

Educate and Prepare Yourself

Earthquakes and Tsunami



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What is the Seismic Network?

It is the official local agency that monitors seismicity for Puerto Rico, the US and British Virgin Islands, and adjacent regions. It is part of the Geology Department at the University of Puerto Rico in Mayagüez and has been accredited by the US Advanced National Seismic System (ANSS). It is also an alternate focal point of information for tsunami in PR/VI as part of tsunami response protocol.



Figure 1. Puerto Rico Seismic Network Building, PRSN

Mission

To detect, process and investigate seismic activity in the Puerto Rico region, and to inform the results in a timely manner for public safety, education, engineering and scientific investigation.

Vision

To become a leader in the management of monitoring, alert and information, scientific investigation, and education in earthquakes and tsunamis for Puerto Rico and the Caribbean.



For more information, scan the QR code

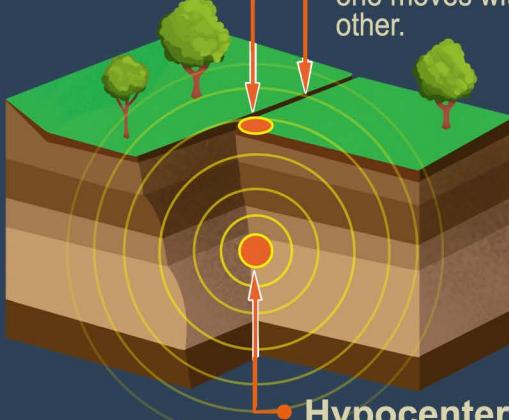
What is an earthquake?

An earthquake is a relatively quick and sudden movement generated by the release of energy from the Earth's interior. This energy moves in the form of seismic waves that result in vibrations when reaching the surface.

Physical Components of an Earthquake

Epicenter:

Point on the Earth's surface directly above the hypocenter or focus.



Geological Fault:

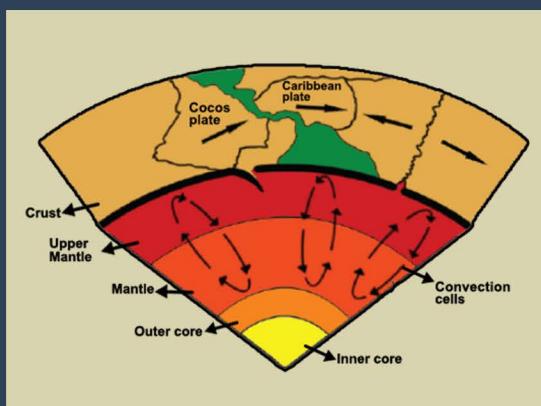
Fracture on the Earth's crust that divides two blocks of rocks, where one moves with respect to the other.

Hypocenter (focus):

Exact point in the Earth's interior where the earthquake is generated.

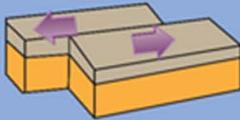
Origin of an Earthquake

Most earthquakes occur along the borders of the tectonic plates that shape the Earth's crust. The plate motion is driven by mantle convection.



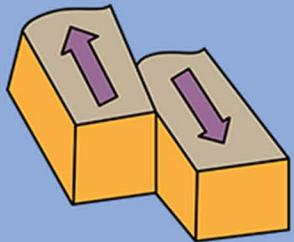
Inner Earth. Adapted from PRSN

Tectonic Plate Movements

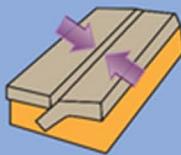


Transform Plate Boundary

Two tectonic plate move with respects to each other in opposite directions.



They move parallel to the fault.
E.g.: The San Andreas Fault



Convergent Plate Boundary

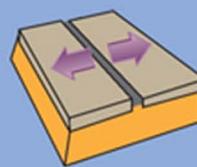
Two tectonic plate move towards the same direction, colliding. In the case of subduction, one plate descends under the other.



These crashes produce mountain chains or ranges.
E.g.: the Himalayas



Because of subduction, they also produce trenches and island arcs. E.g.: Puerto Rico



Divergent Plate Boundary

Two tectonic plate move in opposite directions.



