Resource Material on Management of Disasters

Earthquake



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About the Series

A disaster is an event caused by the sudden disruption of normalcy within society resulting into widespread damage to life and property. Sometimes we also face accidents that are so serious that they have a long term effect on life and property. To avoid such accidents we need to be cautious in our day-to-day activities.

In this series, an attempt has been made to raise awareness in order to handle these disastrous situations effectively so as to minimise losses.

This series comprises of ten booklets covering different areas such as earthquake, landslide, tsunami, flood, draught, fire and accidents, chemical hazards, epidemics like swine flu, malaria and dengue, food poisoning and cholera. You will notice that the topics selected here do not include all the issues related to disaster. These are only illustrative cases. This is because the idea is to impart necessary information to develop skills to enable people to prevent disasters or to reduce their impact by efficient handling of such situations.

Simple and communicative language has been used in the entire series so that children in the age group of 10–16 years can understand it effectively. We hope that the readers will benefit from this material and have confidence to handle such kind of situations proving to be smart and responsible citizens.

It is suggested that the teachers and facilitators use this series as an example to develop related material for school projects. The teachers could also share these projects and hold awareness programmes for the community with an aim to initiate continuous participation when such situations arise.

The Council also welcomes the suggestions from the users of this material.

Earthquake



Rizwan



Teacher



Saumya

विद्यया ऽमृतमश्नुते

एनसीईआरटी
NCERT

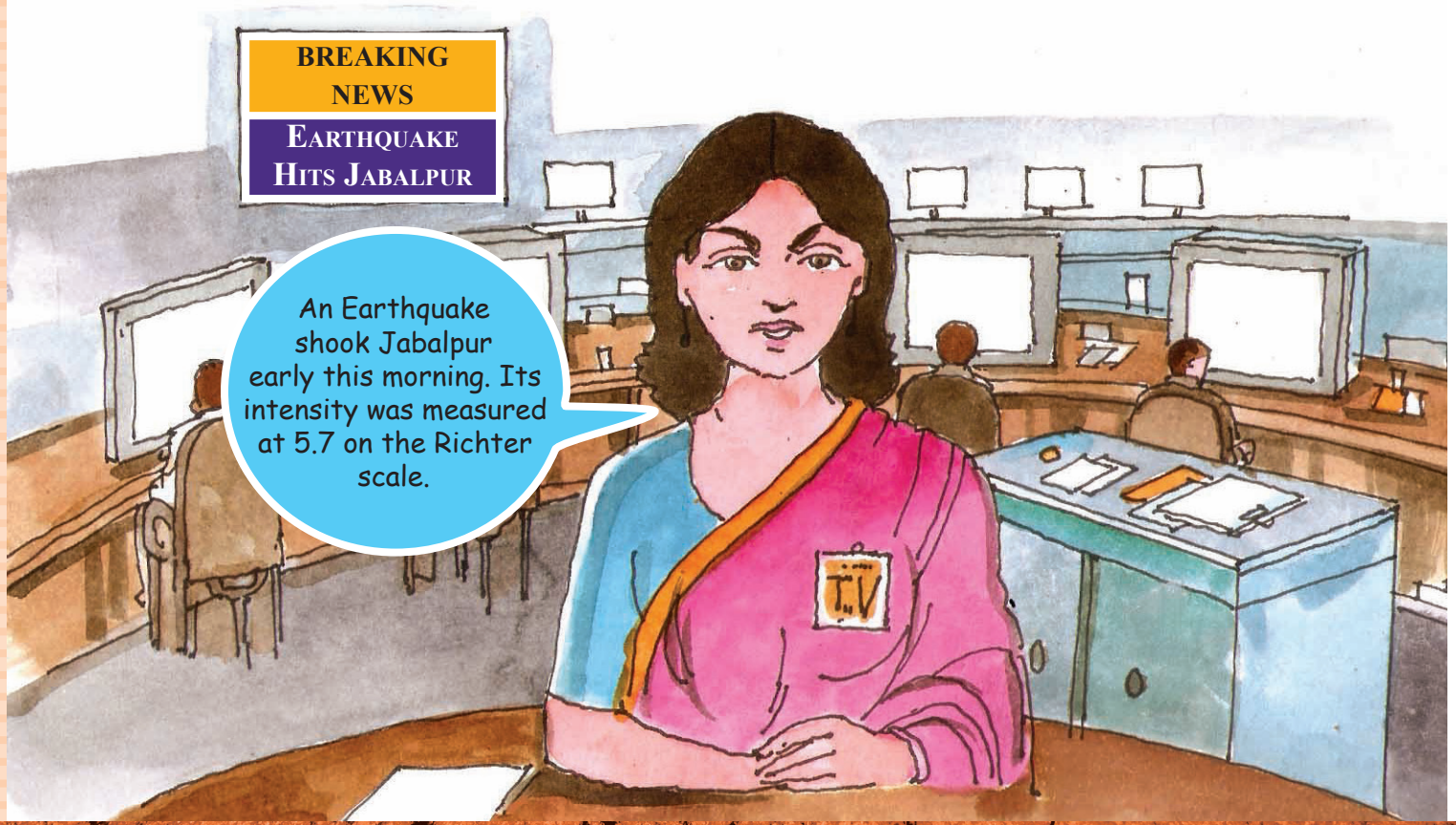
राष्ट्रीय शैक्षिक अनुसंधान और प्रशिक्षण परिषद्
NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING

It was the morning of Thursday, 22nd May 1997 at 4:21 AM at Jabalpur, Madhya Pradesh. Father, an early riser, was up doing exercise, when he suddenly felt the ground shake.



Outside the House

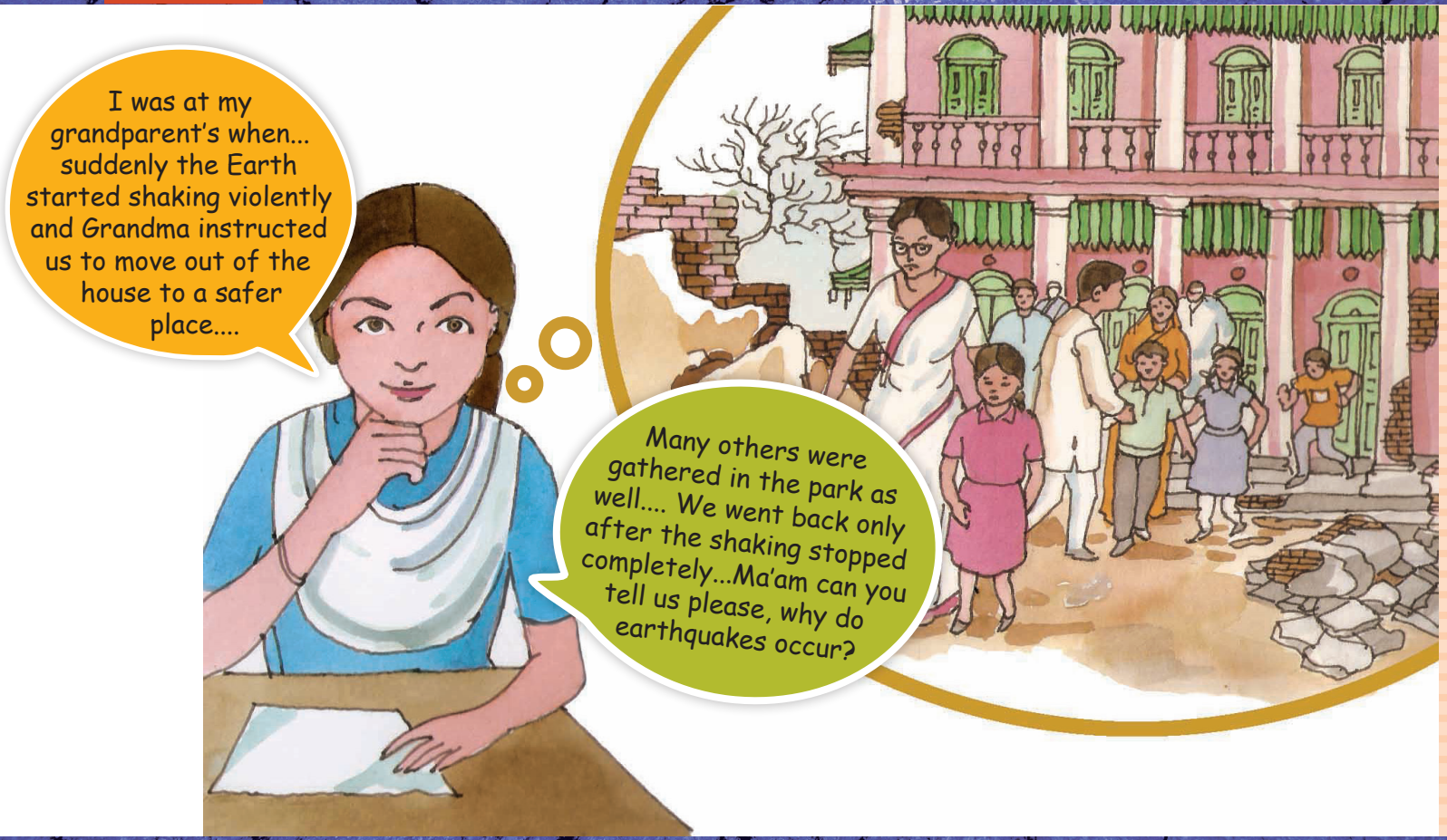



BREAKING NEWS
EARTHQUAKE HITS JABALPUR
An Earthquake shook Jabalpur early this morning. Its intensity was measured at 5.7 on the Richter scale.
T.V

In school

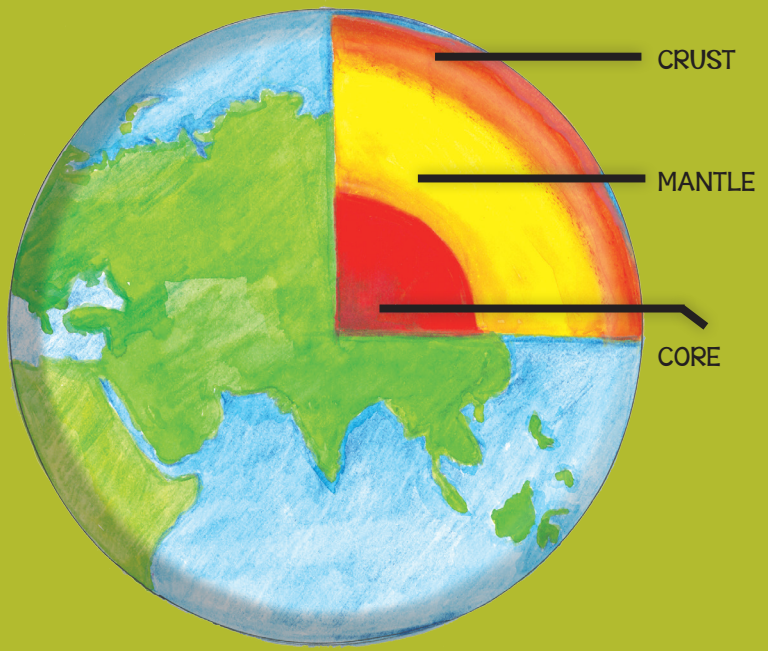

See Ma'am, the class has become so messy. Everything has fallen or scattered. Is it due to the earthquake?
Yes Rahul, the shock has indeed displaced books, files, desks and chairs...


