EARTH SCIENCE

Stress Fractures

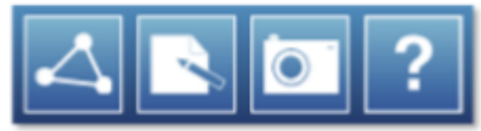
Plate Tectonics

Sally Ride Science

PASCO

012-13210A

Help System



Save, export, print, or submit your work.

Store your snapshots in the journal.

Take a screenshot when you see SNAPSHOT.

Browse the help system.

In Your World

You probably have seen news coverage of the aftermath of a major earthquake. The destruction is not uniform. Some buildings survive intact. Others have jagged cracks or sharply tilted walls. Still others are reduced to rubble.

Big earthquakes pack an awesome destructive power. But where does a quake get its energy? And what determines how buildings respond to all that stress?

Introduction

Slipping and Sliding

Slow and steady – that's how Earth's tectonic plates move. But sometimes the effects of this motion are sudden. Not surprisingly, most of the action happens along the plate edges.

When plates move, their motion puts incredible stresses on the crust. It's a little like stretching a rubber band. As you pull and pull, the rubber band stretches and stretches. It stores energy. Then suddenly – *snap!* – it breaks, and energy is released. *Ouch!* Earth's crust stores energy in a similar way. When the crust gives, however, the effect is bigger than just a snap.

Energy builds up where two tectonic plates meet. What happens when that energy is released?

Introduction

Stress Fractures

Crack! It's an earthquake! A quake is a sudden shift in Earth's crust along a fracture called a fault. When the crust slips, the motion sends energy rippling through the crust. Seismic waves spread out from the quake's epicenter – the point directly above where the fault slipped.

Stress from an earthquake can bend and distort building materials. If the stress is strong enough, the materials may snap. In quake-prone areas, structures and roads must be specially designed and built to survive seismic stress.

Now it's your turn – using pasta as a model, explore how much stress materials of differing shapes can withstand.

An earthquake left a crack in this brick wall. Would you choose bricks for a building in an area with lots of quakes?

Materials and Equipment

Each group needs these materials.

- Force sensor
- Rubber bumper accessory
- Fettuccine, dry (4 pieces)
- Linguine, dry (4 pieces)
- Spaghetti, dry (4 pieces)
- Angel hair pasta, dry (4 pieces)
- Blocks or textbooks (4 to 6)
- Tape
- Ruler
- Safety goggles for each student

Safety

Add this rule to your regular classroom procedures.

- Wear safety goggles throughout the investigation.

Investigation

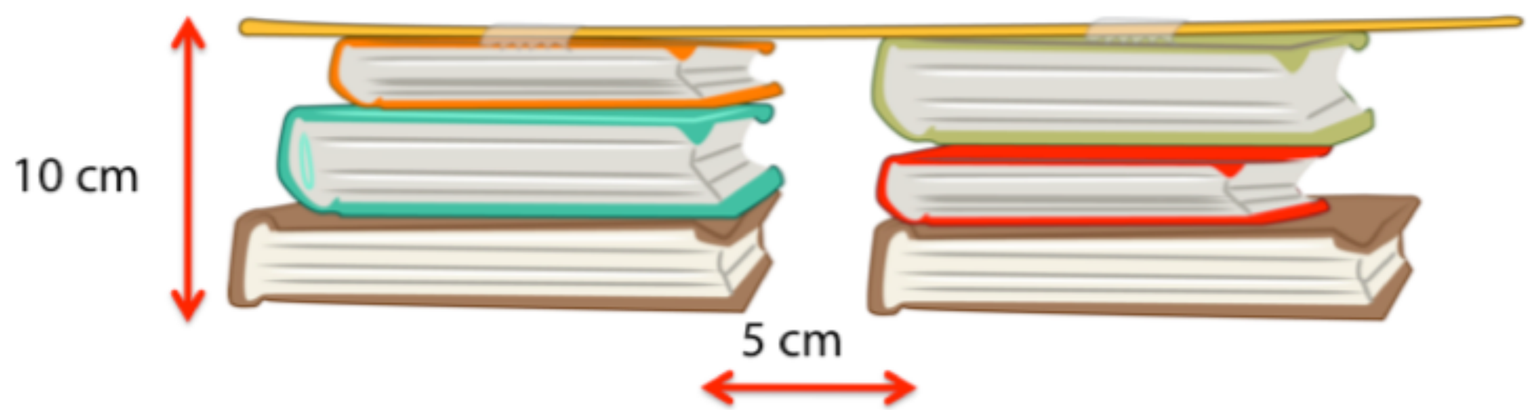
You will place dry pasta across the space between two support structures to simulate a beam in a building. You will press down on the pasta beam with the force sensor until the beam fails. Examine the types of pasta you will use. How do you think the force required to break the different types will compare? Why do you think this?

