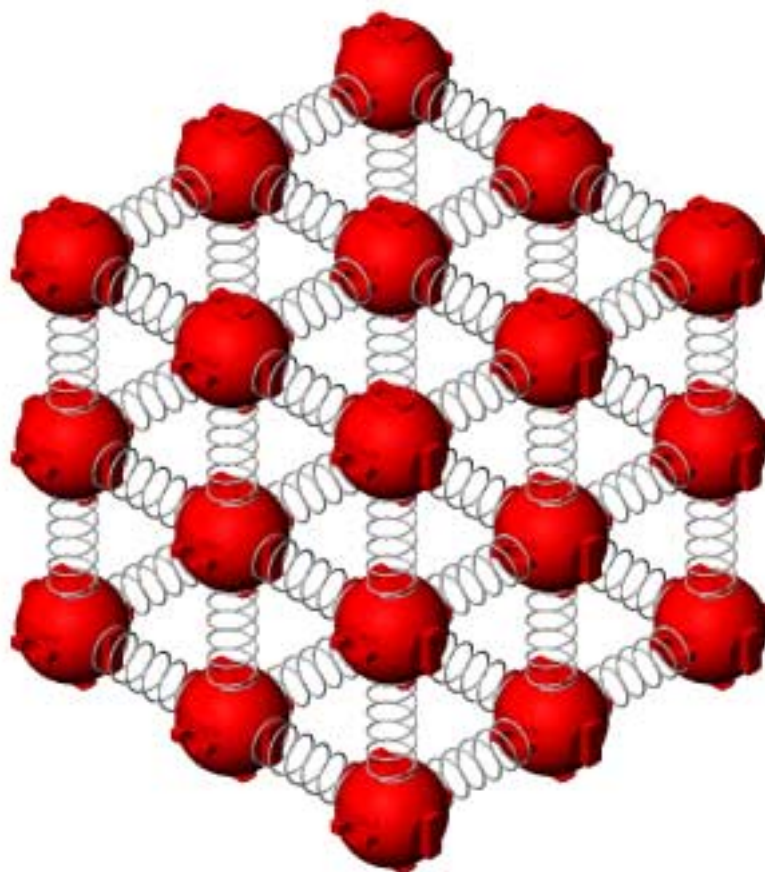




# Matter Model

Model No. ME-9825



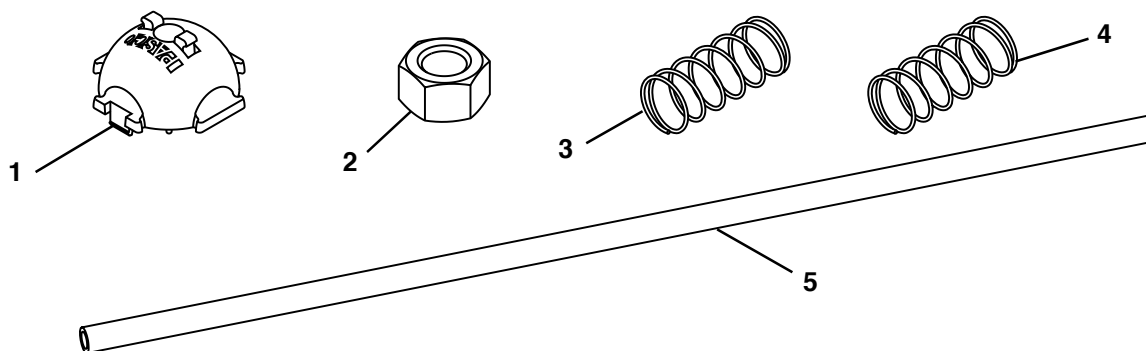
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# Matter Model

Model No. ME-9825

## Equipment List



Included Equipment	Quantity	Replacement Model Number*
1. Atom Half	80	648-07820
2. Hex nut, 3/8 - 16	30	614-080
3. Heavy Spring	60	ME-9829
4. Light Spring	60	ME-9830
5. Tube	1	648-07821

\*Use Replacement Model Numbers to expedite replacement orders.