This type of boudary produces mid-ocean ridges.
E.g.: Mid - Atlantic Ridge



This type of boundary produces rift valleys.
E.g.: Iceland Valley

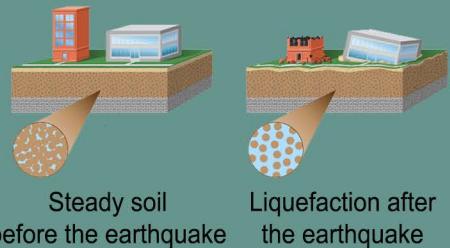


For more information scan the QR code

Most common side effects of an Earthquake

Liquefaction

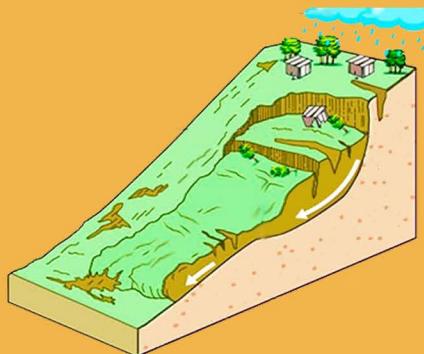
It is a process where loosely packed, waterlogged sediments such as sand, gravel, or water-adjacent zones, lose their strength when shaking occurs and behave instead like fluids.



Adapted from ingegeek.site

Landslides

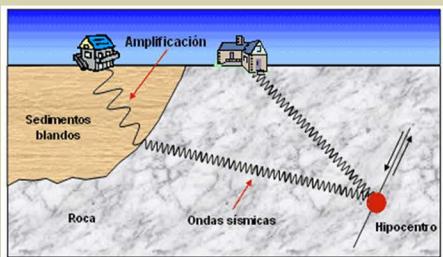
It is the sudden movement of rock, debris, or soil down a slope. Common in steep areas, loosely compacted soil, water saturated soil, and in zones lacking vegetation.



Adapted from larepublica.pe

Amplification

When seismic waves find sandy grounds or infilled lands, they slow down and increase in amplitude, making the earthquake objectively stronger there than in other zones.



From PRSN

Fires

After an earthquake, fires may occur. These are mostly due to gas leaks, short circuits, falling electric cables, and other fire hazard sources.



Adapted from 123rf.com

TSUNAMI



Tsu (port) and nami (wave). It is a series of waves generated by a sudden disturbance or violent activity in the ocean that displaces water as a vertical column.

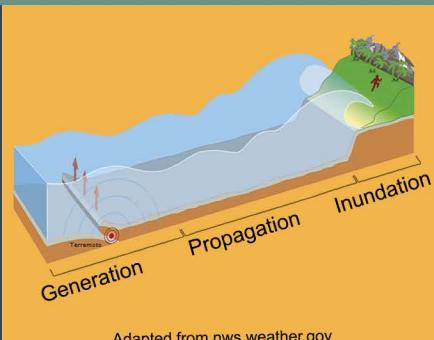
Sources of tsunamis:

TSUNAMIGENIC EARTHQUAKE

Generation: Massive displacement of water caused by a sudden release of energy along a submarine fault.

Propagation: The tsunami's travel towards different directions.

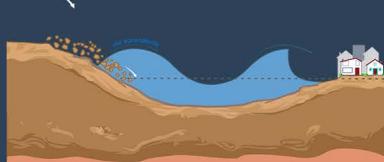
Inundation : When the tsunami's waves move inland.



Adapted from nws.weather.gov

LANDSLIDES

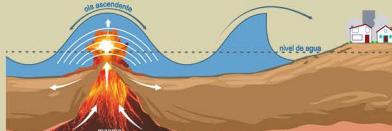
Caused by soil, rocks, or ice breaking off mountains or cliffs and sliding towards the water. E.g.: Alaska tsunami in 1958 at Lituya Bay.



Adapted from
<https://www.dhn.mil.pe/cnat/que-es-un-tsunami>

VOLCANOES

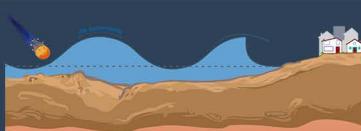
Caused by the eruption of submarine volcanoes or the collapse of a superficial volcano's flanks. E.g.: Indonesia tsunami in 2018 caused by the Anak Kratoa volcano.