SNAPSHOT

I think . . . because . . .

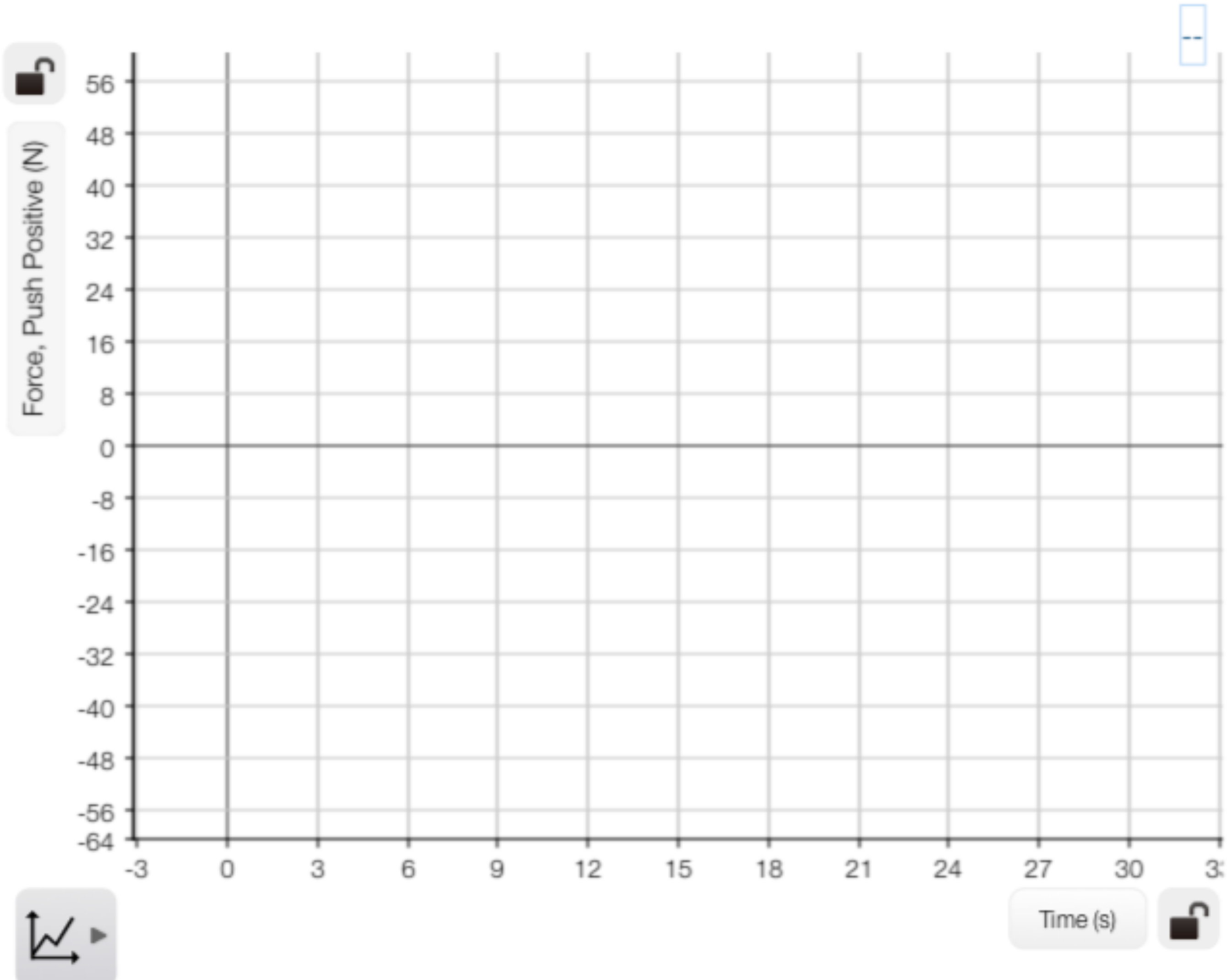
Investigation

1. Position two stacks of textbooks or blocks 5 cm apart. Make sure the stacks are at least 10 cm high and are level. These form the structure that supports the pasta beam.
2. Place a piece of dry pasta across the support structure.
3. Tape the pasta beam in place at each end so it doesn't move around when you apply force to it.