Let us discuss the earthquake as we arrange the class. Tell me, did you all feel the earth shake today?
It is the second time I've experienced it Ma'am, but none of us have any idea why the earth shakes like this...please can you tell us Ma'am?
I sure will, but first, why don't you tell us what you experienced Saumya?


I was at my grandparent's when... suddenly the Earth started shaking violently and Grandma instructed us to move out of the house to a safer place....
Many others were gathered in the park as well.... We went back only after the shaking stopped completely...Ma'am can you tell us please, why do earthquakes occur?

To know about earthquakes we must first understand about the structure of the Earth, so, let's first talk about that... The Earth is made of three layers — the crust, the mantle and the core.

About Earth

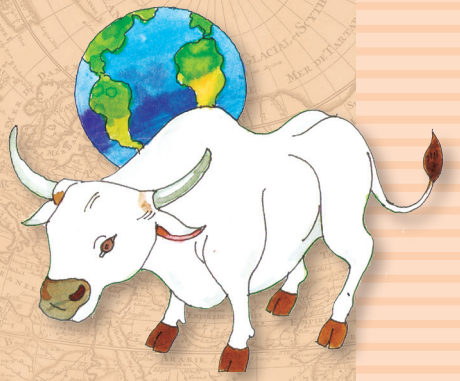


The uppermost layer over the earth's surface is called ***Crust***. It is the thinnest layer and is about 35 km under continental masses and only 5 km under the ocean floor.

Just beneath the crust is the ***Mantle*** which extends up to a depth of 2900 km below the crust.

The innermost layer is the ***Core*** with a radius of about 3500 km.

MYTHS AND LEGENDS ABOUT EARTHQUAKES



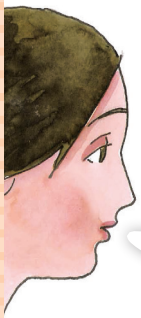
India: The Earth is held up by four elephants that stand on the back of a turtle. The turtle is balanced on top of a cobra. When any of these animals move, the Earth trembles and shakes.

In ancient times people believed that the earth rests on the shoulders of a giant ox and that an earthquake happens when the ox shifts the earth from one shoulder to another.

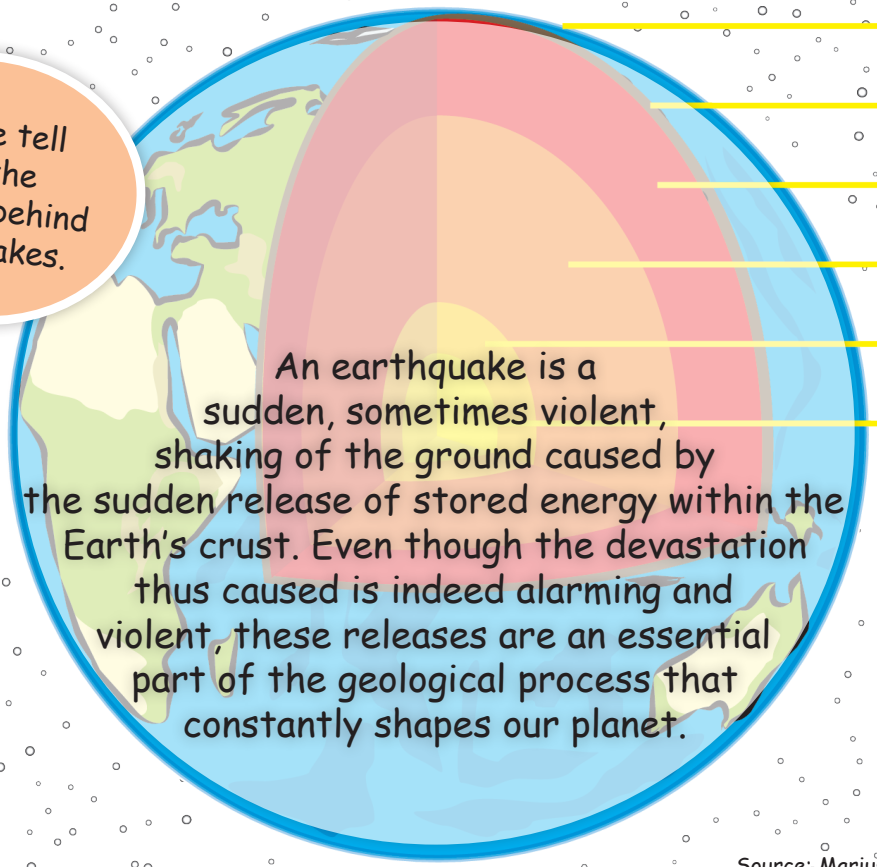
Siberia: The Earth rests on a sled driven by a god named Tuli. The dogs who pull the sled have fleas. When they stop to scratch, the Earth shakes.

Ancient Greeks believed earthquakes were caused by giants fighting underneath the ground. The ancient Japanese thought that there was a giant spider living under the earth, and each time it moved, it caused the earth to quake.

Central America: The square Earth is held up at its four corners by four gods. When they decide that the Earth is becoming overpopulated, they tip it to get rid of surplus people.



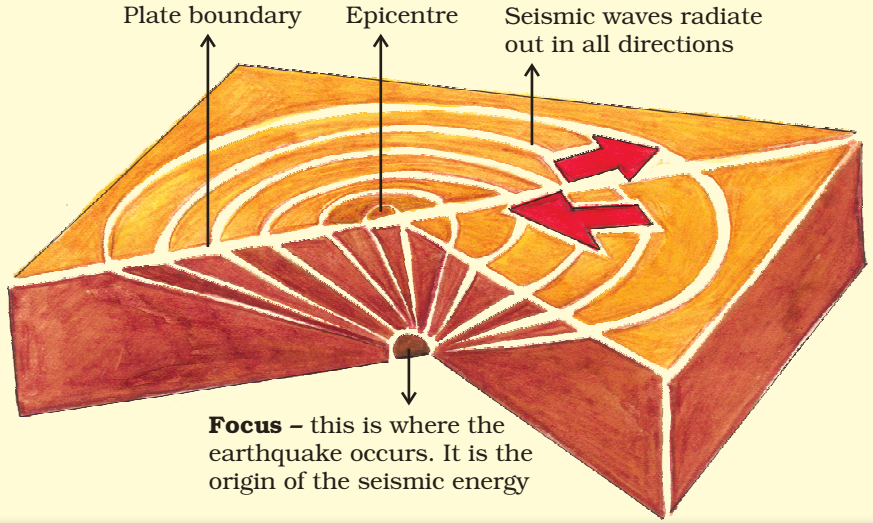
Let me tell you the science behind earthquakes.



An earthquake is a sudden, sometimes violent, shaking of the ground caused by the sudden release of stored energy within the Earth's crust. Even though the devastation thus caused is indeed alarming and violent, these releases are an essential part of the geological process that constantly shapes our planet.

Source: Mariusz Niemiec/123rf.com

In science, earthquakes are called seismic activity. The science of earthquakes is called seismology.



The point where the earthquake starts is the **Focus** or **Hypocenter**, and the point vertically above this on the surface of the Earth is the **Epicenter**. The depth of the focus from the epicenter, called the **Focal Depth**, is an important parameter in determining the damage potential of an earthquake. Most of the destructive earthquakes have shallow focus with focal depths less than about 70 km.
Now let us talk about how earthquakes may be measured. You might have heard that the earthquake was 5.7 on the Richter scale.