Adapted from
<https://www.dhn.mil.pe/cnat/que-es-un-tsunami>

METEOR

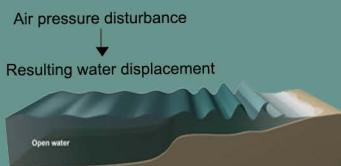
When a meteor or spatial garbage impacts the water.



Adapted from
<https://www.dhn.mil.pe/cnat/que-es-un-tsunami>

METO-TSUNAMI

Also known as a meteorological tsunami, it is large waves generated by rapid changes in barometric pressure, causing the displacement of water. E.g.: Commonly seen in the Great Lakes.



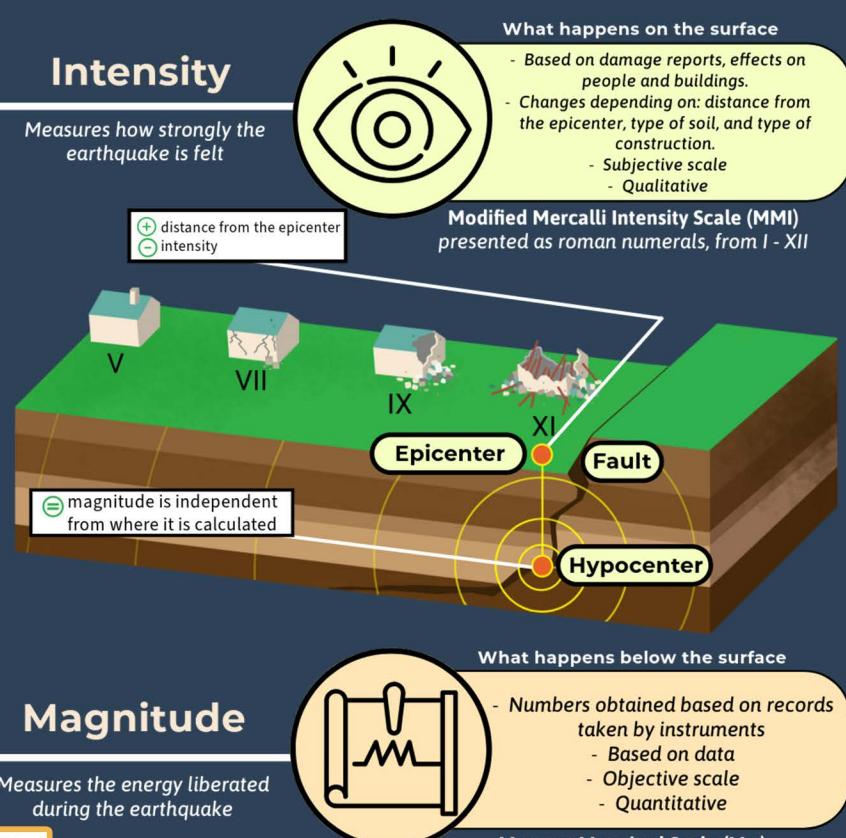
Adapted from The COMET Program

MONITORING

EARTHQUAKES

The PRSN monitors local seismicity in PR, the Virgin Islands, and all nearby zones through seismic stations. A seismic station is composed of a seismometer and a digitizer, which receive signals generated by earthquakes and turn them into digital signals that scientists can analyze. Other instruments, such as accelerometers, GPS, and GPS-GNSS receivers, also complement these stations.