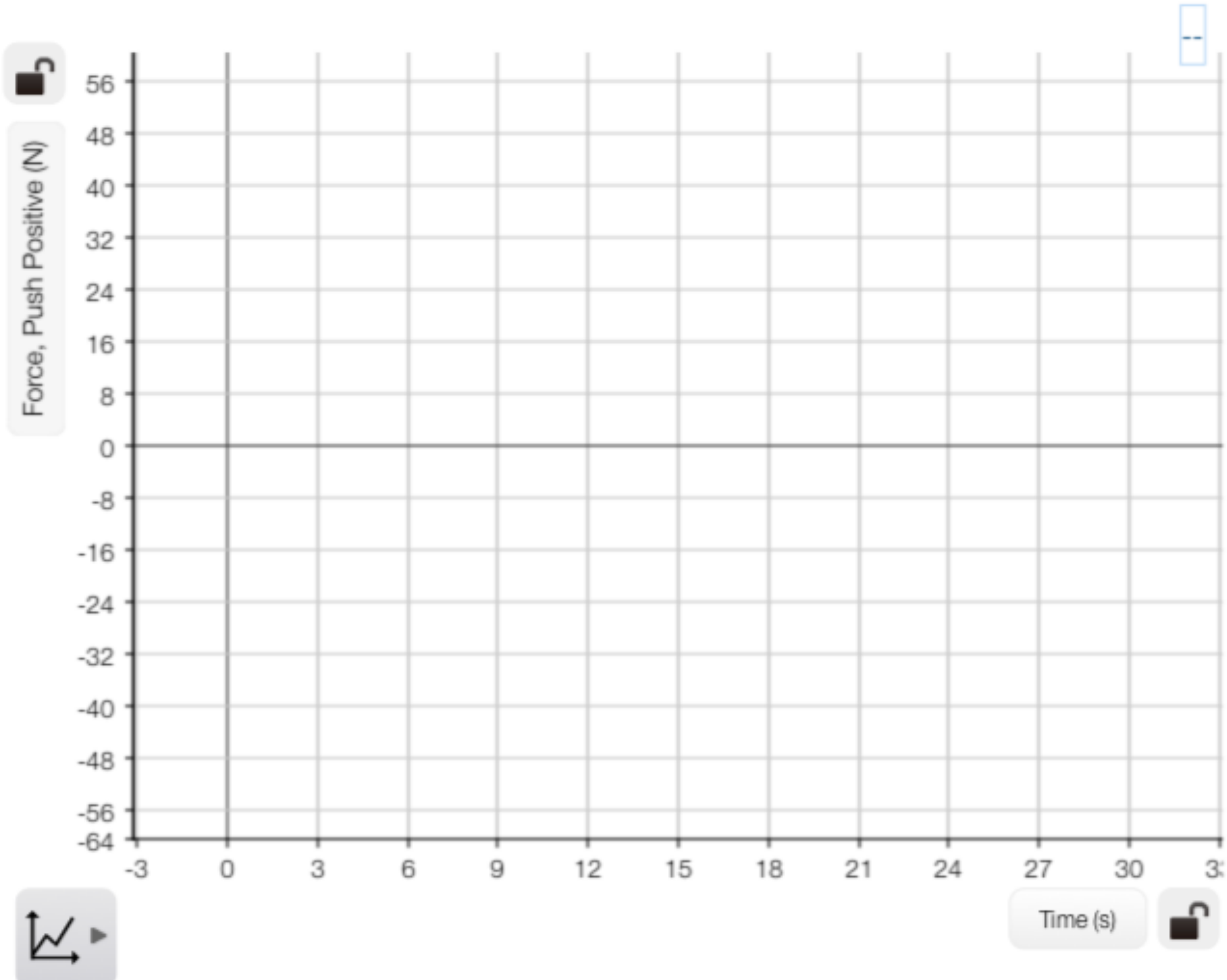
Investigation

4. You will apply a downward force in the middle of the pasta beam, increasing the force slowly and steadily until the beam snaps.
5. Holding the force sensor in a vertical position with the rubber bumper pointing down, press the zero button.
6. Turn to the next slide to begin recording data.



7. Begin recording data.
8. Press down gently on the pasta beam until it breaks.
9. Stop recording data.
10. Remove the pasta beam from the support structure.

SNAPSHOT



11. Repeat the steps for each of the remaining pieces of this type of pasta.
12. When you have finished testing this type of pasta beam, you will have four runs of data.
13. Use the graphing tools to find the maximum force you applied to each piece of pasta.