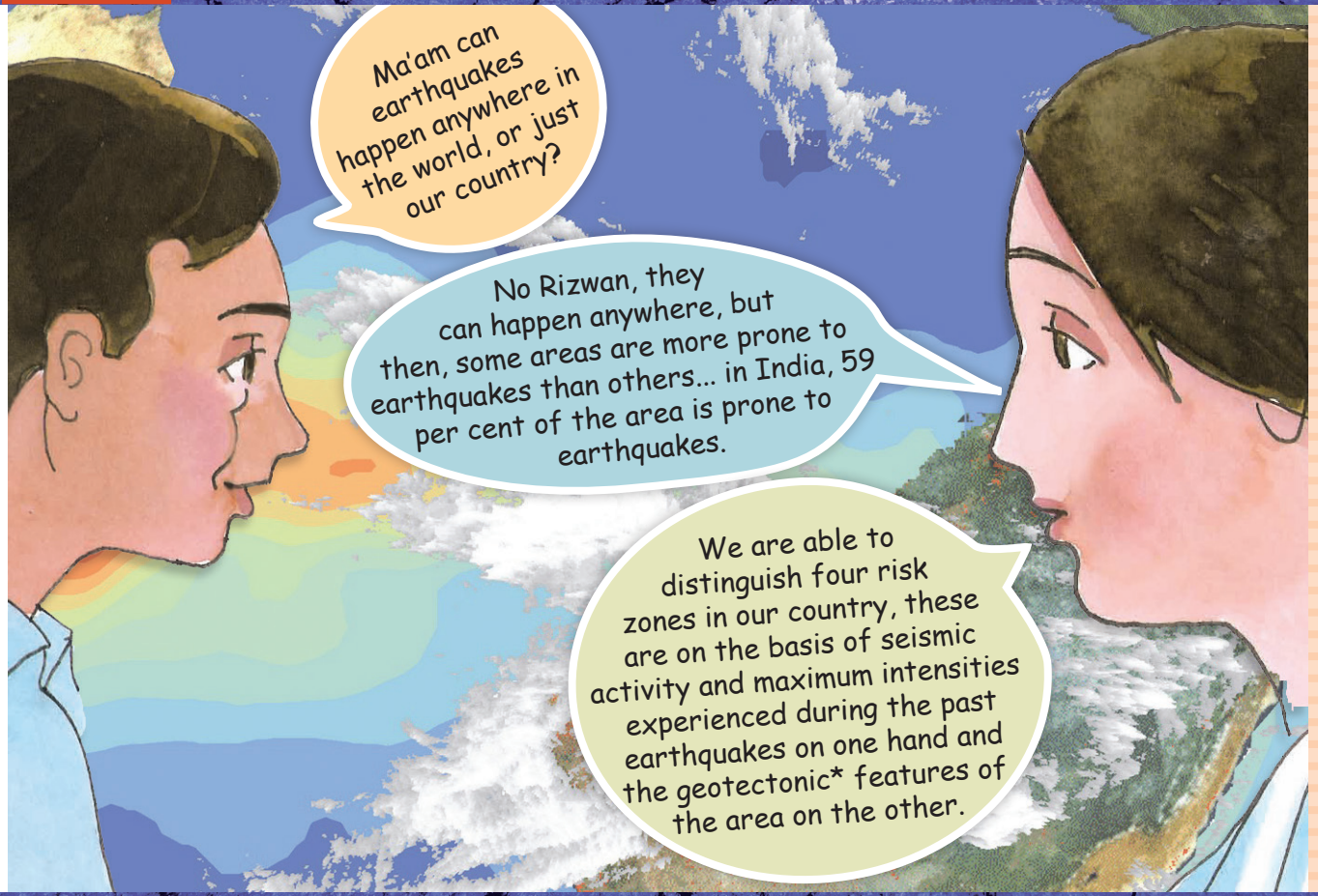
How are earthquakes measured?

The intensity of scales are based on three features of shaking – perception by people and animals, performance of buildings, and changes to natural surroundings.

Richter Scale: The Richter magnitude scale was developed in 1935 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the magnitudes of earthquakes. The magnitude of an earthquake is determined from the logarithm of the amplitude of waves recorded by seismographs.

Seismologists measure the strength of earthquakes by their ***magnitude*** and ***intensity***. Magnitude is a *quantitative* measure of the size of the earthquake and estimates the amount of energy released at the hypocenter. Magnitude of an earthquake is determined using the seismograms recorded by seismographs. ***Intensity*** measures the strength of shaking produced by the earthquake. It depends on the distance of the particular location from the epicenter. A commonly used scale is known as the Richter Scale. Richter Scale is a base-10 logarithmic scale.

S.No.	Magnitude on Richter Scale	Degree of Damage
1	Upto 4.9	Slight
2	5.0 – 6.9	Moderate
3	7.0 – 7.9	High
4	8.0 and more	Very High

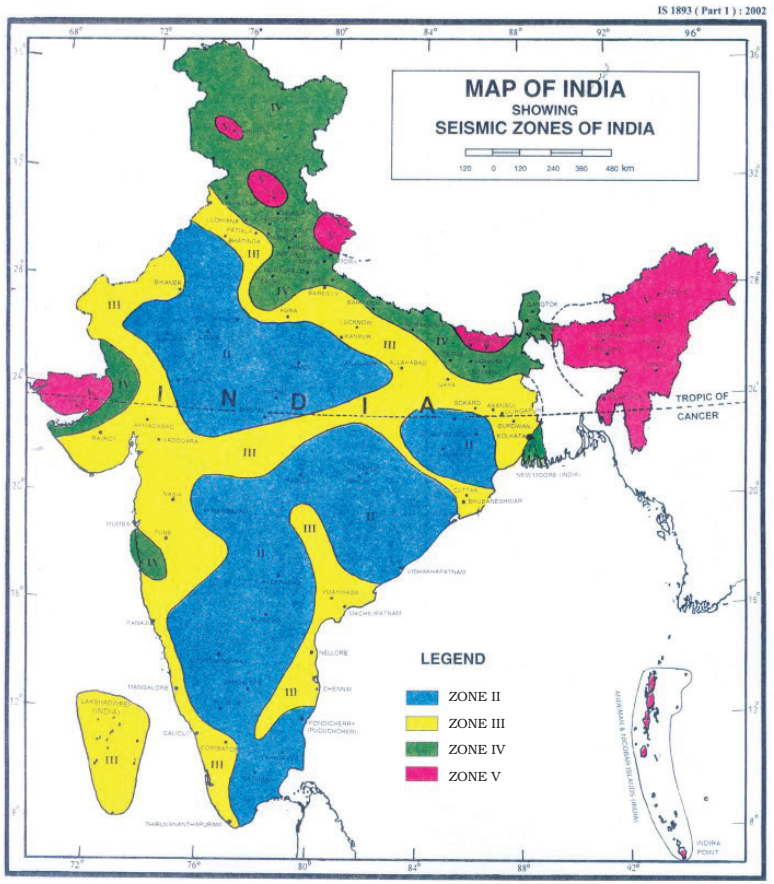


*GEOTECTONIC: *of or relating to the shape, structure, and arrangement of the rock masses in the Earth's crust.*

1) Identify which zone does your state comes under.

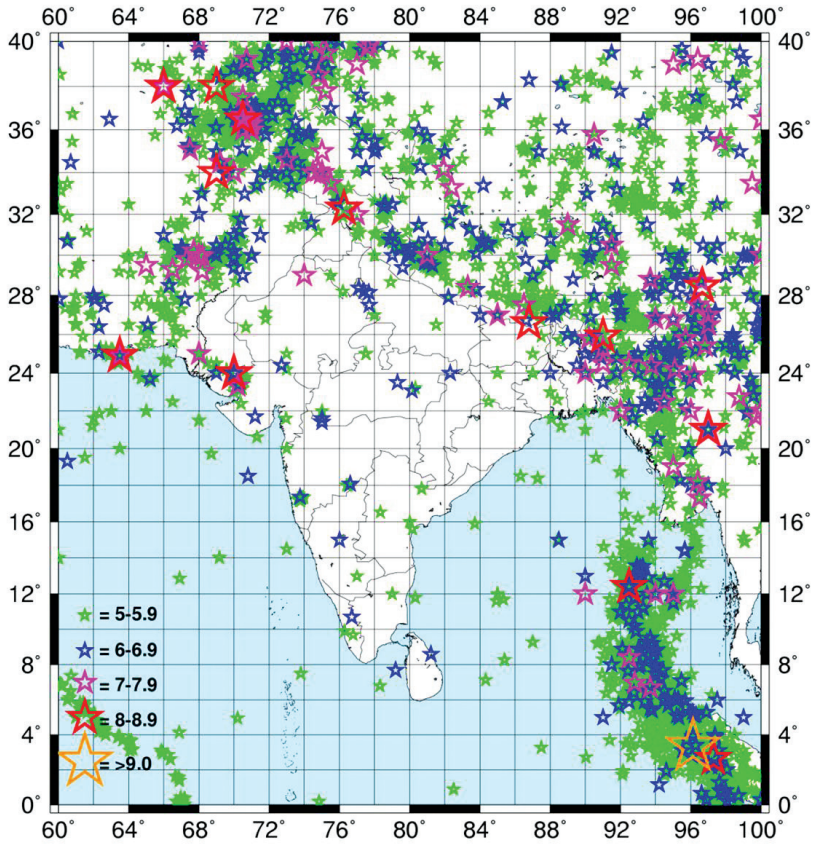
2) Identify more states which come under the same zone.

Seismic Zone	Percentage Area under different seismic zones
II	43
III	27
IV	18
V	12



NOTE : Towns falling at the boundary of zones demarcation line between two zones shall be considered in High Zone

Map showing the seismic zoning of India as per IS:1893.2002



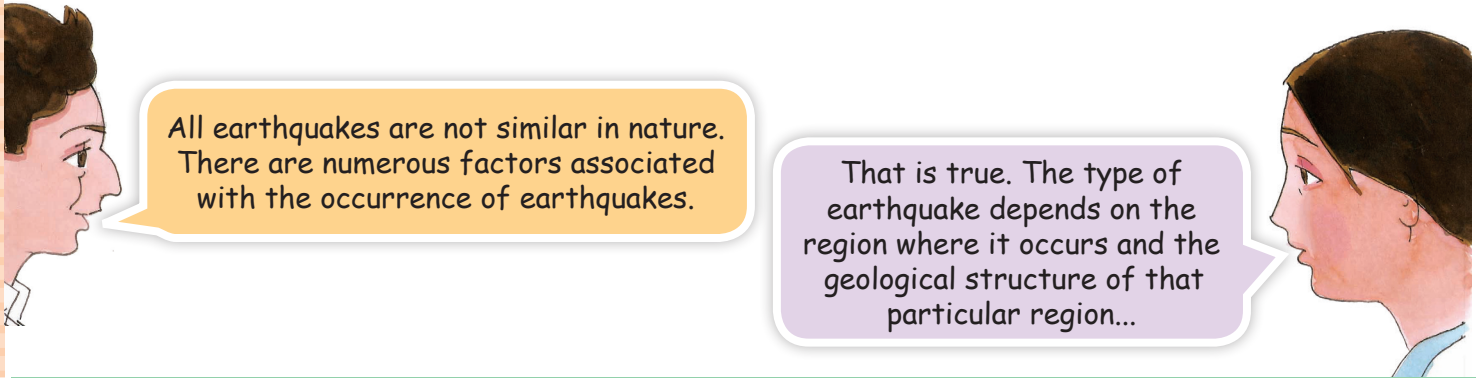
Seismic activity map of India and neighbourhood region (upto January, 2012) with a magnitude of 5 m Richter scale and above


I have heard Ma'am that not only India but many other countries in the world are prone to earthquakes?
Yes, a number of countries are prone to earthquakes. Let me show this to you on a world map.