Magnitude vs Intensity



ANALYSIS

TSUNAMI

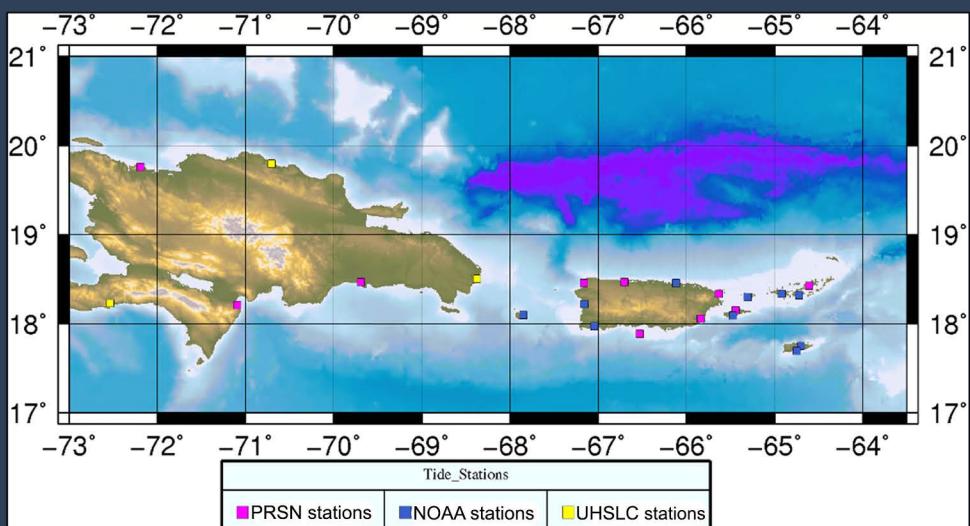
The PRSN operates a sea level monitoring system to observe changes caused by disturbances on the sea floor. The main instrument used for this is the tide gauge, which is equipped with sensors for temperature, pressure, and wind, as well as radars and digitizers.

The PRSN obtains the data from local tide gauge stations as well as the ones located in the Caribbean Sea and the Atlantic Ocean. Data from Dart Buoys (NOAA) and GPS stations are also received.

These instruments work together to detect and confirm the generation of tsunamis.



Tide gauge station in Guayanilla, PRSN



Map of Puerto Rico with the marked locations of tide gauge stations

Historical Earthquakes

1787

May 2, felt Islandwide, structural damages to several churches.

1867

November 18, east of PR, earthquake magnitude 7.3 and intensity VIII. A tsunami was generated.

1918

October 11, earthquake magnitude 7.3 in the Mona Canyon fault. A tsunami was generated.

1943

July 29, felt Northeast of PR with magnitude 7.5

1979

May 23, earthquake intensity VI, near Mona Island.

1987

May 30, earthquake magnitude 4.6 and intensity VI, with epicenter in Boquerón.

2010

May 16, earthquake magnitude 5.8 in Moca and December 24, earthquake magnitude 5.4 in Aguas Buenas.

2014

January 13, earthquake magnitude 6.4 with epicenter in the 19° North Zone fault.

2020

January 7, earthquake magnitude 6.4 in southwestern Puerto Rico.



To learn more about other historical earthquakes in Puerto Rico,
scan the QR code.

in Puerto Rico

1918



2020

- Friday, October 11, at around 10:14 am on San Fermín Day.
- Originated in the Mona Canyon, Northwest of Puerto Rico.
- Approximately 7.3 magnitude, with a maximum intensity of IX felt Islandwide.
- Generated a tsunami with waves as high as 6 meters in Aguadilla. It also caused landslides, amplification and liquefaction.
- About 116 fatalities and about 4 million dollars' worth of damages to infrastructure.
- Thousands of aftershocks followed, the strongest ones being on October 24 and November 12.



- Tuesday, January 7, at 4:24 am.
- Originated in a Southwestern fault zone.
- 6.4 magnitude with maximum intensity of VIII in Guánica, felt Islandwide.
- A non-noticeable local tsunami was registered on PRSN equipment. It also caused landslides, amplification and liquefaction.
- One death directly associated with the earthquake, others due to secondary effects. Losses of up to 400 million dollars.
- Generated tens of thousands of aftershocks for a long period of time, estimated to continue for at least a decade (2030).



What to do NOW?

If an earthquake and/or tsunami occurs

Develop seismic awareness

Be vigilant in case an earthquake or tsunami occurs when you are not home. Do a visual screening wherever you go and identify places where you can protect yourself, away from structural and non-structural dangers. Identify emergency exits and check if your location is within the tsunami evacuation zone.

Identify dangers by:

LOCATION

Check if you live within a tsunami evacuation zone or in a mountainous area.