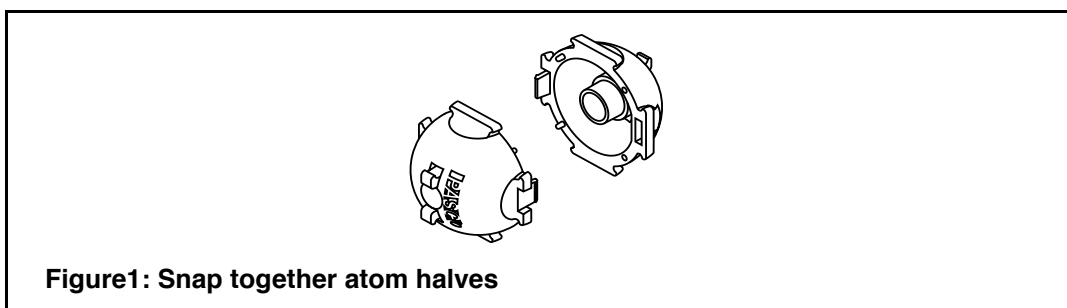
## Introduction

The PASCO ME-9825 is comprised of many components which, when assembled and reassembled in a variety of configurations, can be used to model many demonstrations. Some suggested uses can be found in the Activities section of this manual.

## Equipment Setup

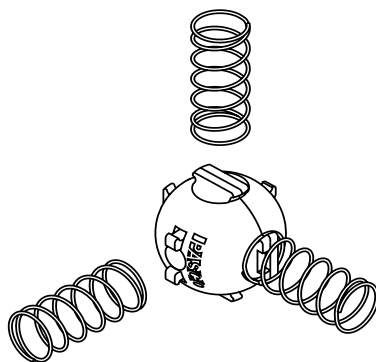
### Assembling Atom Halves

1. Position two atom halves as shown in Figure 1 and snap together.



### Building A Cubic Atom Model

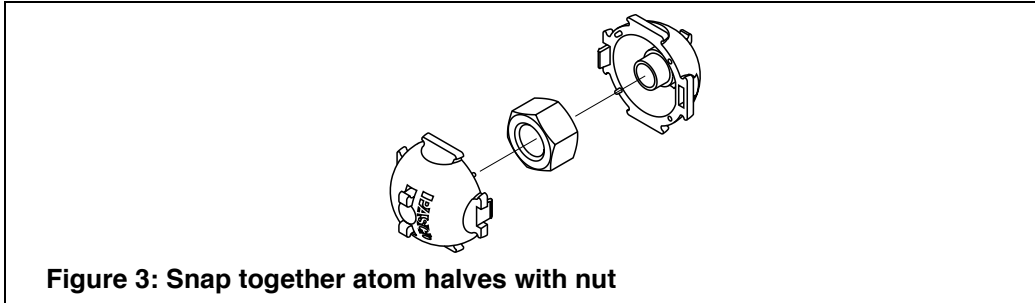
1. Seat the single closed winding at either end of a spring inside a cleat feature of an assembled cubic atom model. See Figure 2.