WHERE CAN EARTHQUAKES OCCUR?

Since 1900, the largest earthquake ever recorded was of magnitude 9.5 in Chile on 22 May 1960. The world's deadliest recorded earthquake occurred in 1556 in central China. It struck a region where most people lived in caves carved from soft rock. These dwellings collapsed during the earthquake, killing an estimated 8,30,000 person.





Types of Earthquake

There are four kinds of earthquake:

Tectonic earthquakes: These occur when rocks in the earth's crust break due to geological forces created by the movement of tectonic plates. These are the most common.

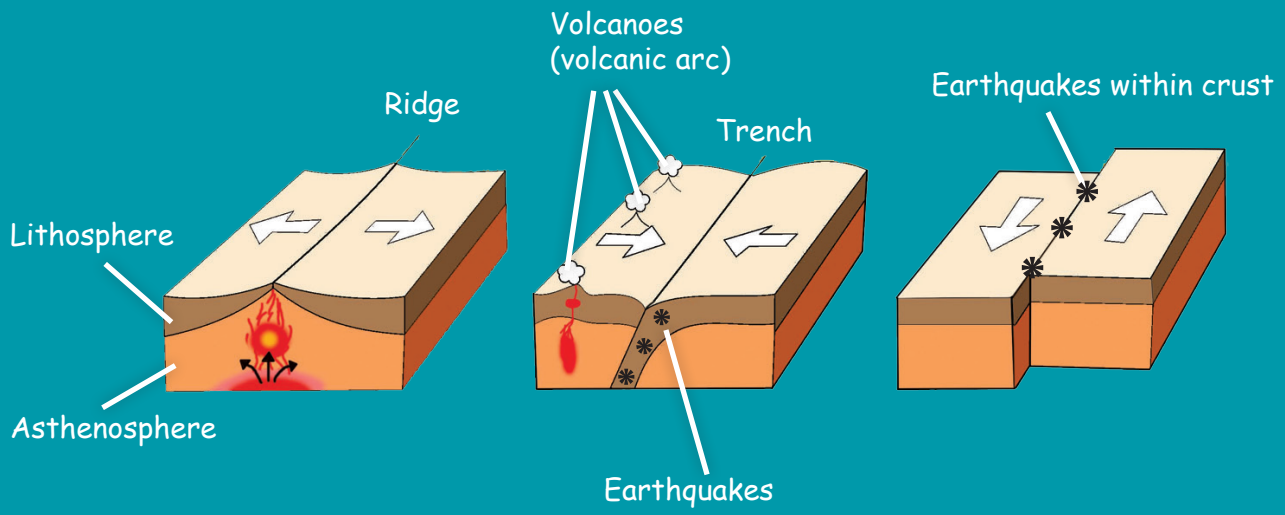
Volcanic earthquakes are associated with volcanic activity.

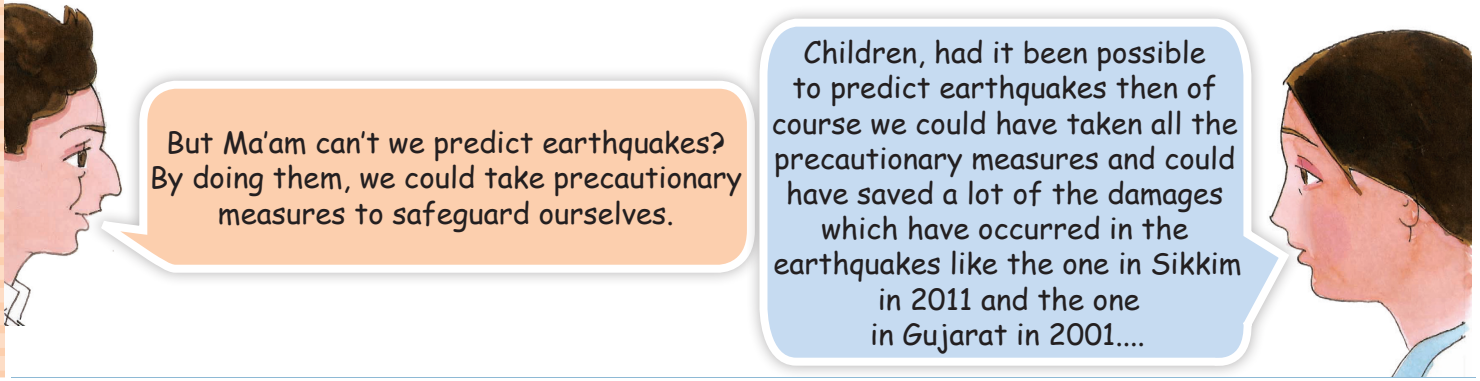
Collapse earthquakes are small earthquakes in underground caverns and mines.

Explosion earthquake results from the explosion of nuclear and chemical devices.

Tectonic Earthquake

Type of Margin	Divergent	Convergent	Transform
Motion	Spreading	Subduction	Lateral Sliding
Topography	Ridge/Rift	Trench	No Major Effect



