all four procedures, press the SAVE TABLES button on DATA TABLE D then use the data tables to complete the graphs and answer the questions in the discussion forum."



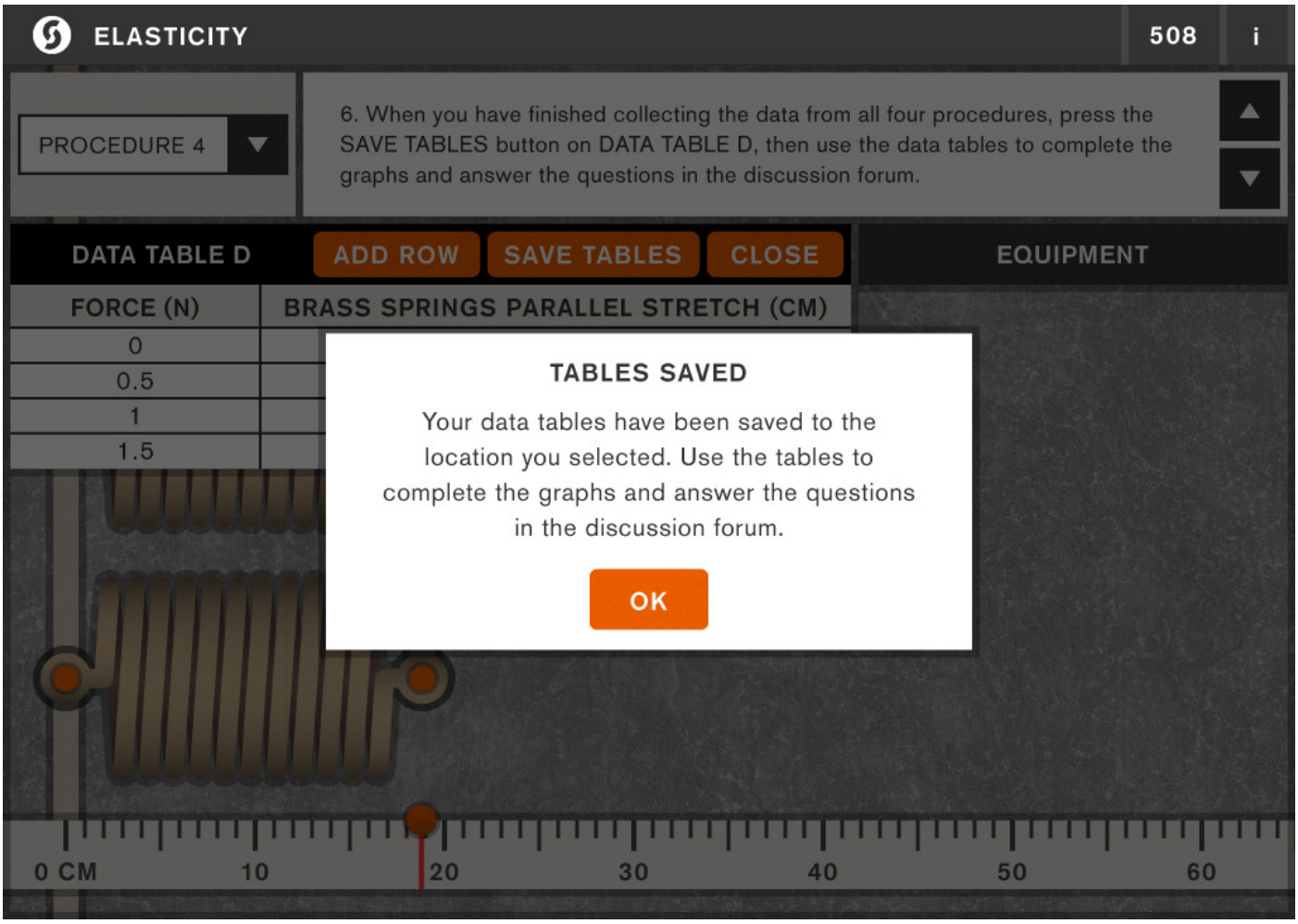
Screen 32

If the student tries saving the tables without enough information in one of their tables, a message like this will display:

"NOT ENOUGH DATA

You do not have enough data points in DATA TABLE D of Procedure 4 to effectively answer the questions in the discussion forum. Please collect more force and stretch measurements before continuing."

The message will change based on which table/procedure has incomplete data.



Screen 33

If the student saves the tables and all of them have enough data, this message will display:

"TABLES SAVED

Your data tables have been saved to the location you selected. Use the tables to complete the graphs and answer the questions in the discussion forum."