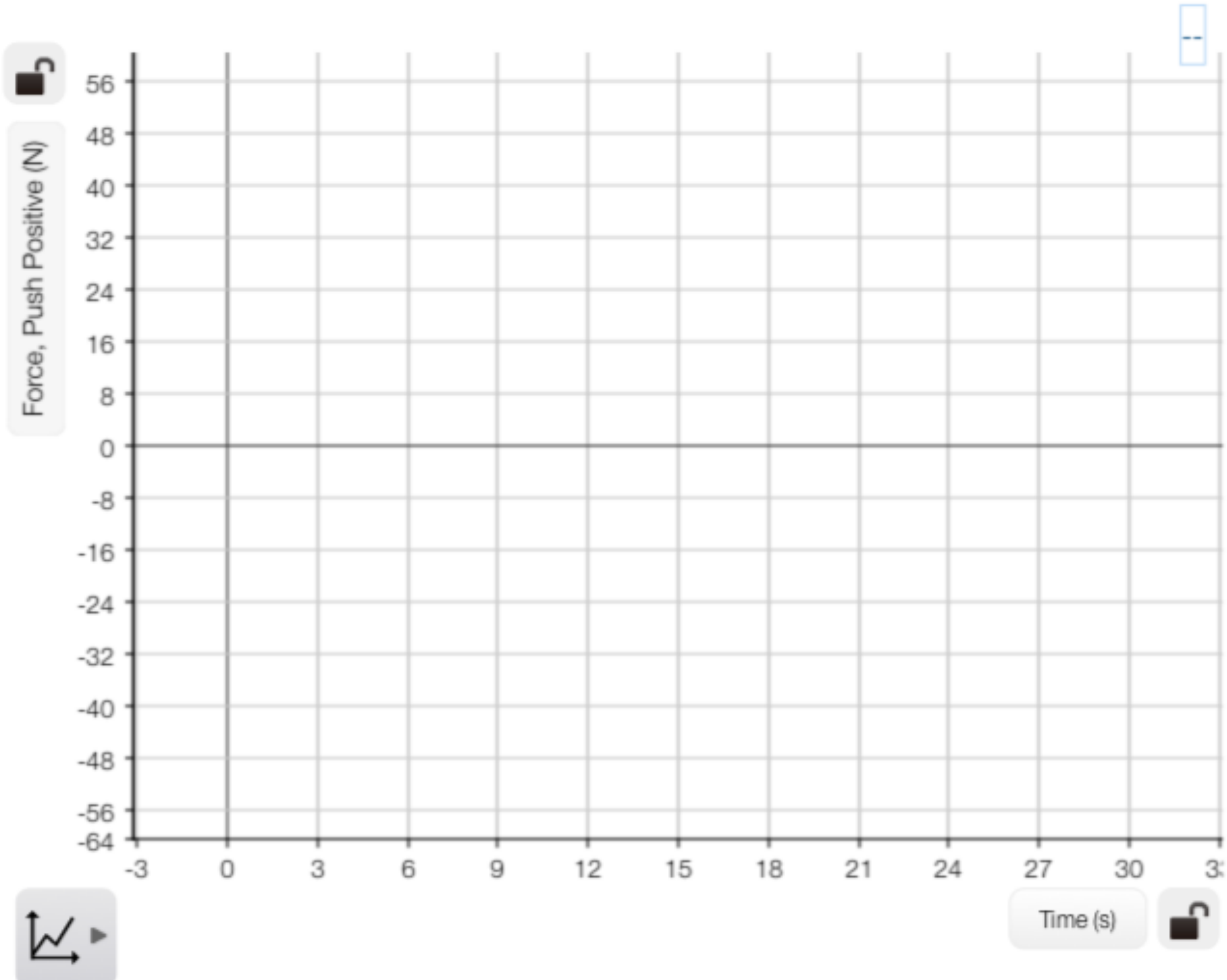
SNAPSHOT

14. Use your math skills to find the average force at which this type of pasta beam failed. Remember, to find the average, add the values and then divide the total by the number of values you added.

SNAPSHOT

The pasta type I used for this trial was . . .

The average force at which this pasta type broke was . . . N.



15. Follow the same steps to test the second type of pasta.
16. When you have finished testing this type of pasta beam, you will have four runs of data.
17. Use the graphing tools to find the maximum force you applied to each piece of pasta.