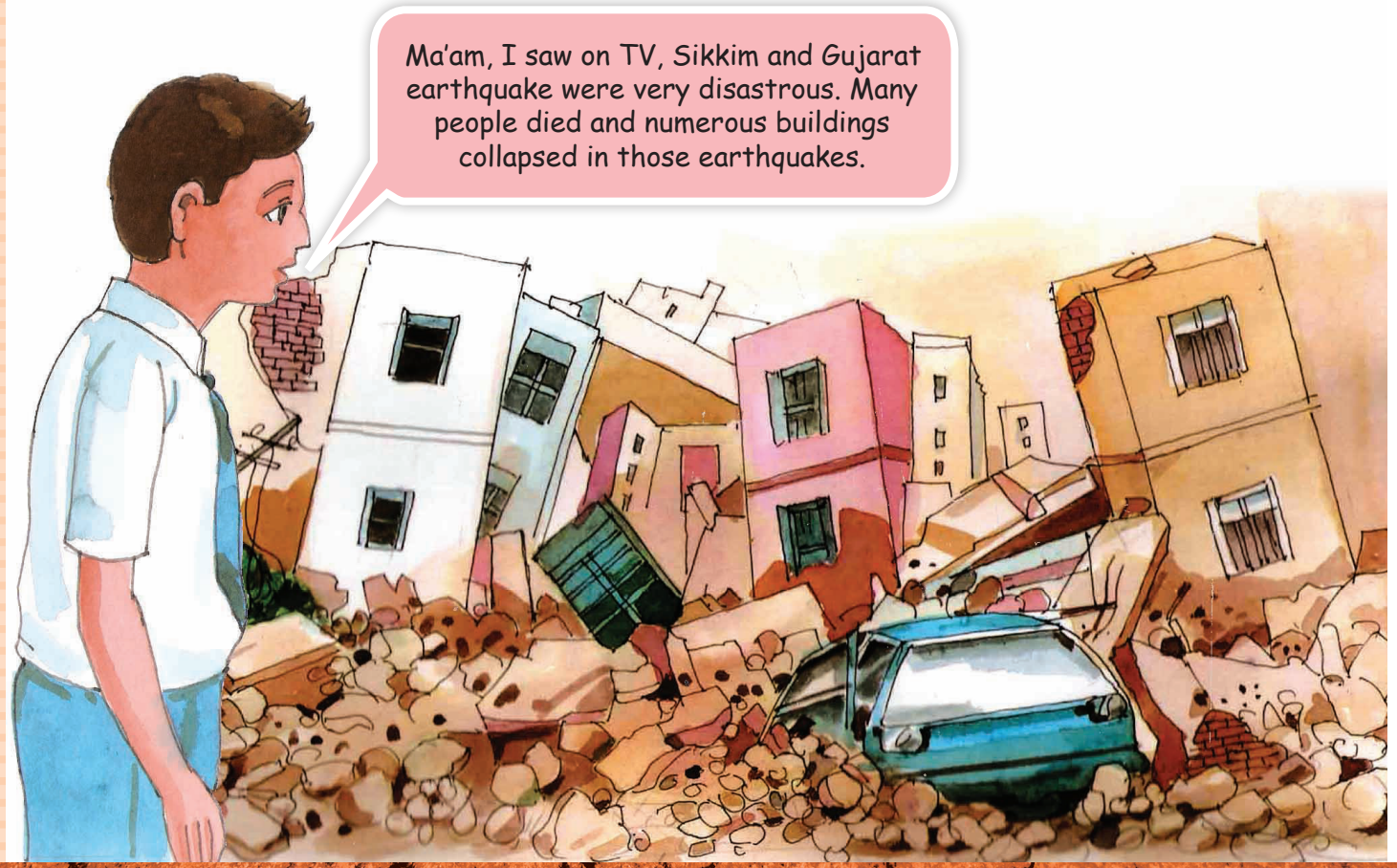


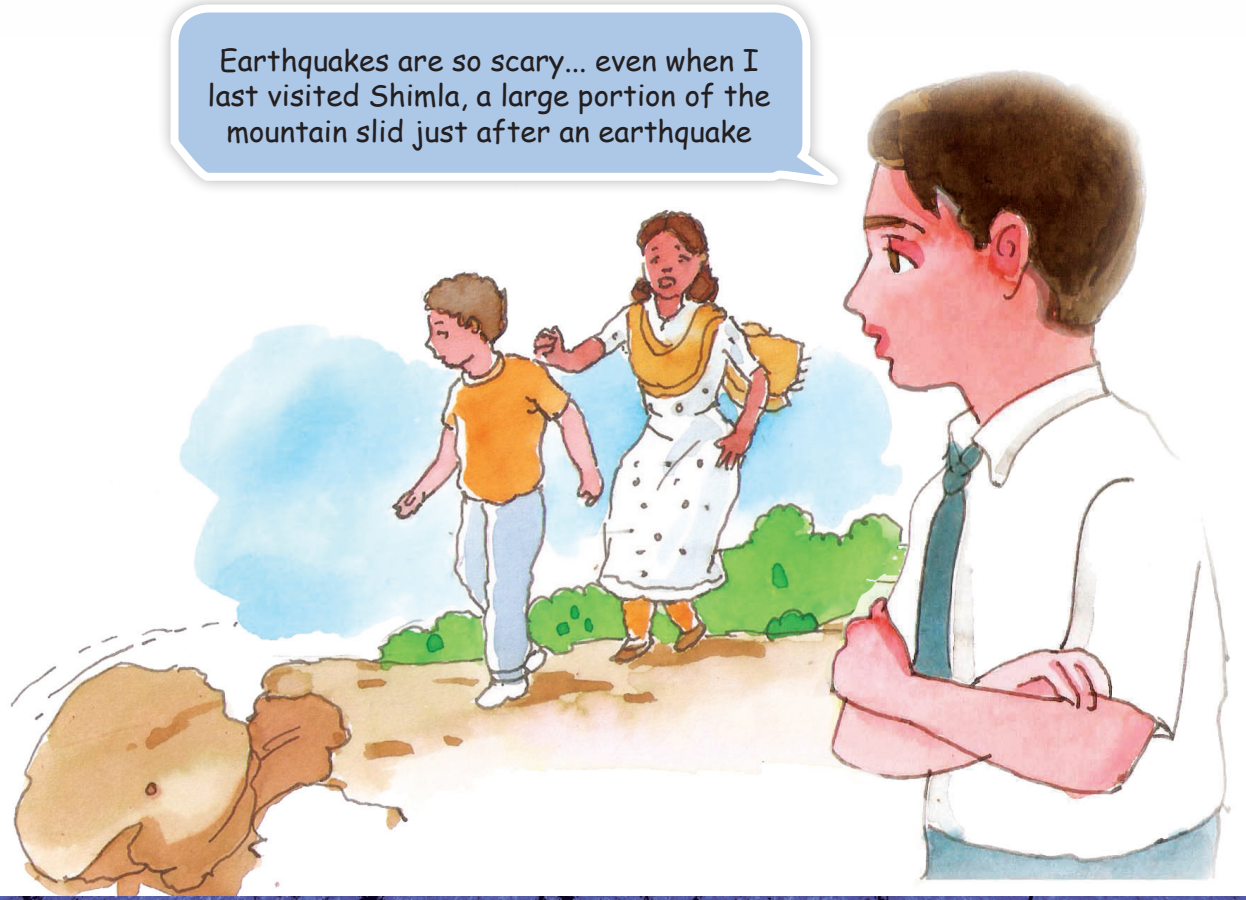
Is it Possible to Predict Earthquakes?

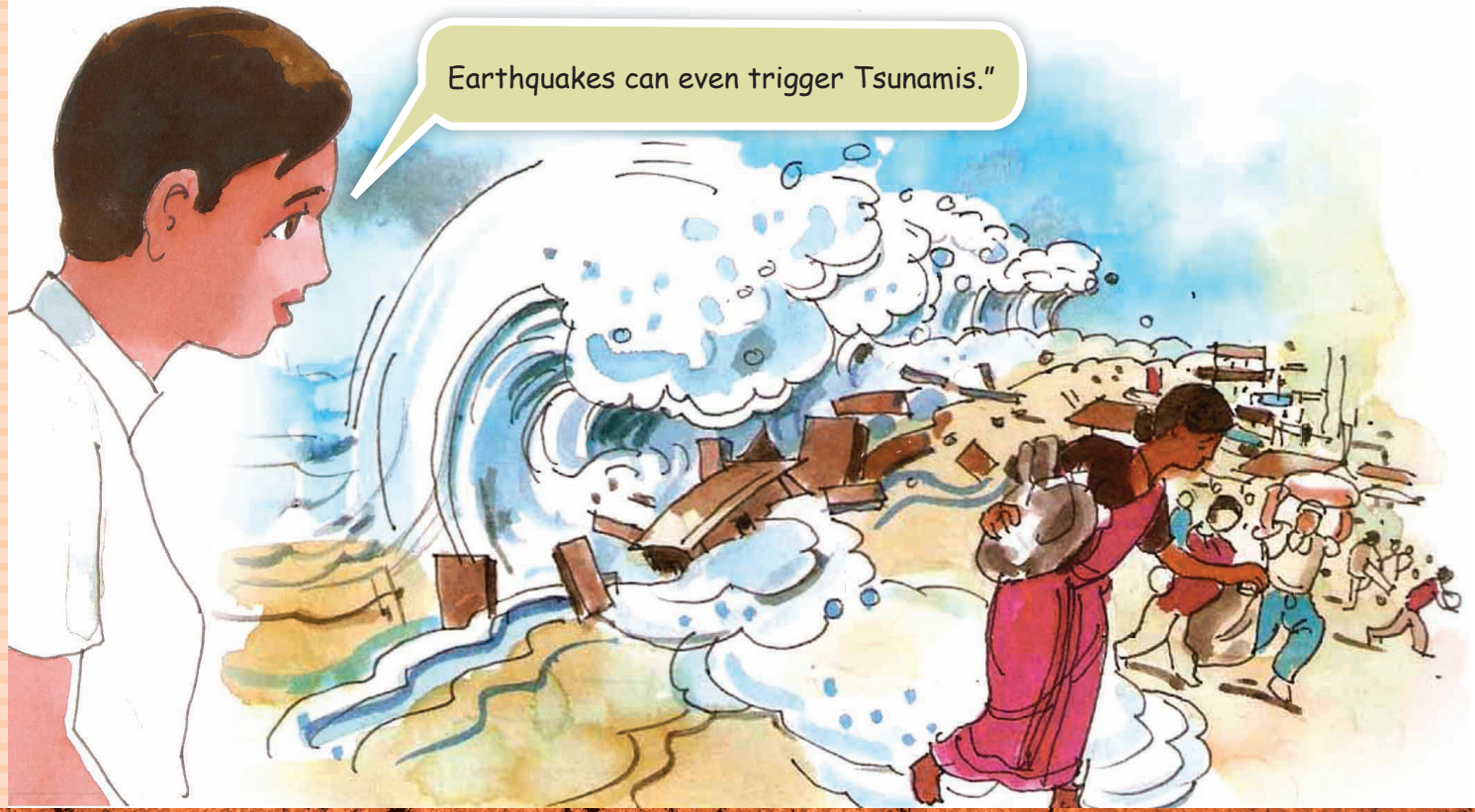
It is not currently possible to predict earthquakes. Although scientists may know where earthquakes are likely to happen, they usually can not say exactly when. It is believed that animals seem to feel earthquakes before humans. The earliest reference we have to unusual animal behaviour prior to a significant earthquake is from Greece in 373 BC. Rats, weasels, snakes and centipedes reportedly left their homes and headed for safety several days before a destructive earthquake. Anecdotal evidence are plenty in case of animals, fish, birds, reptiles, and insects exhibiting strange behaviour anywhere from weeks to seconds before an earthquake. However, consistent and reliable behaviour prior to seismic events and a mechanism explaining how it could work, still eludes us.

Animal Behaviour before an Earthquake

Period of Time Before an Earthquake Event	Animals Known to React	Distance from Epicentre	Animals Known to React
Less than 1 hour	Horses, Chickens, Rats, Dogs, Cattles, Fishes	About 5 Km	Fish, Frogs, Rats, Goats, Eels
1-4 hours	Dogs, Rats, Horses, Deer, Cats, Chickens, Eels, Snakes, Cows	20-50 Km	Chickens, Pigeons, Dogs, Birds
6-12 hours	Chickens, Dogs, Cats, Fishes, Frogs	70-100Km	Horses, Chickens, Frogs, Deers, Cats, Goats, Snakes
1 Day	Cows, Rats, Fishes, Cats, Chickens		
A few Days	Rats, Fish, Eels, Horses, Snakes, Chickens	150-200km	Horses, Pigeons, Fishes, Birds, Rats
A few Weeks	Fish, Pigeons, Snakes		


Ma'am, I saw on TV, Sikkim and Gujarat earthquake were very disastrous. Many people died and numerous buildings collapsed in those earthquakes.


Earthquakes are so scary... even when I last visited Shimla, a large portion of the mountain slid just after an earthquake


Earthquakes can even trigger Tsunamis."

How do earthquakes impact us?

For us, earthquakes become destructive events. Weak constructions, lack of information and awareness, inadequate enforcement of construction codes are some of the reasons why earthquakes become disastrous.