Obtained from
temblor.net



Obtained from dw.com



Collapsed building in Ponce, by Noticel

TYPE OF STRUCTURE

Check the stability of your home, workplace, etc or seek professional help from a structural engineer or an expert in this field who can evaluate your case.

NON-STRUCTURAL DANGERS

This refers to every component added to the house that might fall, break, or cause injuries. Identify those hazards and repair them.



CREATE YOUR EMERGENCY PLAN

An emergency plan is a useful guide to get organized and be prepared now, during, and after an emergency.

Things to consider:

- Make a list including every member in your household, indicating their regular locations, phone numbers, health issues, chores, etc.
- Determine a meeting place or assembly point. In case of a tsunami, familiarize yourself with your evacuation map, practice your evacuation route, and measure the time it takes to get out of the tsunami area.



Scan here to find your evacuation map

Tsunami evacuation map for Añasco, PRSN

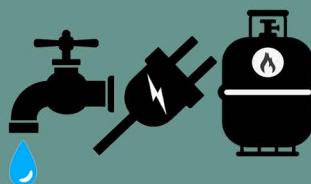
- Know the tsunami alert levels and the recommended actions to take for each.



No tsunami impact expected No action required	Unknown impact from a distant tsunami source Stay tuned for more information	Strong currents and dangerous waves expected from a distant tsunami Stay out of the water and away from ports and marinas	Danger! Tsunami imminent, the coasts will flood Move immediately to high grounds
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CREATE YOUR EMERGENCY PLAN

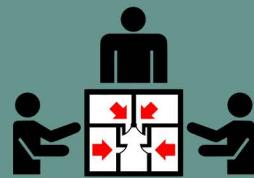
- Prepare and identify areas where you can protect yourself and practice safety skills at home. For example:



Check that water, gas and electricity services are working properly and learn how to close and turn them off.



Have functioning fire extinguishers



Identify and locate emergency exits and evacuation routes

- Have more than one method to receive and issue information to alert family, neighbors, employees, etc.



AM/FM Radio
NOAA Radio



Loudspeakers
(or: megaphones)
Intercom system



Motion sensing lights



Walkie Talkie

- Participate in exercises and drills. The PRSN performs two annual exercises where you can participate.