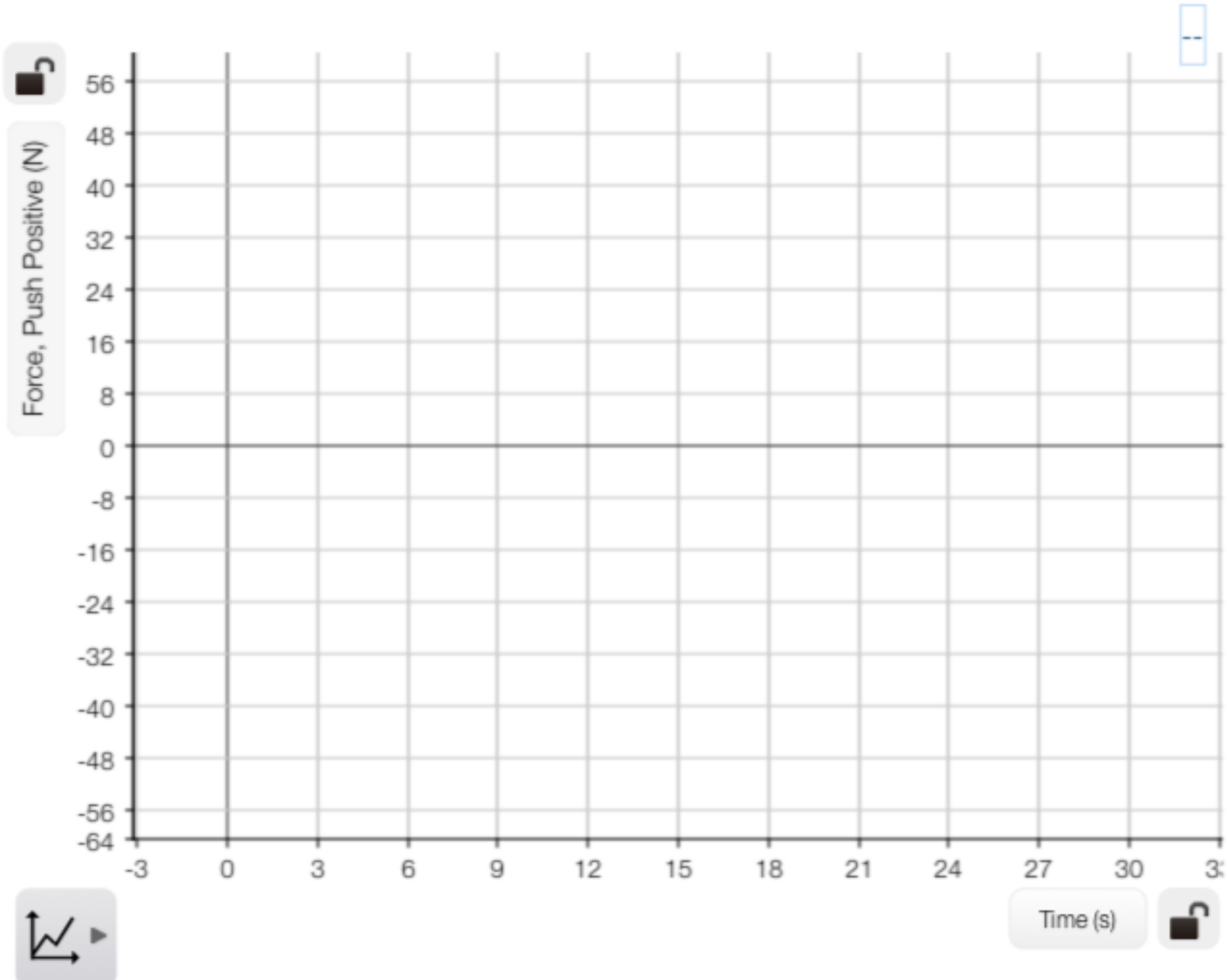
SNAPSHOT

18. Find the average force at which your second type of pasta beam failed.

SNAPSHOT

The pasta type I used for this trial was . . .

The average force at which this pasta type broke was . . . N.



19. Follow the same steps to test the third type of pasta.
20. When you have finished testing this type of pasta beam, you will have four runs of data.
21. Use the graphing tools to find the maximum force you applied to each piece of pasta.