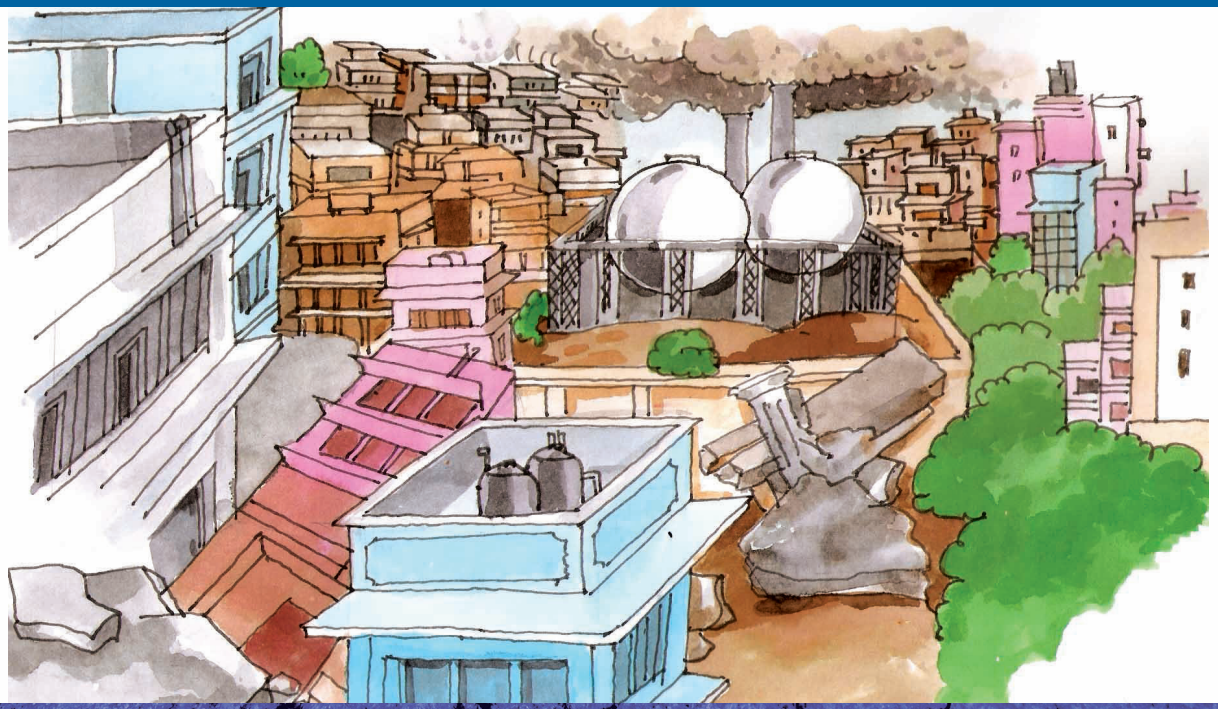


The direct impact of earthquakes can be in the form of catastrophic* damages. Earthquakes sometimes induce landslides, tsunamis or even volcanic eruptions. An earthquake is often followed by devastating fires due to gas leak and/or short-circuits of electrical wiring and may cause injuries, death, huge economic loss.



*CATASTROPHIC: ***Causing sudden great damage***

Earthquakes may also cause liquefaction* of soft soil. Liquefaction takes place when loosely packed, water-logged sediments at or near the ground surface lose their strength in response to strong ground shaking. Liquefaction occurring beneath buildings and other structures can cause falling down of buildings causing major damage during earthquakes.



LIQUEFACTION is a phenomenon in which the strength and stiffness of a soil is reduced by earthquake.



*MITIGATION: *the action of reducing the severity, seriousness, or painfulness of something.*

IMPACT OF EARTHQUAKES IN VARIOUS AREAS OF LIFE

Economic

- Repair and reconstruction investments
- Loss of income and housing facilities

Educational

- Damaged School Buildings
- Teaching time lost
- Increase in drop out rate
- Drop in quality of education



Physical

- Buildings and Infrastructure collapse
- Loss of basic amenities such as electricity, water & gas supply
- Failure of transport network
- Failure of communication channels
- Falling objects
- Blocked fire exits
- Landslides and Tsunami
- Floods due to dam breach

Health

- Multiple fracture/ injuries
- Epidemic casualties due to sanitary failure and safe drinking water
- Lack of sense of continuity of education
- Difficulty to come out of the trauma caused
- Increased stress level

It's not only landslides, tsunamis, collapse of buildings, damage to the dams and fire but an earthquake also has numerous other direct or indirect impacts on human beings.

Mitigation and Preparedness Practices

Strengthening of important lifeline buildings which need to be functional after disaster. Upgrade level of safety of hospitals, fire service, buildings, etc.

Follow Indian Standard Codes for construction of buildings. Enforcement of the Byelaws including Land use control and proper planning on density and heights of buildings.

Make people aware, sensitise and train architects, builders, contractors, designers, engineers, financiers, government functionaries, house owners, masons etc.

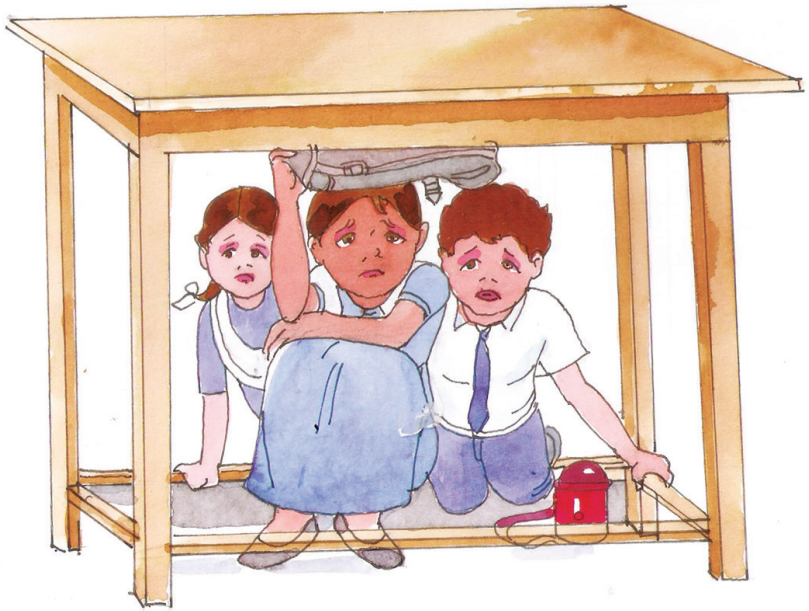
Reduce possible damages from secondary effects such as fires, floods, landslides, etc. For example, identify potential landslide sites and restrict construction in those areas.

Community based mitigation: community preparedness along with public education which is vital for mitigating the earthquake impact. Conduct earthquake drills and public awareness programmes.



Ma'am, I also want to share something about earthquakes that have occured in Gujarat. My cousin lives there and she was studying in school at that time. She told me that on that fateful day during the Republic Day Celebration on 26th January 2001 in her school, all the students were in the class and were waiting for refreshments. Suddenly, the tables and ceiling fans started shaking and bags started to fall from the table.

All the students got frightened. Their class teacher told them not to panic and follow the instructions being given by her. Most of the students of the class sat under the tables but a few taller students who were not able to fit themselves under the tables took positions in the corners and covered their heads with bags.

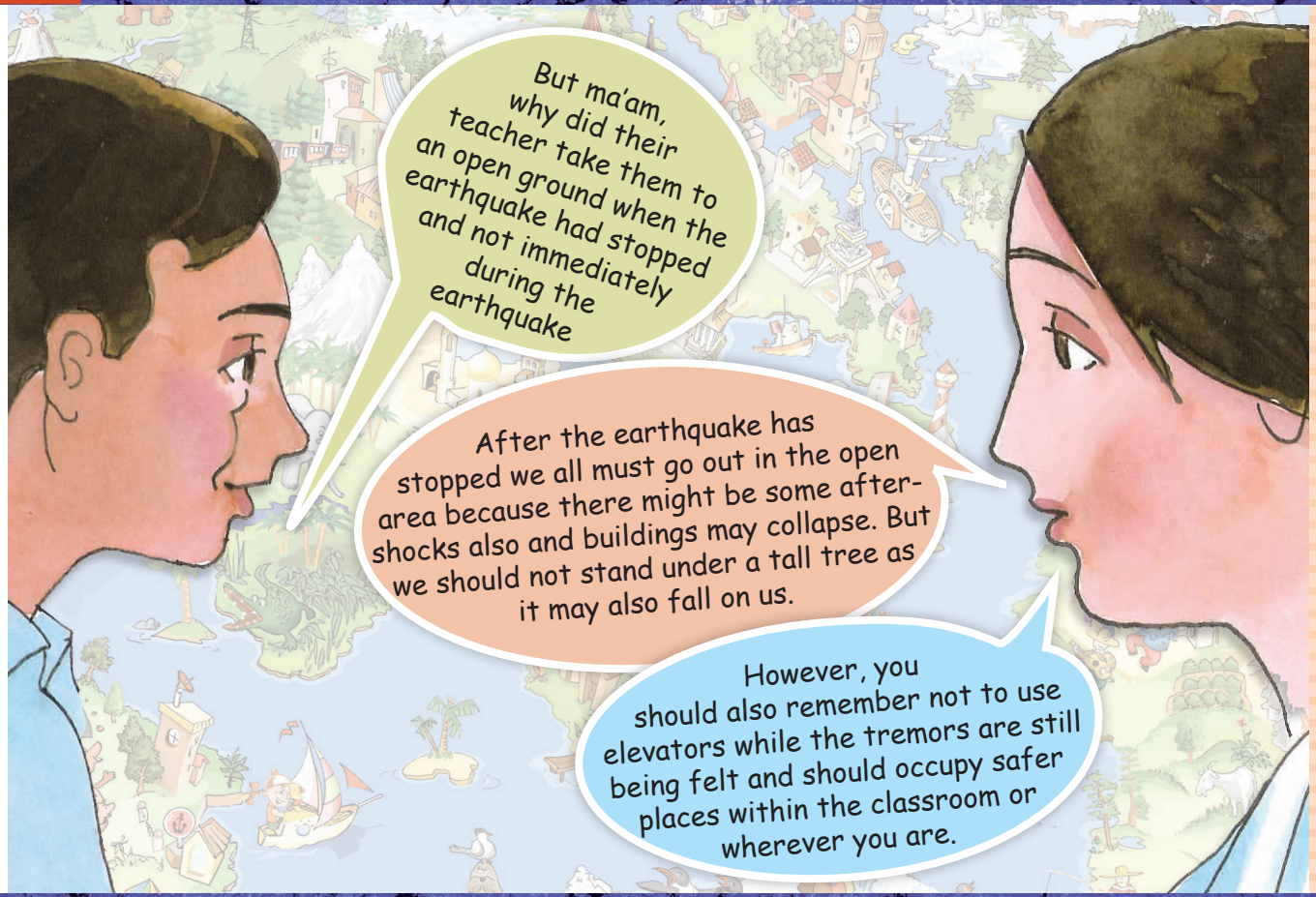




The teacher saw a few students standing near the glass window. She immediately asked them to keep away from the window as the glass may break and harm them.