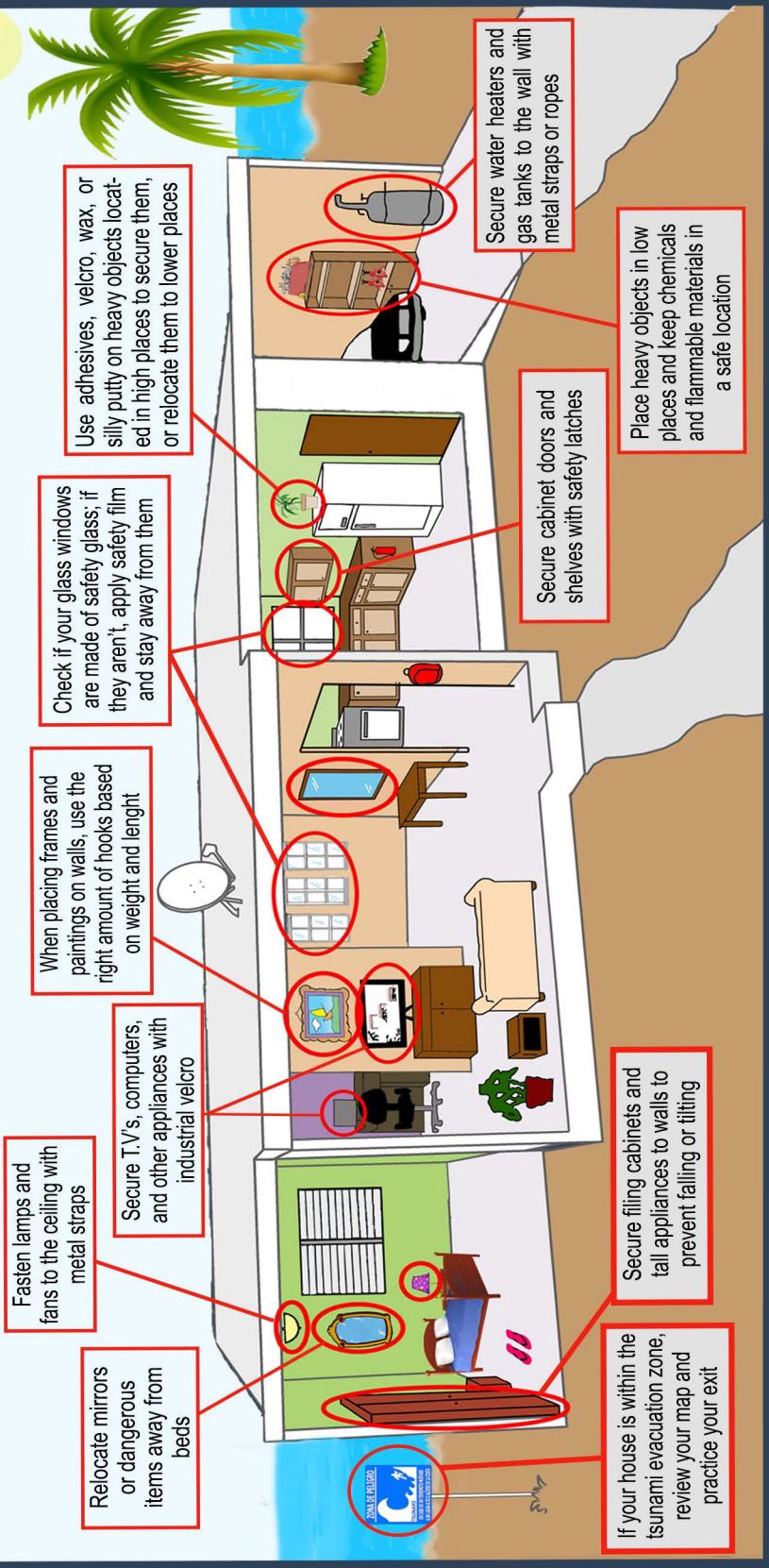


- March
- Participate and register in:
tsunamizone.org



- October
- Participate and register in:
shakeout.org/puertorico

Hazard mitigation



Adapt these recommendations to your house, workplace or school; remember, earthquakes and tsunamis are unpredictable and you may be away from home.

Emergency Safety



Food and water



Prescribed medication and painkillers



First aid kit



AM/FM NOAA radio



Green and red paint



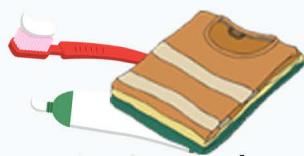
Important documents



Whistle



Flashlights and batteries



Clothes and hygiene products



Disinfecting products and face masks



Games



Money



Scan the QR code for more information

It's recommended to:

- Keep the bag accessible
- Have more than one if necessary
- Keep it updated

- Take it when evacuating
- Adapt it to your specific needs
- A backpack with wheels can be used

Backpack

For Pets



Blanket or towel



Hygiene products



Health documents and pet's picture



Food



Bowl for food and water



Cleaning products to discard waste



Medication



Toys



Crate for transport

Make sure that your pet is identified and that their vaccines are up to date. Protect them.

Emotional

An imaginary bag that consists of emotions, thoughts, and perceptions that determine our capacity to respond in an emergency.



RECOMMENDATIONS

For people with special needs and the elderly

Visual impairment or legal blindness



Move slowly, paying attention to obstacles.
Have a buddy system to assist or ask for help



Put an extra pair of glasses in your backpack



Write your emergency plan using large letters, use images or color codes

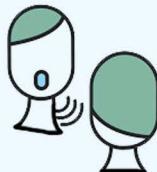


Carry out evacuation drills and walk the evacuation routes with your guide dog

Hearing impairment



Have extra batteries for your hearing devices



If you need to help someone with hearing difficulties, stand face to face and speak clearly, articulating each word