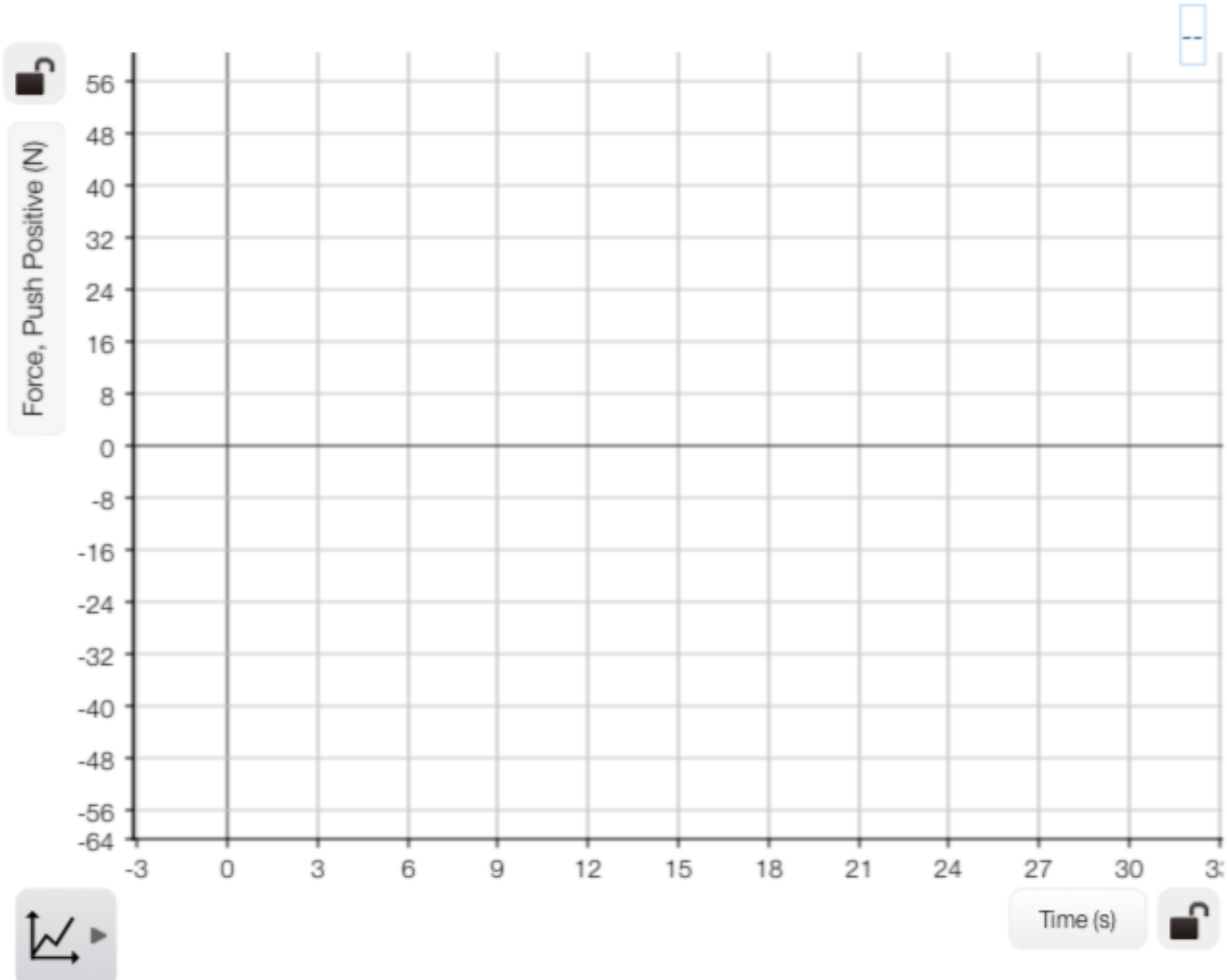
SNAPSHOT

22. Find the average force at which your third type of pasta beam failed.

SNAPSHOT

The pasta type I used for this trial was . . .

The average force at which this pasta type broke was . . . N.



23. Follow the same steps to test the fourth type of pasta.
24. When you have finished testing this type of pasta beam, you will have four runs of data.
25. Use the graphing tools to find the maximum force you applied to each piece of pasta.

SNAPSHOT

26. Find the average force at which your fourth type of pasta beam failed.

SNAPSHOT

The pasta type I used for this trial was . . .

The average force at which this pasta type broke was . . . N.

Interpretation

1. **How is the force it takes to break a pasta beam related to the type of pasta it is? Which type of pasta was strongest? How does this compare to your prediction? Suggest possible reasons for this.**

SNAPSHOT

The force it takes . . .

The strongest type of pasta . . .

Compared to my prediction . . .

Possible reasons . . .

2. **Examine the cross section of each type of pasta. Describe what you observe. How do you think the shape of a pasta beam's cross section influences its strength?**

SNAPSHOT

I observed . . .

I think . . .

3. **Force or stress on a material can cause . . .**

a) deformation.
b) bending.
c) breaking.
d) all of these.

4. **Stress on rock can occur at plate boundaries due to . . .**

a) the Earth's rotation.
b) movement of the plates.
c) unusually heavy snowfall building up.
d) different rock types coming into contact.

SNAPSHOT

Write the letter of your answer:

Explain why you chose this answer.

Write the letter of your answer:

Explain why you chose this answer.

5. **Imagine it's your job to design a new school building that can withstand a major earthquake. How could you use tests like the ones you conducted on the pasta to figure out the best shapes and materials for beams in your building?**

SNAPSHOT

To test building materials . . .