Once the earth stopped shaking everyone took a deep breath of relief. The teacher asked all the students to make a queue and go out in the open ground. She kept instructing them not to push each other or run which might have created panic.


But ma'am, why did their teacher take them to an open ground when the earthquake had stopped and not immediately during the earthquake
After the earthquake has stopped we all must go out in the open area because there might be some after-shocks also and buildings may collapse. But we should not stand under a tall tree as it may also fall on us.
However, you should also remember not to use elevators while the tremors are still being felt and should occupy safer places within the classroom or wherever you are.

The 2001 Gujarat earthquake



The 2001 Gujarat earthquake occurred on 26 January, 2001; India's 51st Republic Day, at 08:46 AM and lasted for over two minutes. It caused extensive damage to life and property. The quake killed around 20,000 people (including 18 in south eastern Pakistan), injured another 167,000 and destroyed nearly 400,000 homes. The earthquake reached a magnitude of 7.6 and 7.7 and had a maximum felt intensity of X (Intense). At a depth of only 23 kms below surface this quake generated intense shaking which was felt in 70% region of India and far beyond in neighbouring Pakistan and Nepal too. This was followed by intense aftershocks that became a continued source of anxiety for everyone.

The affected areas even spread up to 300 kms from the epicentre. In the Kutch District, four major urban areas – Bhuj, Anjar, Bachau and Rapar suffered near total destruction. The rural areas in the region were also very badly affected with over 450 villages almost totally destroyed.



Sikkim Earthquake, 2011

According to the Indian Meteorological Department (IMD), a strong earthquake of Magnitude 6.8 shook Sikkim and Darjeeling areas of India and adjoining Nepal at 18:11 hours IST on 18th September 2011 with its epicenter (27.7°N, 88.2°E) lying near the Sikkim-Nepal border, about 68 km northwest of Gangtok, Sikkim, with the depth of its hypocenter at about 10 kms. This earthquake was widely felt in Sikkim, West Bengal to Rajasthan in the west and the northeastern states of India, and also in Nepal, Bhutan and Bangladesh. This major earthquake triggered several landslides in the region

Source: 'Aftermath of the 18th September 2011 Sikkim earthquake' by : Indranil Chakraborty, Dr. Saibal Ghosh, Debasish Bhattacharya and Anjan Bora, Engineering Geology Division, Geological Survey of India, Eastern Region, Kolkata





Nepal earthquake in photos: All about the disaster that killed 6,100 and destroyed 6 lakh houses

The death toll in Nepal from a massive weekend earthquake has risen to 6,100 on Friday, according to a new tally by disaster management officials.

A total of 6,100 people are so far known to have died in Nepal alone from Saturday's quake, and around 100 more in neighbouring India and China. Around 10,000 were injured while the United Nations estimates that 8 million people have been affected and 600,000 houses have been destroyed or damaged by Nepal's worst natural disaster in eight decades.

Prime Minister Sushil Koirala told Reuters on Tuesday that the death toll could reach 10,000, as information on damage from far-flung villages and towns is yet to come in.

If the number does reach that it would surpass the 8,500 who died in a 1934 earthquake, the last disaster on this scale to hit the Himalayan nation of 28 million people located between India and China.

Earthquake

The earthquake occurred at 11:43am IST on 25 April 2015 with a maximum magnitude of 7.8. The earthquake was initially reported as 7.5 by the United States Geological Survey (USGS) before being quickly upgraded to 7.9.

Epicentre

Its epicentre was approximately 34 km east-southeast of Lamjung in Nepal, and its hypocentre was at a depth of approximately 15 km. Bharatpur was the nearest major city to the main earthquake, 53 km from the epicentre.



The second earthquake occurred 81 km northwest of Kathmandu, the capital of Nepal. Over 35 aftershocks of magnitude 4.5 or greater occurred following the initial earthquake, including one of magnitude 6.6 triggered several landslides in the region

Impact

Tremors were felt in the Indian states of Bihar, Uttar Pradesh, Assam, West Bengal, Sikkim, Uttarakhand, Odisha, Andhra Pradesh, Gujarat, New Delhi and as far south as Karnataka.

The earthquake was also experienced across southwestern China, ranging from the Tibet Autonomous Region to Chengdu, which is 1,900 km away from the epicentre. Tremors were also felt in Pakistan and Bhutan.

Aftermath

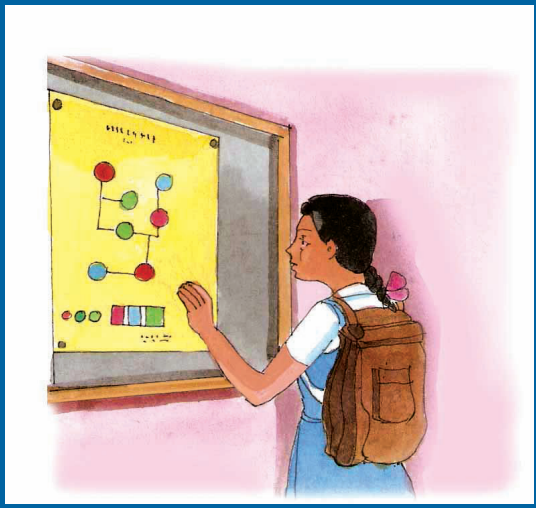
The Unicef has said that close to a 1 million children have been "severely affected" by the disaster. The UN says the quake has affected 8.1 million people — more than a fourth of Nepal's population of 27.8 million and that 1.4 million needed food assistance.

Source: Pratyush Ranjan, Hindustan Times, New Delhi | Updated: May 01, 2015 15:18 IST

Dos and Don'ts – Preparing for an Earthquake

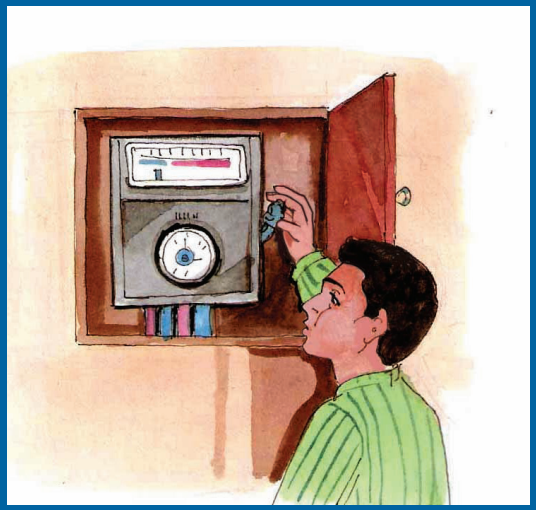


Now, as we all know, that earthquakes can be very damaging and life threatening, let us discuss how we can reduce the vulnerability to earthquakes considerably by taking some precautionary actions before, during and after an earthquake has hit.



Make the emergency route maps available in every classroom and at other appropriate places such as notice board, corridors etc

Dos and Don'ts – Earthquake

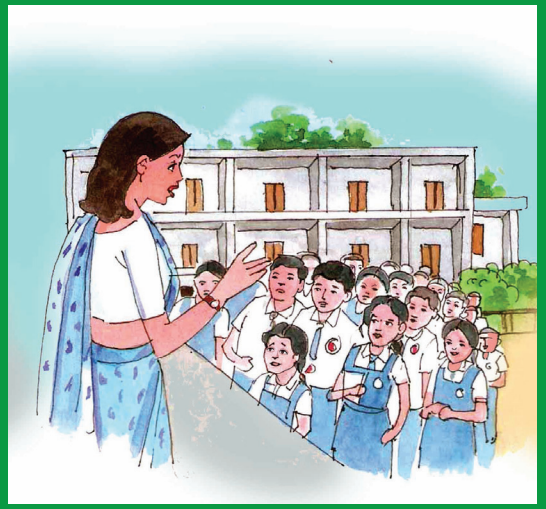


Identify the place of switches for gas and electricity in the kitchen or the science lab and turn off in case of emergency.



Make sure that the shelves and furniture is fixed properly and that the objects are arranged in a way that heavy things are at the lower level and lighter on top.

Dos and Don'ts – Combating an Earthquake



Conduct announced and unannounced mock drills in school at least once a month.



Keep an emergency kit and fire extinguishers at home and at school at an easy to find place. Check the equipment for fire fighting regularly.

Dos and Don'ts – Combating an Earthquake



Make a disaster management team in each class.

Dos and Don'ts during an Earthquake



- Do not panic, do not run, do not push others.
- If you are on an underground passage, walk away calmly and quickly.
- If you are on a bus or a train, do not panic and jump outside. Stay in the bus or train temporarily and put your arms or a bag on your head.

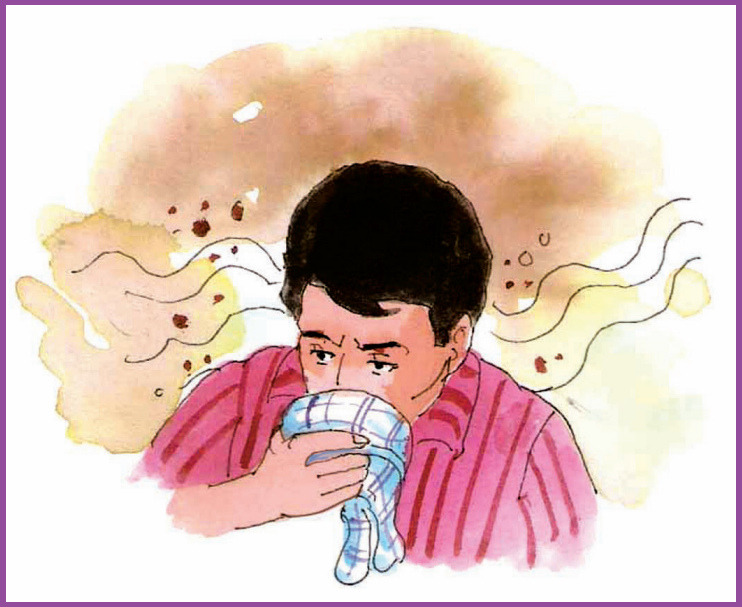


- If travelling in a moving vehicle, stop as quickly as safety permits and stay in the vehicle. Avoid stopping near or under buildings, trees, overpasses, and utility (electricity, telephone) wires.