Learn different ways to communicate



Ease lip reading by using a flashlight or lamp

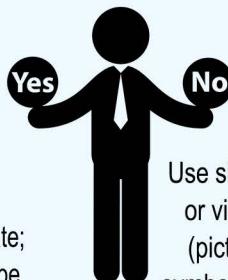
Cognitive impairment



Be patient to understand what they're saying



If possible, help them evacuate; their sense of direction may be limited



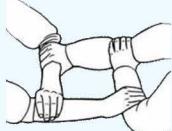
Use simple short words or visual information (pictures, drawings, symbols) when giving an instruction

Physical Impairment



Move away from objects that may fall, lock the wheelchair breaks and protect head with arms

If you have to move a person in a wheelchair, secure them to it with its buckle or safety straps



If you have to move a person without a wheelchair, find help and carry them making a chair-like frame with your arms



If evacuating on stairs alongside a person with a cane, offer your shoulder for support and do not remove their hands from the handrail or cane

Elderly and children



Consider food specifications, medications, and how to store them



Keep frequented areas free from obstacles and objects that could fall and cause harm



If possible, get essential health devices that are portable and/or battery operated. Keep the instructions on how to use them and show others how they work



Have a list with your physician's name and contact information, as well as information about your health plan and medications taken

Take control of your safety, get prepared now

WHAT TO DO DURING?

In case of an Earthquake



“DROP, COVER and HOLD on” when you feel an earthquake, and stay protected until the movement stops. Keep your eyes and mouth closed to protect them from debris.

If there's no place where you can seek protection, look for corners reinforced by columns, drop to the ground, and cover your head with your arms.



If you have to exit the building, wait until the earthquake stops. Find an open space away from trees, buildings and electric wires. Avoid using stairs and elevators.

If in a vehicle:



- Pull over to the side of the road, shift into “park”, apply the breaks, and stay inside the vehicle until the shaking stops.
- Turn on the radio to get updated information on the emergency.
- Avoid bridges and slopes.

Do not run; during a strong earthquake you may experience dizziness and loss of balance.



WHAT TO DO DURING?

In case of a Tsunami



Be aware of natural signs:

- Strong and lengthy earthquake (20 seconds or longer).
- Sudden change in sea level.
- Loud sound coming from the sea.



Follow the designated routes toward your assembly site or walk inland to a higher place (**horizontal evacuation**).



If the tsunami is so close you are unable to walk inland, walk up a structure that is at least four stories high (**vertical evacuation**).



If in a vehicle:

If you are within the evacuation zone, get out of the car and look for a higher place, somewhere away from the coast, an assembly point, or opt for vertical evacuation.



In a ship or boat:

If at the port, consider getting out of the ship immediately, otherwise stay in deep waters of at least 600 feet in depth.



Scan to see the Harbor and Maritime Community Guide for Tsunamis (only available in Spanish)

WHAT TO DO AFTER?

In case of an EARTHQUAKE or TSUNAMI



Stay calm



Beware of aftershocks



Offer first aid only if possible; remember to put your own safety first



Keep an eye on the news and tsunami warning levels



Avoid making unnecessary phone calls, send a text message instead



Cooperate with authorities



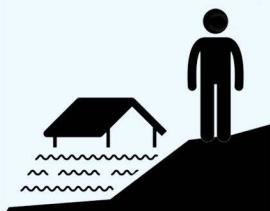
Do not wander or put your life in danger



Check for damages at your home, work or frequented places



Update your emergency plan and safety backpack



Evacuate to high places and do not return to tsunami prone zones until an "all-clear" has been issued by the pertinent authorities

Emergency phone numbers:

9 -1-1

**Puerto Rico Emergency Management and
Disaster Administration Agency (NMEAD)**

787-724-0124

Puerto Rico Police

787-343-2020

American Red Cross

787-759-7979; 787-758-8150

State Medical Emergencies

787-754-2550

Firefighters

787-722-1120

Find additional information in:

www.redsismica.uprm.edu

www.earthquakecountry.org

www.ready.gov

Puerto Rico Seismic Network



787-833-8433



educación@prsnmail.uprm.edu



/redsismicadepuertorico



redismicapr



Scan me

The suggestions and illustrations presented here are shown only in an attempt to increase preparedness and seismic awareness. Therefore, this does not guarantee an individual or a structure's safety.



Designed by Jesenia M. Figueroa Nieves
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