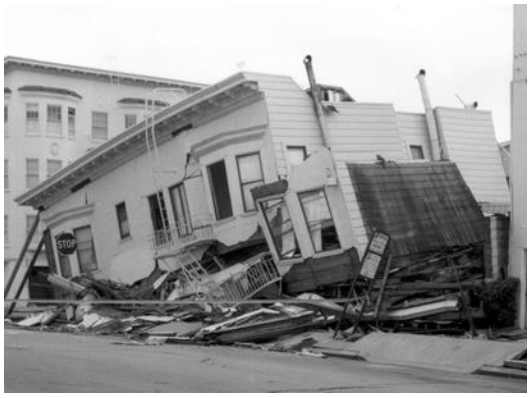
Name: _____ Date: _____

Student Exploration: Earthquake-Proof Homes

Vocabulary: base isolation, bedrock, earthquake, fault, foundation, foundation clips, frame, landfill, liquify, natural disaster, reinforced door, shatterproof glass, wetlands

Prior Knowledge Questions (Do these BEFORE using the Gizmo.)
The image shows a house in San Francisco damaged by the Loma Prieta **earthquake** in 1989.



1. Why do you think the house fell down?

   _____

   _____

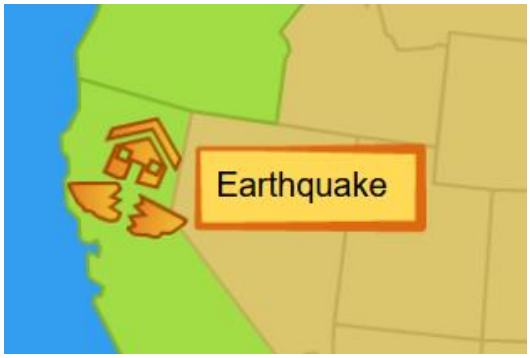
2. What do you think a builder could do to make a house less likely to fall down in an earthquake?

   _____

   _____

   _____

Gizmo Warm-up
An earthquake is a type of **natural disaster**. A natural disaster is a sudden event that can destroy homes and hurt people. With the *Disaster-Proof Homes* Gizmo, you can try to build a house that won't fall down in an earthquake.



1. Select **Earthquake**. What is a **fault**? _____

   _____

2. Select **Next**. Watch what happens in San Francisco.

   A. What is an earthquake? _____

   B. Why do you think many earthquakes happen in San Francisco? _____

   _____

Activity A: **Earthquake damage**	Get the Gizmo ready: • If necessary, select **Earthquake** on the map. • Click **Next** until you get to the **Location** choice.	

Introduction: San Francisco is a city in California that has many earthquakes. In 1906, a large earthquake started a fire that destroyed much of the city. Another large earthquake hit the city in 1989. This earthquake damaged bridges, highways, and houses.

Question: How do earthquakes damage a house?

1. Predict. Check that you are on the **Location** screen. Select **Location 1 – Bedrock**. Your first house will be built on **bedrock**, or layers of solid rock below the soil. From the **Saved houses** area, drag house **A** into the building site. House A is a basic house.

   What do you think will happen to house A in an earthquake? _____

   _____

2. Test: Click **Test house** and then click **Play** ( ). After the earthquake, what damage can you see? _____

   _____

3. Describe: Select **Show house interior** to see the inside of the house. What damage do you see inside the house? _____

   _____

   _____

4. Assess: Select **Show damage report**. Don't worry about the different components now. The **Score** describes how well the house stood up in an earthquake by comparing the cost of repairs to the cost of the house. (100% is great, 0% is bad.) How did the house do?

   Cost of repairs: _____ House cost: _____ Score: _____

5. Infer: Do you think this house would do a good job of protecting the people inside? _____

   Explain. _____

   _____

   _____

Activity B: **Earthquake-proof house**	Get the Gizmo ready: • If necessary, select **Earthquake** on the map. • Navigate to the **Build** screen.	

Goal: Design a house to survive an earthquake.