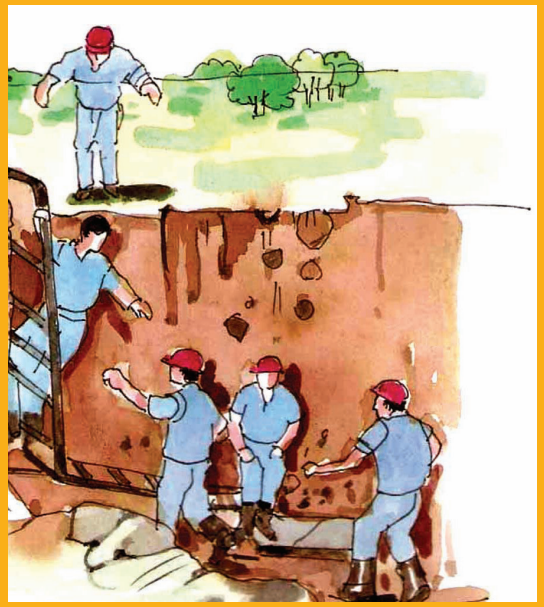
Dos and Don'ts during an earthquake

- If trapped under debris —

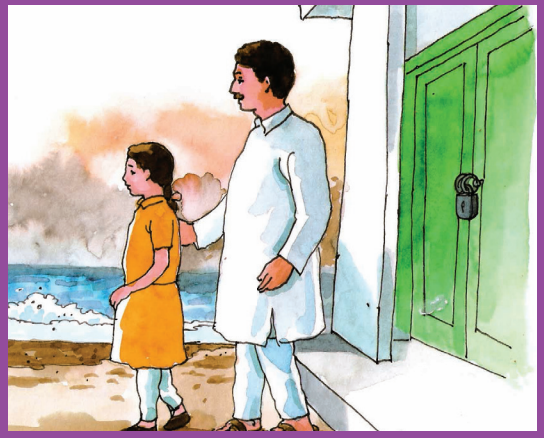
  – do not light a match.
  – do not move about or kick up dust.
  – cover your mouth with a handkerchief or cloth.
  – tap on a pipe or wall so rescuers can locate you. Use a whistle if one is available. Shout only as a last resort. Shouting can cause you to inhale dangerous amounts of dust and cause loose earth to move.



Dos and Don'ts during an Earthquake

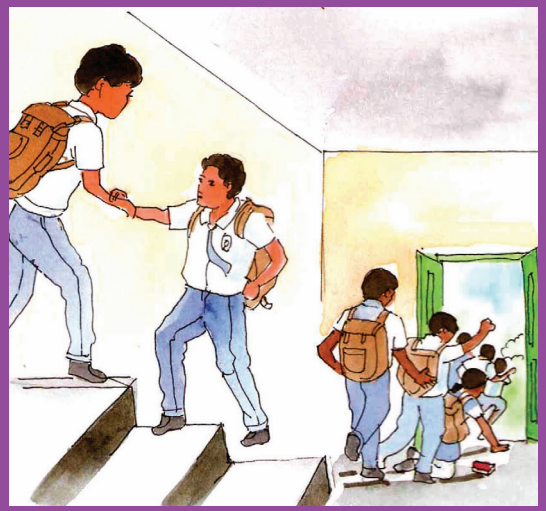


Help others also in moving towards safer places.

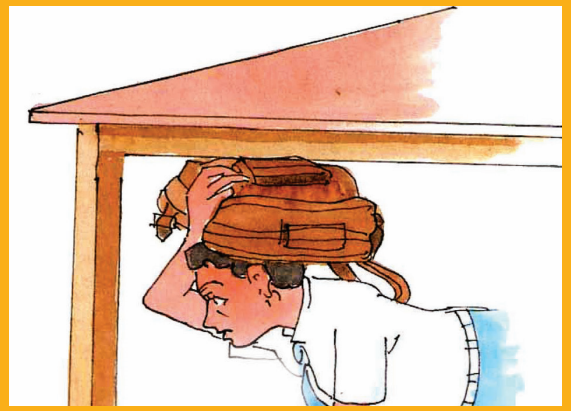


Stay inside until the shaking stops and it is safe to go outside. Do not exit a building during the shaking. Research has shown that most injuries occur when people inside a building attempt to move to a different location inside the building or try to leave.

Dos and Don'ts during an earthquake

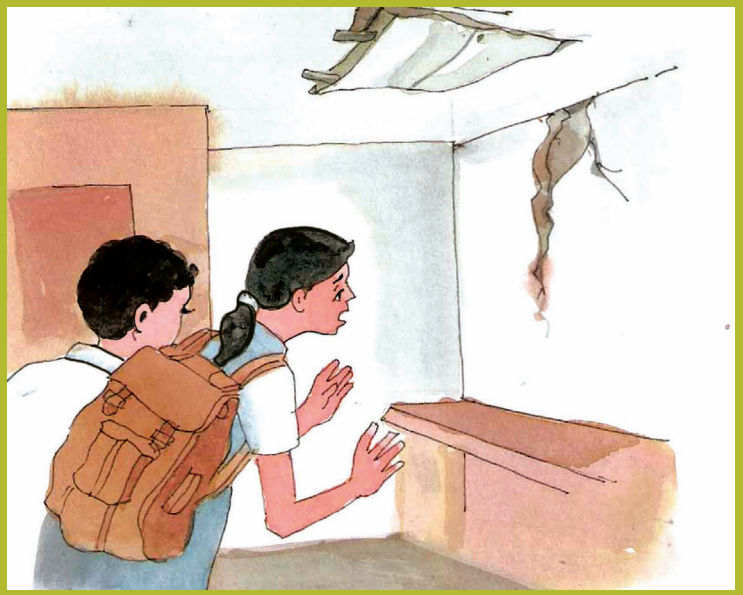


Calmly walk down to the nearest open and safe place. Do not use elevators. Use staircase.



DROP to the ground; take COVER by getting under a sturdy table or other pieces of furniture; and try to move alongwith the table towards the door. HOLD ON until the shaking stops. If there isn't a table or desk near you, cover your face and head with your arms and crouch in an inside corner of the building.

AFTER AN EARTHQUAKE

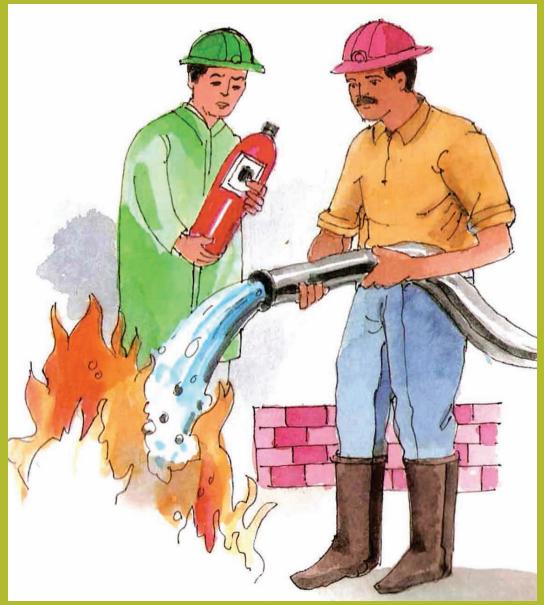


When the shaking stops, look around to make sure it is safe to move. Then exit the building.

Inspect the school or house for any cracks. If beams or columns are damaged leave the classroom or the house as soon as possible and immediately inform elders.

Follow your teachers' instruction. If at home, listen to the news on battery operated radio or TV. Do not believe rumours.

AFTER AN EARTHQUAKE



Look for, and extinguish small fires. Fire is the most common hazard after an earthquake.

Volunteer disaster management team in rescue operation and distribution of ration, clothes, medicines, etc.

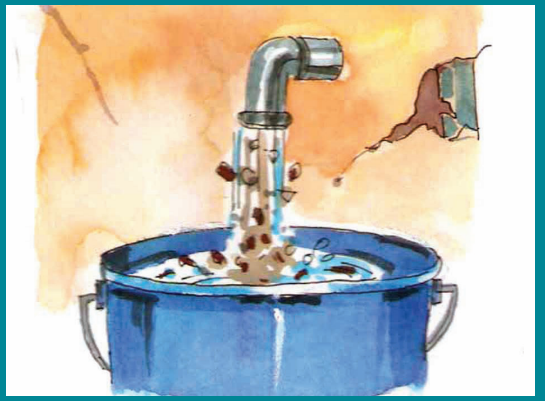


Help each other in the disaster rescue. Have a look at the other buildings nearby. Their occupants may need your help.

After an Earthquake



Open cabinets cautiously. Beware of objects that can fall off shelves. Stay away from glass, windows, outside doors and walls, and anything that could fall, such as electrical fitting or furniture.



Check for sewage and water lines damage. If you suspect sewage lines are damaged, avoid using the toilets and call a plumber. If water pipes are damaged, contact the water authority and avoid using water from the tap. You can obtain safe water by melting ice cubes.

After an Earthquake



Expect aftershocks. These secondary shockwaves are usually less violent than the main quake but can be strong enough to do additional damage to weakened structures and can occur in the first hours, days, weeks, or even months after the quake.

Earthquake Emergency Kit



- Torch
- Bottles of Water
- First Aid Kit
- Non-perishable Food Packets
- Radio or any other Communication device
- Rope
- Fire Extinguishers
- Whistle

EARTHQUAKE MOCK DRILLS IN SCHOOLS : STOP DROP ROLL

A distinctive signal — a siren or bell is set off to alert students and teachers in the school.





Response: While the signal is ongoing- move away from windows, glass and unfastened objects.

Everyone should perform "drop, cover and hold" under tables, desks or chairs until the "shaking" signal stops.





School bags can be used to protect head where sufficient number of desks are not available or where there are no desks at all.











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