Pasta Quake Magnitude Activity
Grade Level: 3-5

Adapted from the Cascadia Earthscope Earthquake Tsunami Education Project (CEETEP) https://ceetep.oregonstate.edu

Purpose: Students will learn about earthquake magnitude by breaking different size bundles of uncooked spaghetti noodles. This activity introduces the concept of earthquake size (magnitude) and energy and an understanding that the earthquake magnitude scale is not a linear one.

Time: 30 - 40 minutes of class time to complete the activity. 60 – 90 minutes of preparation time for the teacher.

Educational Standards:
3PS2-3, 3-PS2-4, R1.3.1, W.5.9.a,b, ESS2-1, ESS2-3 MP.2,

Materials: 1 pound package of thin spaghetti or a two pound package of regular spaghetti. 4 large rubber bands Optional: plastic tarp of at least 8' diameter and a measuring tape.

Computer and computer projector and screen

•Materials explanation: You will need a single strand of pasta (representing a magnitude 5 earthquake on the Pasta Magnitude Scale [M5], a bundle of 30 [M6], and a bundle of 900 [M7] – this is an M6 multiplied by 30[M7]

Procedure:
1. Prepare your pasta bundles ahead of time.
(a) Do this yourself or organize students into groups to make a minimum of 30 bundles of 30 strands of spaghetti. This will allow you to demonstrate the energy in an M5 (1 strand), an M6 (30 strands) and an M7 (900 strands) earthquake.
(b) To demonstrate the energy of an M8 earthquake, you will need 900 bundles of 30 strands each (27,000 strands) – rather than making this M8 bundle, show the video link here for a visual of this large bundle: https://www.iris.edu/hq/inclass/video/pasta_quake_modeling_magnitude_scale_using_spaghetti this video includes visual demonstrations of an M5, M6, M7, M8 and an M9 earthquake.
(c) Another way to demonstrate the magnitude of an M6, M7, M8 and an M9 earthquake is to cut circles out of a tarp with the diameter of the bundle specifications listed here:

Pasta Quake Math

Magnitude	Strands of Spaghetti	Diameter of the bundle=tarp

		diameter
5	1	
6	30	1.2 cm = 0.47 in
7	900	6.8 cm = 2.67 in
8	27000	38.47 cm= 15.14 in
9	810,000	217.62 cm = 85.68 in = 7ft 14in

2. As part of your preparation, go to: https://www.iris.edu/hq/inclass/video/pasta_quake_modeling_magnitude_scale_using_spaghetti for a video demonstration of the Pasta Quake Activity as well as an explanation of how to model the difference between a magnitude 6 and a magnitude 9 earthquake. (Please note the demonstration is using the value of 30 to demonstrate differences in magnitude while more accurate multiplier is 32.)

3. To Do and Notice with students-
[adapted from https://ceetep.oregonstate.edu/sites/ceetep.oregonstate.edu/files/10-pasta_quake.pdf]

Complete this activity with the students, demonstrating what to do and having students complete the activity for a Magnitude 5 and Magnitude 6 earthquake. Consider demonstrating the magnitude 7 earthquake (with 900 pieces of spaghetti) as this bundle is spaghetti resource intensive!
(a) Hold up one piece of spaghetti. Bend the piece between your hands until it breaks. Notice the work it takes to break the spaghetti. Call this a 5 on the Pasta Magnitude scale. Hold up a bundle of 30 pieces of spaghetti. Bend the bundle until it breaks. Notice the work it takes to break the bundle. If the pasta magnitude scale were like the earthquake magnitude scale this would be a Pasta Magnitude 6 break. Hold up 900 pieces of pasta, the remainder of the package. Bend the bundle until it breaks. Notice the work it takes to break the bundle. This is a Pasta Magnitude 7 break.

(b) Explain to the students - What's Going On? *{for the teacher: The magnitude scales for earthquakes are logarithmic scales. In particular for the Richter scale, each increase of 1 unit on the scale, say from 6 to 7, represented an increase of one order of magnitude, i.e. times 10, in the amount of motion recorded on a particular type of seismograph. The now-common Moment Magnitude scale was defined because the Richter scale does not adequately differentiate between the largest earthquakes. The new "moment magnitude" scale is a new technique of using the Richter scale.}*
•In the moment-magnitude scale a magnitude increase of one unit corresponds to a factor of 30 increase in the energy released by the breaking of the fault in an

earthquake. That's why we increased the number of spaghetti noodles from 1 to 30 to 900 (900 =30 x 30).
•So What? In order to release the energy of one M 7 earthquake you would have to have 30 M 6 quakes or 900 magnitude 5's. Notice also all the little "quakes" before and after the big-quake break. In this model, what does the spaghetti represent? (The earth, rocks, tectonic plates) What do your hands represent? (Forces, stress, another plate) What does the breaking spaghetti represent? (An earthquake)

4. Review the video
https://www.iris.edu/hq/inclass/video/pasta_quake_modeling_magnitude_scale_using_spaghetti following the activity to reinforce what the students (or you) did to demonstrate earthquake magnitude.

5. Ask students to explain orally or in writing what the breaking of the spaghetti strands represents in terms of an earthquake. Have students write a summary comparing different earthquake magnitudes, based on their experiences in this Pasta Quake Magnitude activity. Include their interpretation of a magnitude 9 as in the Japan 2011 earthquake in the Kamome story.

Extension Activities:
1. Hands-on Activity: Magnitude of the Richter Scale
https://www.teachengineering.org/activities/view/cub_natdis_lesson03_activity4

2. Hands-on Activity: Testing Model Structures: Jell-O Earthquake in the Classroom
https://www.teachengineering.org/activities/view/cub_natdis_lesson03_activity1

3. For the teacher: Seismic Wave Energy in Earthquakes Energy Equivalents graphic
https://earthquake.usgs.gov/learn/topics/mag-intensity/images/Mag-Energy-Freq-lg.gif

4. For the teacher or as a class demonstration: For an online - Try It Yourself Calculator - to compare earthquake magnitudes
https://earthquake.usgs.gov/learn/topics/how_much_bigger.php

5. Exploring energy further: Check out the activities in the Teach Engineering Curriculum for grades 3 – 5
https://www.teachengineering.org/curricularunits/view/cub_energy2_curricularunit