1. Predict: From the **Build** screen, click **Reset house**. Now it's your turn! Your challenge is to build a house that can get through an earthquake with the least amount of damage.

   What materials do you think you might find in an earthquake-proof house? _____

   _____

2. Build: To start your house, select a **Foundation**. The **foundation** is the base of the house. Then select options for the **frame**, walls, roof type, and roof material. If you want, you can add "extras" to the house after choosing the roof.

   List the features of your house below. What is the cost of the house? _____

Foundation		Roof material	
Frame		Extras	
Walls			

3. Test: Click **Test house** and then click **Play**.

   A. How does the outside of the house look? _____

   _____

   B. Select **Show house interior**. How does the inside of the house look? _____

   _____

   C. Select **Show damage report**. What was the score of your house? _____

4. Experiment: Select **Build**. Try to build a house with a score above 80%. When you succeed, select **Save house**. Which features did you choose?

Foundation		Roof material	
Frame		Extras	
Walls			

   What is the cost of the house? _____ What is the score? _____

(Activity B continued on next page)

Activity B (continued from previous page)

5. Compare: Select **Build** and then click the right arrow until you see the **Extras**. Experiment by building a house with each of the extra components. Explain how each "extra" feature of the house helps in an earthquake.

   Foundation clips: _____

   Shatterproof glass: _____

   Reinforced door: _____

   Of these three components, which do you think is most important? _____

   Explain: _____

6. Experiment: Select **Build** and drag house **A** into the building site. Add **foundation clips** to the house. House A has a wooden frame. Test this house, then test the **concrete** and **steel** frames. Turn on **Show damage report** and record the score of each house.

   Wood frame: _____ Concrete frame: _____ Steel frame: _____

7. Experiment: Test the four types of walls. Then test the three types of roof materials.

   Which wall was the worst? _____ Which roof was the worst? _____

8. Draw conclusions: Compare the material that was the worst for the frame, the material that was the worst for walls, and the material that was worst for the roof.

   What do these materials have in common? _____

   _____

   Flexible materials like wood and steel are better in earthquakes than materials that don't bend. Concrete, brick, and tile are likely to crack and crumble when shaken.

9. Explore: Build a house with a **springs** foundation and **foundation clips**. This foundation is also called a **base isolation** foundation. What do you notice when you test this house?

   _____

   _____

   In a base isolation foundation, the bottom part of the foundation shakes with the ground, but the top part does not move as much. Base isolation foundations are expensive and mainly used for large buildings. Only Japan has many homes with base isolation foundations.

Activity C: **Landfill**	Get the Gizmo ready: • If necessary, select **Earthquake** on the map. • Click **Next** until you get to the **Location** choice.	

Introduction: Some parts of San Francisco used to be marshes, or **wetlands**. These areas were filled in with soil to form dry land. This type of ground is called **landfill**. Houses and even tall buildings are built on landfill in San Francisco.

Question: How does the location affect how much earthquake damage occurs?

1. Predict: Which location do you think will be better for building an earthquake-proof house,

   bedrock or landfill? _____

2. Observe: Select **Location 2 – Landfill**. Build a house that you think will do well in an earthquake. Select **Test house** and click **Play**. Observe the outside and inside of the house.

   What happens? _____

   _____

   In some landfill areas, the shaking of an earthquake can cause solid ground to **liquify**, or act like a liquid. When this happens, houses can sink into the ground and break apart.

3. Compare: Turn on **Show damage report**. Record the **Cost of repairs** and **Score** for the house in the landfill location. Then select **Location**, go to **Location 1**, and test the same house in the bedrock location. Record the **Cost of repairs** and **Score** for this location.

Landfill house		**Bedrock house**	
Cost of repairs		**Cost of repairs**	
Score		**Score**	

4. Analyze: Which location is better in an earthquake? _____

   Explain your choice. _____

5. Apply: Remember the collapsed house from the beginning of this lesson? What kind of ground do you think this house was built on? Explain.

   _____

   _____

   _____