2. Create desired cubic atom model by alternately assembling atom models and springs.

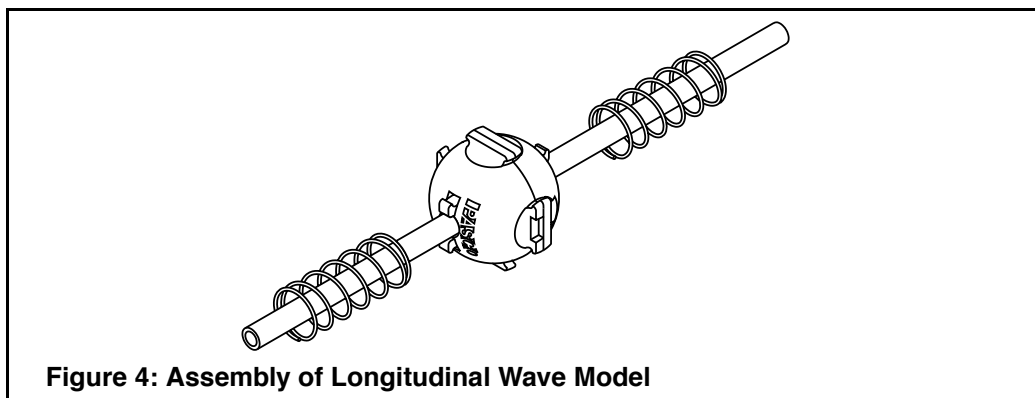
### Increasing the Mass of the Atom

1. Position one hex nut between two atom halves and snap together. See Figure 3.



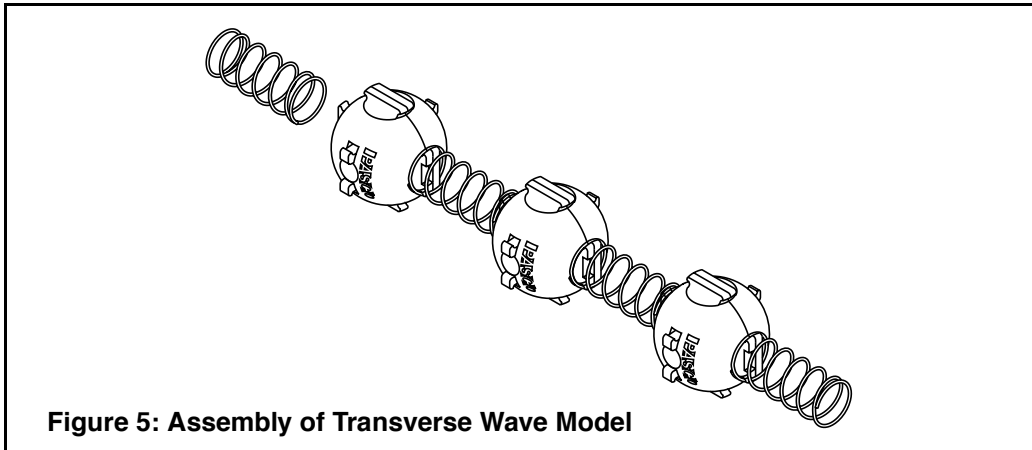
### Assembling A Longitudinal Wave Model

1. Seat the single closed winding at either end of a spring inside a cleat feature of an assembled atom model (with nuts).
2. Create desired longitudinal wave model by alternately assembling atom models and springs onto tube as shown in Figure 4.



### Assembling A Transverse Wave Model

1. Seat the single closed winding of a heavy spring inside a cleat feature of an assembled atom model. Be certain to attach springs along the seam of the atom to prevent splitting (fission) from occurring.
2. Create desired length transverse wave model by alternately assembling atom models and springs onto tube as shown in Figure 5.



## Activities

### Mechanisms of Normal Forces



**Figure 6: Demonstration of Normal Forces**

Students often have difficulty believing that solid objects, such as a table, can exert forces. Instead, they believe that the table simply "gets in the way" of the object. By using the matter model with a heavy book, students can see the atoms compress when the book is placed on it. A 4 x 3 x 2 arrangement should be used for this activity, so the matter model is more stable when the book is placed on it.

### Vibrations

The effects of vibrations can be seen quite vividly in the matter model. Any rectangular or cubic arrangement can be used. Strike the matter model with an impact force and observe the vibrational patterns.

## Torque and Shear Forces



**Figure 7: Demonstration of Torque Forces**

The effects of torque and shearing forces can be demonstrated when the matter model is constructed in a 5 x 3 x 2 configuration. In addition, when supported only on one side a cantilever can be modeled effectively.

## Wave Patterns



**Figure 8: Demonstration of a Transverse Wave**



**Figure 9: Demonstration of a Longitudinal Wave**

By connecting many atoms (without nuts) in a linear arrangement with the heavy springs, students can easily generate standing wave patterns. The atoms should be laid on a smooth tabletop or floor for this activity. The mass of each atom can be changed by inserting the included nuts.

## Wave Speed and Density

Each of the atoms is designed to allow an included nut to be inserted. In this way, students can change the density of the wave medium and observe the relationship between wave speed and density. This effect can be investigated for both transverse and longitudinal waves. Use the configuration suggested in the previous activity for transverse waves. For a demonstration of longitudinal waves, use the included brass tube, which fits through the hole in each atom. It is more effective to use the light springs for a longitudinal wave activity, since the wave speeds will be lower.

## Pressure



**Figure 10: Demonstration of Pressure**

With the atoms in a linear configuration and using the provided brass tube, turning the arrangement vertically is a nice demonstration of pressure. The lowest atoms must support the weight of all atoms above. This causes the lower springs to be more compressed, thus the atoms are closer together.